FLOREAT LAKES RESIDENTIAL DEVELOPMENT NORTH WEST SECTOR HERDSMAN LAKE

Sherwood Overseas Co Pty Ltd

Report and Recommendations of the Environmental Protection Authority

Environmental Protection Authority
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North West Sector Herdsman Lake

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Summary and Recommendations

Sherwood Overseas Co Pty Ltd (Sherwood) and the State Planning Commission (SPC) propose to develop the north west sector of Herdsman Lake, to be known as Floreat Lakes Residential Development.

The proposal, which is dependent upon the realignment of the Stephenson Highway road reserve, entails:

- dredging of both public and private land to continue the protective moat around Herdsman Lake and provide fill for the urban land;
- removal of peat from urban land and road reserve, placement of peat in adjacent Industrial Lake, on the foreshore and in the moat (backfill the moat to R.L. -1.0 to achieve a summer depth of 7.4 metres);
- importation of fill;
- development of the urban land for residential purposes;
- development of the foreshore area for recreation and conservation purposes; and
- diversion and management of the Balgay and Osborne Main Drains.

To ensure the works proceed in a manner satisfactory to the SPC and Sherwood, there would be an agreement between the two which allows for incremental planning, a management structure, the provision of a bond and the employment of a consultant to supervise the works.

Development of the north west sector would complete Improvement Plan 21 which was gazetted in 1986 to coordinate planning, development and land use at Herdsman Lake. A major component of the Improvement Plan is the creation of a protective moat around the central core of the Lake area. The Plan shows the north west sector as an area to be replanned, with the intention being that a lakeside residential development occurs on the land.

The Environmental Protection Authority (EPA) determined that, because an essential component of the proposed Floreat Lakes Residential Development is the creation of a deep moat, a Public Environmental Report (PER) would be required to assess the proposal. However, because the proposed residential development is dependent upon the realignment of the Stephenson Highway road reserve, the EPA determined that it would not report on the PER until the process required to amend the Metropolitan Region Scheme to realign the road reserve was concluded.

The PER had a public review period of eight weeks closing 18 July 1988. During this period, the EPA received 140 government agency and public submissions.

The major environmental issues associated with the proposed development are:

- depth, extent and management of the moat;
- location and management of the main drains;
- design, extent and management of the public open space; and
- impact on existing residences (eg dust and noise).

Many of the submissions received by the EPA raised issues which did not relate to the proposed residential development but which were associated with the proposed realignment of Stephenson Highway. Because the proposal is dependent upon realignment of the Stephenson Highway road reserve, in advising the SPC and Sherwood of the level of assessment for the proposed residential development, the EPA also indicated that the issue of the road reserve realignment should be addressed separately through the normal statutory planning process. The proposed amendment to the Metropolitan Region Scheme which would realign the road reserve was advertised on 12 August 1988, the closing date for submissions being 14 October 1988. The EPA has made a submission to the SPC on the amendment. The submission included a summary of issues relating to the proposed realignment raised in the submissions received by the EPA on the PER. The EPA also noted in its submission to the SPC that the Western Suburbs Highway Stage II Study concluded that there was no further basis for the Highway, and that the current Road Reserves Review should, therefore, examine in detail the road requirements for future north/south vehicular access in the locality.

Given that the proposed amendment has been advertised, the EPA's advice on the amendment provided and the review period for the amendment closed, it is now appropriate to release the EPA's Report and

Recommendations on the proposed Floreat Lakes Residential Development. Necessarily, however, finalisation of the development proposal will depend on satisfactory resolution of the Stephenson Highway road reserve issue.

During its assessment of the proposed development, the EPA recognised that without deep dredging of the moat to provide fill for the residential area, the project would not be viable. That is, the proponent would not proceed with the development if approval was conditional upon creating a moat no deeper than 1 metre in summer, and consequently the benefits to the environment associated with completing the moat would be lost. The EPA's assessment was, therefore, based on consideration of a deep moat or the alternative of no moat at all.

The EPA has concluded that the depth and extent of the proposed moat would be environmentally acceptable providing appropriate management was undertaken to maintain water quality, details of which are to be provided in the Floreat Lakes Monitoring and Management Programme. However, the peat proposed to be placed in the Industrial Lake should instead be used to reduce the area of deep water. The SPC and Sherwood have developed a draft Peat Management Plan which addresses the consequences of placing the peat in contact with water bodies and also on Public Open Space.

The Osborne and Balgay Main Drains would be realigned and the moat divided into sections with a series of stop log structures. However, the realigned Osborne Main Drain should not encroach upon the central conservation area.

The SPC and Sherwood propose to prepare an overall water management plan for Herdsman Lake which will provide a system of containment, monitoring and reporting of pollution events.

Physical impacts (eg dust, noise and general disturbance) associated with development of the site would be acceptable providing adequate management controls were incorporated.

Based on its assessment of the proposal and additional information provided by Sherwood and the SPC in response to issues raised in submissions, the Authority recommends as follows:

Recommendation 1

The Environmental Protection Authority concludes that the proposed Floreat Lakes Residential Development is environmentally acceptable and that it may proceed subject to appropriate management, the recommendations in this Report, and Sherwood abiding by the commitments in the Public Environmental Report and subsequent documentation including:

- **Sherwood will remove no more than 850 000 cubic metres of sand fill from the moat; and**
- **Sherwood will continue to bid competitively for sand to be imported to the site for fill.**

Recommendation 2

The Environmental Protection Authority recommends that prior to the commencement of dredging Sherwood should prepare a detailed design of the final moat in consultation with the Department of Conservation and Land Management to the satisfaction of the Environmental Protection Authority. The moat design should meet the following criteria:

- **no more than 850 000 cubic metres of sand fill to be obtained from the moat;**
- **peat should not be placed in the Industrial Lake, but should be used in the Floreat Lakes moat to reduce the area of deep water; and**
- **final contours after placement of peat in the moat should be such that the area of deep water is minimised, and conversely, that the area of shallow water (<1 m in summer) is maximised.**

Recommendation 3

The Environmental Protection Authority recommends that, prior to commencement of dredging, Sherwood should finalise the monitoring and management programme for Floreat Lakes to the satisfaction of the Environmental Protection Authority. Matters addressed in this programme should include:

- **maintaining water quality in the moat; and**
- **peat management.**

Sherwood should report the results of the Floreat Lakes Monitoring and Management Programme to the Environmental Protection Authority every two years, and following handover, the agency responsible for management of Herdsman Lake should continue to provide those reports to the Environmental Protection Authority.

Recommendation 4

The Environmental Protection Authority recommends that Sherwood should ensure all works associated with the proposal, including the realigned Osborne Main Drain, do not encroach upon the central conservation area as defined by the "limit of dredging" line in Improvement Plan 21.

Recommendation 5

The Environmental Protection Authority recommends that an overall water management plan for Herdsman Lake should be prepared by the State Planning Commission in consultation with the Department of Conservation and Land Management, Water Authority of WA, and City of Stirling and to the satisfaction of the Environmental Protection Authority. The plan should be prepared prior to completion of the Floreat Lakes development.

Recommendation 6

The Environmental Protection Authority recommends that Sherwood should undertake the necessary dust control measures during development of the site to ensure that dust is minimised to the satisfaction of the Environmental Protection Authority.

Recommendation 7

The Environmental Protection Authority recommends that Sherwood should ensure that noise impacts associated with the proposed development are minimised. Matters requiring particular attention in this regard would include:

- hours of operation, in particular the timing of any noisy procedures;
- use of quietest machinery available; and
- routes to be used by service and construction vehicles and machines.

Measures to ensure the minimisation of noise impacts should be formulated in consultation with the City of Stirling and to the satisfaction of the Environmental Protection Authority.

Recommendation 8

The Environmental Protection Authority recommends that Sherwood and the State Planning Commission should provide a post-construction report to the Environmental Protection Authority on completion of the development. The post-construction report should detail any unexpected impacts, problems encountered and the means used to resolve them, and include a survey of the moat to show the finished size and depth.

1. Introduction

Sherwood Overseas Co Pty Ltd (Sherwood) and the State Planning Commission (SPC) propose to develop the north west sector of Herdsman Lake, to be known as Floreat Lakes Residential Development.

Improvement Plan 21 was gazetted in 1986 to coordinate planning, development and land use at Herdsman Lake. A major component of the Plan is the creation of a protective moat around the central core of the Lake area. Developments in the south western section of the lake (Floreat Waters), the north eastern section (Herdsman Industrial Park) and the south east section have created a major portion of the protective moat. The only remaining section is the north west which is shown on the Improvement Plan as an area to be replanned, with the intention being that a lakeside residential development would occur on the land.

The Environmental Protection Authority (EPA) determined that, because an essential component of the proposed Floreat Lakes Residential Development is the creation of a deep and wide moat, a Public Environmental Report (PER) would be required to assess the proposal. The PER had a public review period of eight weeks closing 18 July 1988. During this period the EPA received 140 government agency and public submissions.

In its review of the environmental implications of the proposal, the EPA has considered the information contained in the PER, commitments made by Sherwood and the SPC (Appendix A), the issues raised in the submissions (Appendix B), and the response by Sherwood and the SPC to those submissions (Appendix C).

Also, when the EPA first received notice of the proposed residential development in 1987, a meeting was arranged to discuss the issue of water management in relation to the proposed deep moat. The meeting was attended by representatives of Sherwood, the various authorities involved with Herdsman Lake and also relevant academics. Information and suggestions provided at this meeting were also considered by the EPA during its review of the proposal.

2. The Proposal

2.1 Description

Sherwood and SPC propose to develop the north west sector of Herdsman Lake (see Figure 1). Sherwood's objective is to create a water orientated residential development similar to Floreat Waters. SPC's objectives are to complete Improvement Plan 21, re-plan the north west sector, develop the moat and open space for passive recreation, gain land for Parks and Recreation, gain land for reserves, complete development of the urban land, achieve an improved drainage system, create an "A" Class reserve, and realise on surplus landholdings. The proposal entails:

- dredging of both public and private land to continue the protective moat around Herdsman Lake and provide sand fill for the urban land;
- removal of peat from the urban land and road reserve, placement of peat in the adjacent Industrial Lake, on the foreshore and in the moat (partially backfill the moat to Reduced Level (RL) -1.0 m to achieve a summer depth of 7.4 m);
- importation of fill;
- development of the urban land for residential purposes;
- development of the foreshore area for recreation and conservation purposes; and
- diversion and management of the Balgay and Osborne Main Drains.

Sherwood has a current development approval to strip and stockpile peat within its landholding and to fill with imported clean filling sand as it becomes available. These operations commenced in 1987.

The proposal assumes that the Stephenson Highway road reserve, which currently lies between the urban land and Herdsman Lake, will be realigned along the western side of the subdivision. Such a realignment requires an amendment to the Metropolitan Region Scheme (MRS), and the proposed amendment was advertised by the SPC on 12 August 1988, the closing date for submissions being 14 October 1988. Figures showing the existing and proposed MRS zonings have been provided (see Figures 2 and 3).

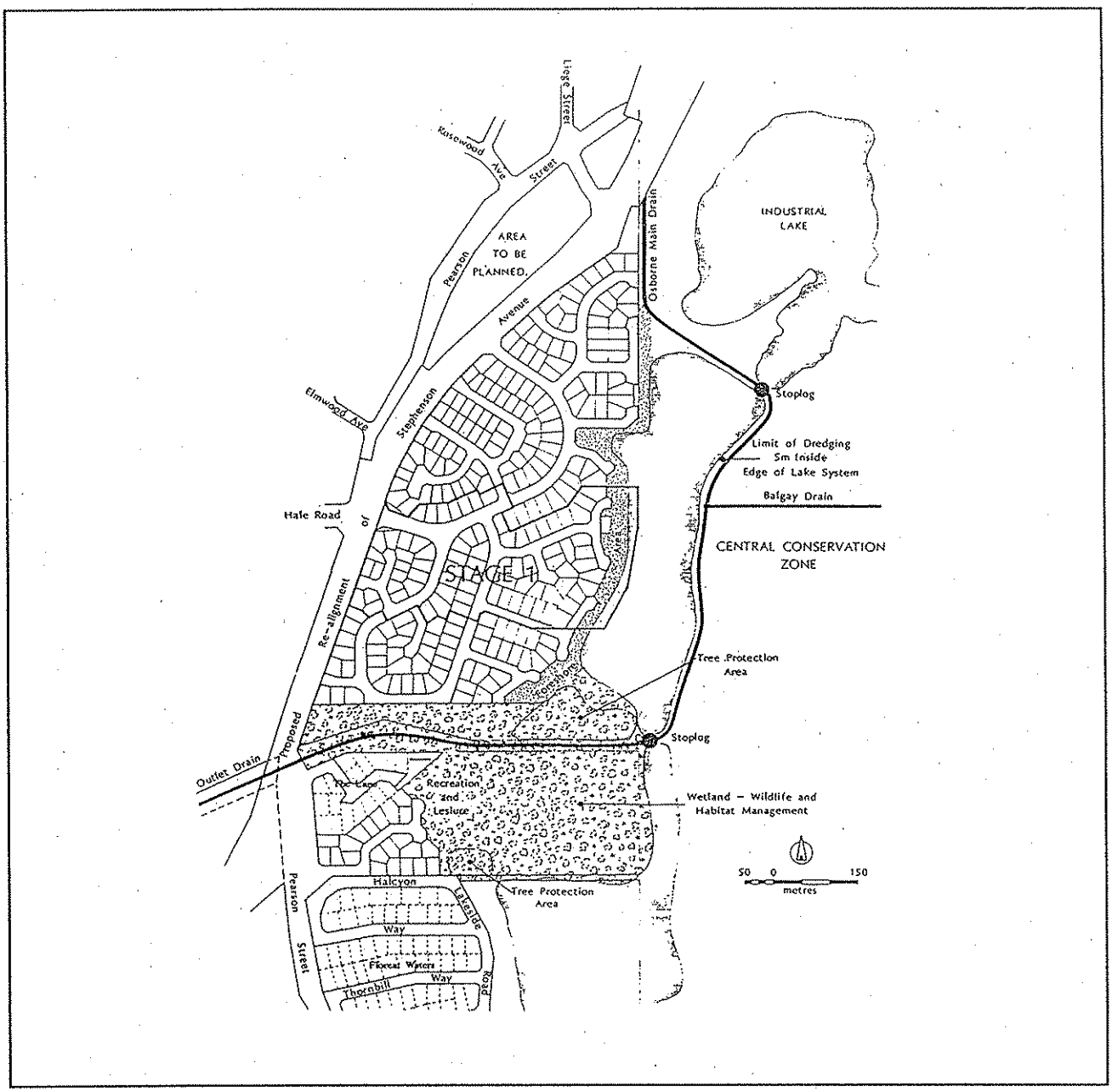

Figure 1. Floreat Lakes Residential Development

The total development area is 52.7 ha, and the proposal assumes 5 ha of this will be reserved for Other Major Highway. Of the remaining 47.7 ha, 31 ha (65%) will be developed for urban purposes, and 16.7 ha (35%) for Parks and Recreation (14.7 ha of parkland and 2 ha of open water).

Development of the land using fill obtained entirely off-site has been judged by the proponent to be uneconomical. It is therefore proposed that, of the total fill requirement (980 000 cubic metres), the moat be used as a source of 850 000 cubic metres of fill. The additional 130 000 cubic metres would be imported to the site. It is proposed that dredging would be to a depth of RL -10.0 m, and that peat from the development area would be disposed of in the moat resulting in a finished depth of RL -1.0 m (7.4 m deep in summer), with shallow margins fringing the moat.

Two hectares of the moat would be on private land and the remainder within Crown land reserved for Parks and Recreation. The moat would be 120-200 m in width fronting the residential development, and a minimum of 50 m in width between Floreat Lakes and Floreat Waters.

In addition to backfilling the moat, it is proposed that peat stripped from the urban land, the road reserve and the area to be dredged would be used to build up the public open space, landscape and backfill the adjacent Industrial Lake (100 000 cubic metres). It is expected that all works associated with the peat stripping and dredging would be completed by 1990.

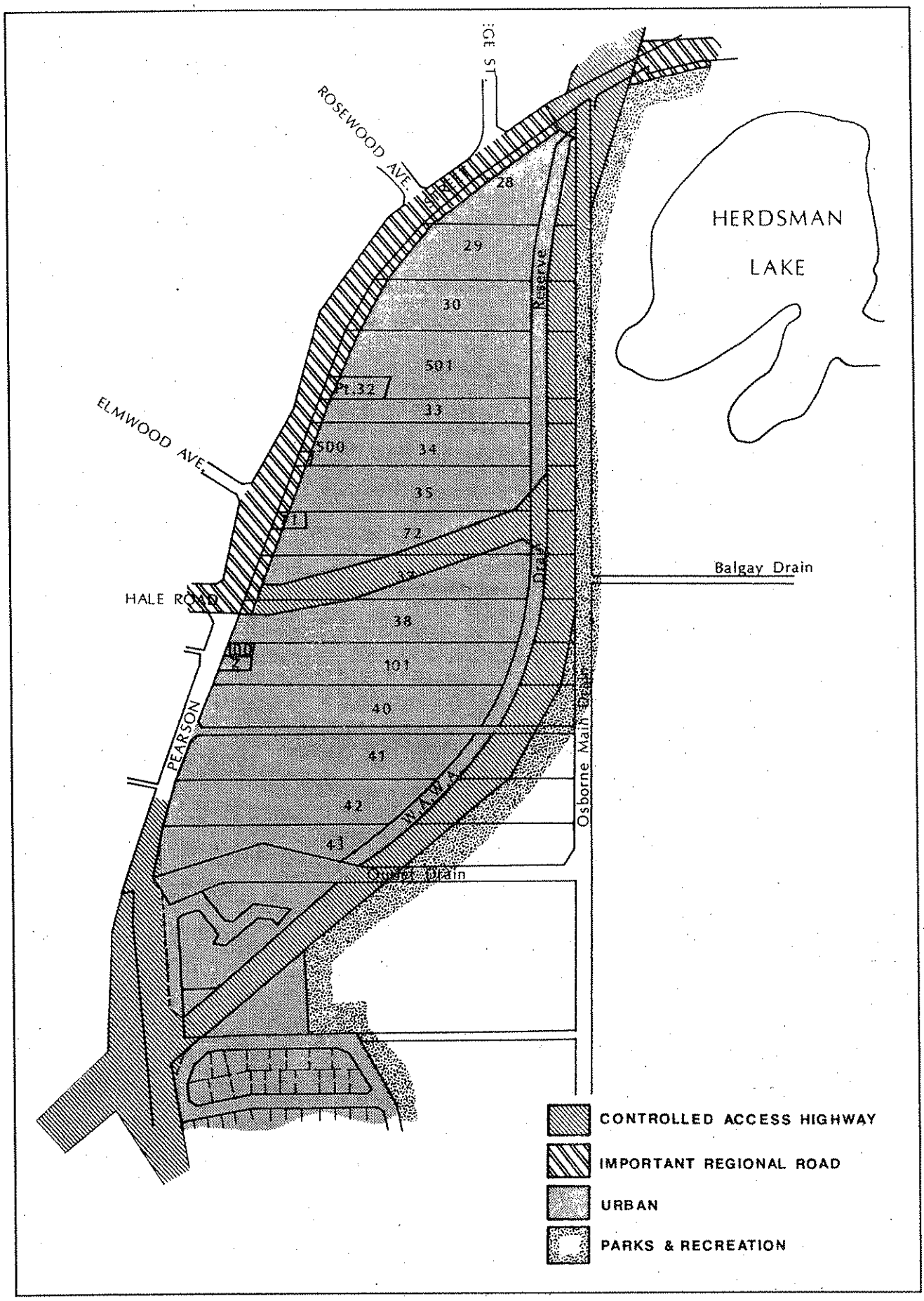

Figure 2. Existing Metropolitan Region Scheme Zoning

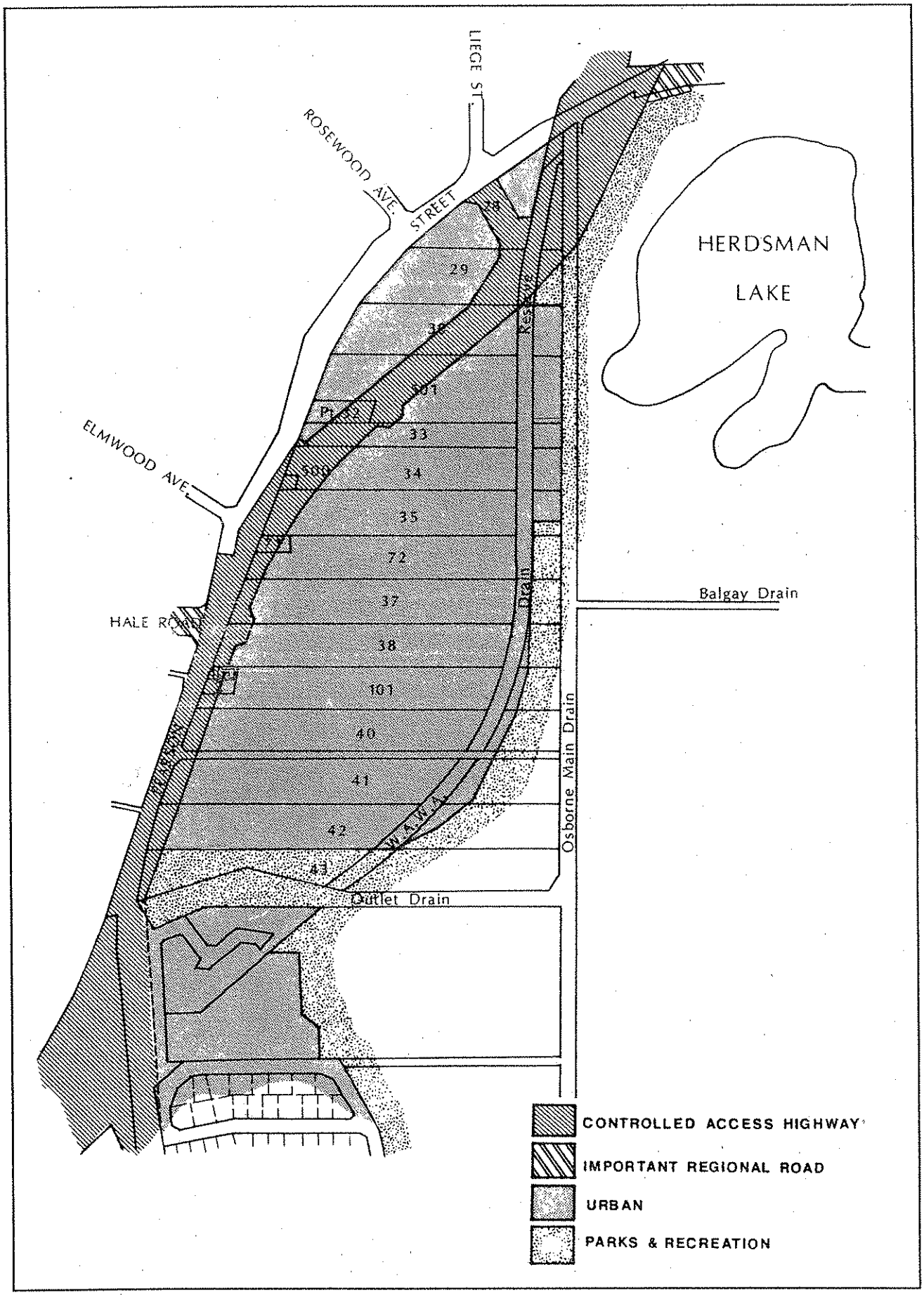

Figure 3. Proposed Metropolitan Region Scheme Zoning

Final designs for the foreshore areas have not been prepared as yet. Sherwood would act as the designer to the satisfaction of SPC, and advice would be sought from CALM, the City of Stirling and other interested parties. Sherwood is prepared to clearly delineate and, in some cases, fence off the tree protection areas, wetlands and private land from the area to be developed for housing. Once the development is completed, Sherwood would maintain the area for a further twelve months.

The moat margins, foreshore, tree protection areas and wetlands in the north west sector would all become part of the "A" Class reserve, although details of management and maintenance would be resolved following discussions between SPC, CALM and the City of Stirling.

An outline of a water monitoring and management programme for the proposed moat has been prepared by Sherwood and SPC and is included in Appendix D. It is proposed that the final management and monitoring programme provide details of the variables to be monitored, monitoring intervals and necessary management responses for which Sherwood and SPC would be collectively responsible from commencement of construction until handover to the SPC.

A new drainage system for Herdsman Lake has been designed by SPC and Sherwood and a water management plan for the whole of Herdsman Lake is in preparation. A precis of the Herdsman Lake Water Management Plan, which would provide a system of containment, monitoring and reporting of pollution events for the whole of Herdsman Lake, is included in Appendix E.

In regard to the new drainage system, Sherwood have already made a commitment to fill the subsidiary drain (west of the Osborne Main Drain) which was installed to improve the market gardens, and move the Osborne Main Drain to the east of the moat. Stop-log structures would be installed in the drainage system to permit diversion of water to the moat or the central area, or detainment in the Osborne and Balgay Main Drains and disposal directly to the Outflow Drain (see Figure 1).

As a result of concerns raised about using peat on housing sites, foreshores and as back fill to the moat, Sherwood and SPC have completed some initial testing and prepared a draft Peat Management Plan (Appendix D).

2.2 Alternatives

Alternatives proposed by the proponent relate to the source of fill, construction of the moat and design of the new drainage system for Herdsman Lake.

Sherwood examined various options for obtaining fill and concluded that a combination of importing fill and obtaining it from the moat would achieve a viable project and environmental objectives. To minimise the requirement for sand fill from the moat:

- fill required for SPC land south of the drain and north west of the realigned Stephenson Highway would be imported;
- design levels of the residential area have been altered to reduce the average fill level; and
- importation of commercially viable fill as it becomes available would continue.

Also, all available peat would be placed in the moat as refill so as to minimise water depth.

Sherwood considered nine criteria relating to the dimensions of the proposed moat, including light penetration, prevention of Typha invasion, need for a physical barrier around the conservation area, the need for sand and landscape development. The specifications of the proposed moat are:

- finished depth no deeper than 7.4 m;
- "limit of dredging" line in Improvement Plan 21 observed; and
- 120-200 m wide in front of the residential development, and 50 m wide between Floreat Lakes and Floreat Waters.

The slope of the banks would be determined by the requirements for human safety, mosquito and midge breeding control and wildlife habitat. The depth in the remaining areas would be deliberately varied.

Five parameters were used in deriving a new drainage layout for Herdsman Lake, including the need for a system of channels to carry flows to the ocean, a means of controlling pollution events and management of water quality in the moat. Of the three options derived, the SPC considered Option B, which realigned the

Osborne Main Drain east of the "limit of dredging" line, to be the most practical drainage system which achieved all of the parameters (see Figure 4).

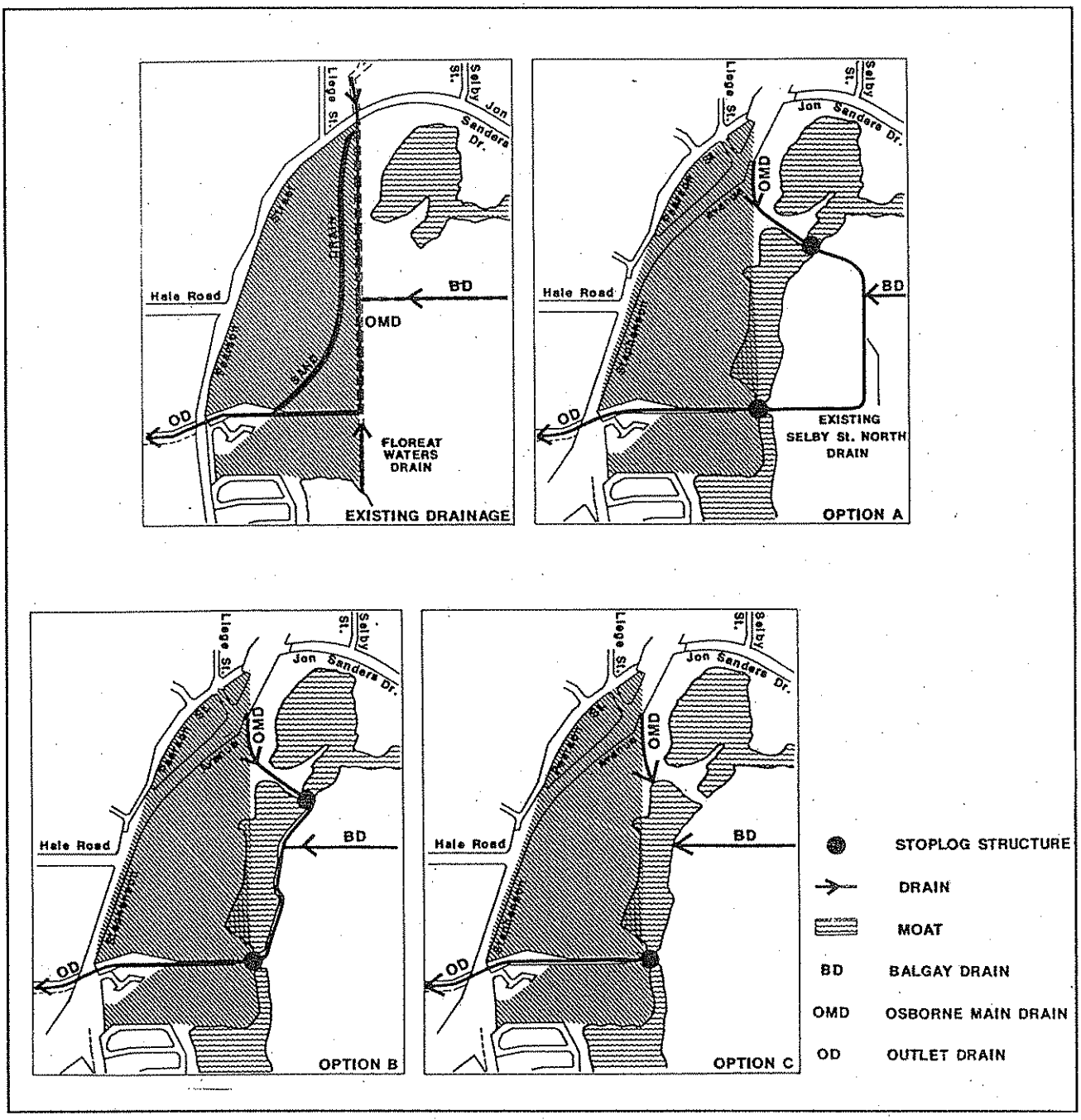

Figure 4. Alternatives considered for Main Drains.

2.3 Statutory Requirements, Vesting and Management Responsibility

As discussed earlier, an assumption of the proposed Floreat Lakes Residential Development is that the Stephenson Highway Road Reserve will be realigned. An amendment to the MRS was initiated in July to realign the route for Stephenson Highway and to transfer the land no longer required for Controlled Access Highway to the Urban Zone and Parks and Recreation Reservation. The review period closed on 14 October 1988, and the Minister for Planning has not yet provided his determination.

Sherwood is required to seek development and subdivision approval from the SPC, and an amendment to the City of Stirling District Planning Scheme. Sherwood must also comply with the requirements of the Water Authority of WA (WAWA), CALM, Main Roads Department, Mines Department and the State Energy Commission.

A management plan for the proposed "A" Class reserve, which will include the moat, foreshore, tree protection areas and wetlands in the north west sector, is being developed by CALM, and the reserve will be vested in the National Parks and Nature Conservation Authority. Details regarding responsibility for management of certain areas such as the foreshore are still to be resolved.

3. Public and Government Submissions

The PER was released for public comment for an eight week period from 21 May 1988 until 18 July 1988.

A total of 140 submissions was received, and 122 of these opposed the development, 3 supported it, and 6 provided technical comment only. Of the 122 submissions opposing the development, 88 were letters in one of three standard formats to which a signature and address were added.

The following table summarises the submissions received.

	Total	For	Against	Information	Stephenson Hwy Only
Standard (1)	32	-	32	-	-
Standard (2)	41	-	41	-	-
Standard (3)	15	-	15	-	-
Individual	41	3	29	-	9
Non-govt. organisation	6	-	5	1	-
Government	5	-	-	5	-
	140	3	*122	6	9

*Of the 122 submissions opposed to the development, 114 also raised the issue of the proposed realignment of Stephenson Highway.

Opposition to the Proposal

The majority of submissions received expressed opposition to the proposal in one of three standard formats. All three standard letters identified a number of issues relating to the development, some of which were of a non- environmental nature. However, the main issue of concern, but which is not being addressed by the EPA in its assessment of the proposed development, was the proposed realignment of Stephenson Highway.

Issues raised in individual submissions included limited access to the foreshore, high density of the development, impact on Herdsman Lake as a result of an increase in people, pets, fire and stormwater discharge, uncertainty regarding the impact of a deep moat, loss of habitat and loss of public open space.

Inaccuracies and an overall lack of detail in the PER were also identified as limiting the degree to which the proposal could be assessed. Also, advertising the MRS amendment to realign Stephenson Highway after the review period for the PER had closed was seen as denying the public the opportunity to comment constructively on related issues.

The majority of individual submissions also raised the issue of the proposed realignment of Stephenson Highway .

Support for the Proposal

Three submissions received supported the proposal in principle, although concerns were raised regarding the density of development, access to facilities and potential dust problems during development.

Information Only

Six submissions were received providing technical information only, five from Government Departments and one from a non-government organisation. Overall the submissions accepted the principle of developing a moat within a reserve and providing fill for a residential development. There was also general support for the SPC's intention to prepare a Water Management Plan for Herdsman Lake. The WAWA found the proposed drainage system (Option B) to be acceptable, and requested that Sherwood consult with it during the preparation of the monitoring and management programme.

Stephenson Highway Realignment

Nine of the submissions received did not address the proposed development at all, but only the proposed realignment of Stephenson Highway.

The proposed amendment to the MRS which would realign the road reserve was advertised on 12 August 1988, the closing date for submissions being 14 October 1988. The EPA has made a submission to the SPC on this issue. As indicated, many of the submissions received by the EPA on the PER raised issues relating to proposed realignment. Therefore, the EPA's submission on the proposed MRS amendment also included a summary of these issues. The EPA also noted in its submission to the SPC that the Western Suburbs Highway Stage II Study concluded that there was no further basis for the Highway, and that the current Road Reserves Review should, therefore, examine in detail the road requirements for future north/south vehicular access in the locality.

The EPA has considered the environmental issues relating to the proposed residential development raised in the submissions during its assessment and, in many instances, the matters have been incorporated in the recommendations made (either directly or through the underlying rationale).

4. Environmental Assessment

Because the proposed Floreat Lakes development is dependent upon realignment of the Stephenson Highway road reserve, in advising the SPC and Sherwood of the level of assessment for the proposal, the EPA also indicated that the issue of the road reserve realignment should be addressed separately through the normal statutory planning process. The proposed amendment has now been advertised and the EPA's advice on the amendment provided. Therefore, there is considered to be no advantage in withholding the EPA's report on the proposed residential development any longer. The EPA's Report and Recommendations on the proposed Floreat Lakes Residential Development, which is subject to satisfactory resolution of the Stephenson Highway road reserve issue, is now provided.

The major environmental issues associated with the proposed development are:

- depth, extent and management of the moat;
- location and management of the main drains;
- design, extent and management of the public open space; and
- impacts on existing residences (eg dust and noise).

During its assessment of the proposed development, the EPA recognised that without deep dredging of the moat to provide fill for the residential area, the project would not be viable. That is, the proponent would not proceed with the development if approval was conditional upon creating a moat no deeper than 1 metre in summer, and consequently the benefits to the environment associated with completing the moat would be lost. The EPA's assessment was, therefore, based on consideration of a deep moat or the alternative of no moat at all.

The EPA has completed its assessment of the environmental issues associated with the proposed Floreat Lakes Residential Development and has concluded that it is environmentally acceptable subject to this Report and Sherwood abiding by its commitments, and assuming satisfactory resolution of the Stephenson Highway road reserve issue.

Recommendation 1

The Environmental Protection Authority concludes that the proposed Floreat Lakes Residential Development is environmentally acceptable and that it may proceed subject to appropriate management, the recommendations in this Report, and Sherwood abiding by the commitments in the Public Environmental Report and subsequent documentation including:

- **Sherwood will remove no more than 850 000 cubic metres of sand fill from the moat; and**
- **Sherwood will continue to bid competitively for sand to be imported to the site for fill.**

4.1 Depth, Extent and Management of the Moat

The environmental concerns relating to depth and extent of the moat in the north west sector are:

- to act as a protective barrier for the central conservation area, the moat should be more than 20 m wide and have a depth of at least 1 m in summer to prevent Typha from reinvading;
- a greater area of open water may result in losses of emergent plant communities which have significant habitat value;
- a greater water depth may result in management problems arising from the potential for stratification at depth in the water bodies with pooling of low oxygen/high nutrient waters at depth;
- a water depth greater than 1 m in summer will provide a less useful habitat for birdlife; and
- the moat has a role in water quality maintenance, and compensation of drainage waters.

Other constraints on the design of the moat are:

- the need for sand to complete the development works on the adjacent urban land;
- the need to dispose of peat stripped from the adjacent land;
- landscape development for scenic attractiveness; and
- "limit of dredging" line in Improvement Plan 21.

In an earlier assessment of a proposal to dredge sand for fill from an area in the south of Herdsman Lake, the EPA recommended that the finished moat should be no deeper than 7.4 m in summer. This recommendation was based on an assessment of early monitoring data which suggested that in deep water (greater than 7.4 m) a thermocline developed in summer and autumn, with an overturn in June-July. The phenomenon led to an accumulation of oxygen depleted nutrient enriched waters below the thermocline in summer and autumn, and following overturn the nutrients were mixed through the water column leading in turn to an increase in algal biomass.

More recent data collected from the existing Herdsman Lake moat and analysed by Sherwood and SPC suggest that the location of the thermocline is in fact quite variable. However, no matter at what depth stratification and deoxygenation occur, the eventual turnover will result in nutrients being made available to the whole system. Also, blue green algae are positively buoyant. During summer and autumn when there is intense surface water heating and less deep mixing, blue green algae are favoured and become dominant. Other more beneficial, but less bouyant algae are not as successful in summer and autumn conditions.

Of course, a major difficulty with the water bodies at Herdsman Lake is the variable quality of water inputs to the Lake which, to date, have not been controlled.

Upon reviewing the information presented in the PER, and also examining other sources of relevant information, the EPA has concluded that a deep moat at Floreat Waters would be environmentally acceptable providing:

- monitoring and management of the water in the moat is undertaken both during and after construction (eg artificial deep mixing and/or aeration of the water as required to effectively extend the winter and spring situation); and
- monitoring and management of incoming waters is undertaken enabling diversion of poor quality water around the moat at certain times of the year (see Section 4.2).

As discussed in Section 2.1, a draft Water Monitoring and Management Programme has been prepared by Sherwood and the SPC and is included in Appendix D. The detailed programme should accommodate the abovementioned management techniques.

Provided the above management practices occur, the EPA believes there would be no environmental advantage in requiring the finished moat depth to be no deeper than 7.4 m in summer. Rather, an environmentally preferable objective would be to minimise the area of deep water while allowing the moat to be deeper than 7.4 m.

Such a moat would still provide the necessary fill, have a significant amount of usable wildlife habitat, and be more easily managed. Therefore, the EPA has concluded that to achieve the "optimum" moat, it should be designed to meet the following criteria:

- no more than 850 000 cubic metres of sand fill to be obtained from the moat;
- peat should not be placed in the Industrial Lake as proposed, but should be used in the Floreat Lakes moat to reduce the area of deep water; and
- final contours following placement of peat in the moat should be such that the area of deep water is minimised, and conversely, that the area of shallow water (<1 m in summer) is maximised.

Obviously, certain engineering requirements such as slope, need to be considered in the design of the final contours. Also, the design should provide a diverse range of habitats, and in particular, shallow mudflat areas should be constructed adjacent to the core area and reed areas on the outside of the moat.

Recommendation 2

The Environmental Protection Authority recommends that prior to the commencement of dredging Sherwood should prepare a detailed design of the final moat in consultation with the Department of Conservation and Land Management to the satisfaction of the Environmental Protection Authority. The moat design should meet the following criteria:

- **no more than 850 000 cubic metres of sand fill to be obtained from the moat;**
- **peat should not be placed in the Industrial Lake, but should be used in the Floreat Lakes moat to reduce the area of deep water; and**
- **final contours after placement of peat in the moat should be such that the area of deep water is minimised, and conversely, that the area of shallow water (<1 m in summer) is maximised.**

Sherwood has given a commitment to continue obtaining viable fill from elsewhere, including investigating the possibility of dredging the swamp at Glendalough. It should be noted that any proposal to dredge the Glendalough swamp would need to be formally assessed by the EPA.

Because of concerns the EPA had regarding the acceptability of using the peat to backfill the moat (given the past landuse), Sherwood was requested to provide further information on the nutrient and pesticide levels of the peat, and the implications of using the peat for backfill, and also as fill on housing sites and foreshores. Initial testing has been completed, and Sherwood is awaiting further results. A draft Peat Management Plan has been prepared and is included in Appendix D.

The EPA is satisfied that the results of the initial testing along with the draft Peat Management Plan suggest that appropriate management of any contaminated peat will be possible.

In regard to both the Water Monitoring and Management Programme outline and the draft Peat Management Plan (Appendix D), the EPA considers final details should be prepared and submitted to the Authority for its approval prior to the commencement of dredging. The documentation should be in the form of one overall monitoring and management programme for Floreat Lakes which addresses both water quality and peat, and also construction and post- construction impacts. The document should provide for corrective management as required, including long-term maintenance of acceptable water quality (discussed above).

Recommendation 3

The Environmental Protection Authority recommends that, prior to commencement of dredging, Sherwood finalises the monitoring and management programme for Floreat Lakes to the satisfaction of the Environmental Protection Authority. Matters addressed in this programme should include:

- **maintaining water quality in the moat; and**
- **peat management.**

Sherwood should report the results of the Floreat Lakes Monitoring and Management Programme to the Environmental Protection Authority every two years and following handover, the agency responsible for management of Herdsman Lake should continue to provide those reports to the Environmental Protection Authority.

4.2 Location and Management of the Drains

Sherwood and the SPC have examined a number of alternatives regarding the location and management of the Osborne Main and Balgay Drains (see Figure 4) and have selected Option B as the preferred option. The WAWA has advised that it finds the proposed drainage system acceptable, and has requested that the detailed designs provide for access along the realigned Osborne Main Drain for maintenance purposes. Given that the drain realignment has implications for the proposed "A" Class reserve, CALM should also be consulted.

The EPA supports the proposed drainage layout, including the use of stop- log structures to manage the water inputs, presented in the PER providing the realigned Osborne Main Drain does not encroach on the central conservation area (as defined by the "limit of dredging" line in Improvement Plan 21).

Recommendation 4

The Environmental Protection Authority recommends that Sherwood should ensure all works associated with the proposal, including the realigned Osborne Main Drain, do not encroach upon the central conservation area as defined by the "limit of dredging" line in Improvement Plan 21.

The risks associated with discharge of stormwater to Herdsman Lake have long been recognised. While the quality of water entering Herdsman Lake through the urban drains from the catchment is not the responsibility of Sherwood, it could cause severe and ongoing management problems associated with the moat and jeopardise conservation values. Overcoming or reducing these risks through management will make the drainage function subservient to wider management objectives.

The Herdsman Lake Water Management Plan , a precis of which is included in Appendix E, is currently being prepared by the SPC. It will provide a system of containment, monitoring and reporting of pollution events and this is supported by the EPA. The management plan must be placed in the context of the future management of Herdsman Lake and recognise that drainage waters will be used to benefit the wildlife. Also, it is essential that the management plan gives consideration to management of the lake's 3000 ha catchment which includes industrial, residential and recreation areas.

The flexibility built into the operation of the plan must be properly researched and appropriate guidelines for operation developed. It is noted that management of the drainage waters will be the responsibility of SPC until the "A" Class reserve is vested.

Recommendation 5

The Environmental Protection Authority recommends that an overall water management plan for Herdsman Lake should be prepared by the State Planning Commission in consultation with the Department of Conservation and Land Management, Water Authority of WA, and the City of Stirling and to the satisfaction of the Environmental Protection Authority. The plan should be prepared prior to completion of the Floreat Lakes development.

In regard to drainage from the subdivision itself, the Authority supports the commitment to install silt traps and biological filters on the drains.

4.3 Design, Extent and Management of Public Open Space

Of the total development area (52.7 ha), 16.7 ha will be developed for Parks and Recreation (including 2 ha of open water).

The EPA supports the staged method of designing and developing the Public Open Space and notes that advice will be sought from CALM, the City of Stirling and other interested parties on this matter. In particular, the issue of lots directly abutting areas of public open space must be resolved.

As discussed in Section 4.1, the EPA became concerned about nutrient and pesticide levels of the peat material on-site and requested that this be investigated. Specifically, the EPA was concerned about the environmental implications of using the peat on housing sites, public open space and as backfill to the lake. The EPA is satisfied that the results of the initial testing along with the draft Peat Management Plan suggest that appropriate management of any contaminated peat will be possible. This issue will be incorporated into the Floreat Lakes Monitoring and Management Programme.

4.4 Impact on Nearby Residents

The main issue of concern to the EPA is the potential nuisance to nearby residents associated with development of the site, in particular dust generated by dewatered peat and fill and noise from the working dredge, and earthmoving machinery.

The EPA is becoming increasingly concerned about dust generated as a result of works for residential developments. A number of submissions received on the PER suggested that dust management last summer was not satisfactory.

It is noted that Sherwood has made a commitment to maintain dust levels below accepted standards during construction. Given that concern has already been expressed by the public it would seem to be in the proponent's interest to actually minimise dust generation rather than just meet accepted standards.

Recommendation 6

The Environmental Protection Authority recommends that Sherwood should undertake the necessary dust control measures during development of the site to ensure that dust is minimised to the satisfaction of the Environmental Protection Authority.

The PER does not adequately address the issue of noise during construction, and contains no commitment regarding the hours of operation. In particular, the acceptability of operating machinery outside normal working hours has not been addressed. This matter has been raised with Sherwood and an undertaking has now been given for:

- investigation of the prevailing noise climate within adjoining residential areas, in consultation with the City of Stirling; and
- assessment of the contribution to the noise environment of the earthmoving and service works to be undertaken during development at various times during the day and night and under all prevailing weather conditions.

Recommendation 7

The Environmental Protection Authority recommends that Sherwood should ensure that noise impacts associated with the proposed development are minimised. Matters requiring particular attention in this regard would include:

- **hours of operation, in particular the timing of any noisy procedures;**
- **use of quietest machinery available; and**
- **routes to be used by service and construction vehicles and machines.**

Measures to ensure the minimisation of noise impacts should be formulated in consultation with the City of Stirling and to the satisfaction of the Environmental Protection Authority.

4.5 Reporting

Reporting requirements regarding the Floreat Lakes Monitoring and Management Programme and the overall Herdsman Lake Water Management Plan have already been discussed (Sections 4.1, 4.2).

The EPA considers it would be very useful for a post-construction report to be prepared when development is completed, detailing any unexpected impacts, problems encountered and the means used to resolve them. In addition, a survey of the moat should be provided to show its size and depth.

Recommendation 8

The Environmental Protection Authority recommends that Sherwood and the State Planning Commission should provide a post-construction report to the Environmental Protection Authority on completion of the development. The post-construction report should detail any unexpected impacts, problems encountered and the means used to resolve them, and include a survey of the moat to show the finished size and depth.

5. Conclusion

Sherwood Overseas Co Pty Ltd and the State Planning Commission propose to develop the north west sector of Herdsman Lake for residential purposes. The proposal, which assumes realignment of the Stephenson Highway road reserve, was detailed in a Public Environmental Report requested by the Environmental Protection Authority and made available for public comment for eight weeks. The proposal entails dredging a deep lake which would complete the protective moat around Herdsman Lake, filling and developing the urban land and realigning and managing the main drains.

Having considered the Public Environmental Report and subsequent documentation, issues raised in the public submissions and the response by Sherwood and SPC, the Environmental Protection Authority concludes that the proposal as described is environmentally acceptable subject to the Recommendations contained in this Report.

6. References

Department of Conservation and Environment (1981), Water Quality Criteria for Marine and Estuarine Waters of Western Australia. Report of theWorking Group established by the Environmental Protection Authority. Bulletin 103, Department of Conservation and Environment, Western Australia.

Department of Conservation and Environment (1982), Herdsman Park Estate, Environmental Review and Management Programme, Report and Recommendations by the Environmental Protection Authority, Bulletin 111, Department of Conservation and Environment, Western Australia.

Environmental Protection Authority (1986), Herdsman Lake - South East Sector Proposals by the State Planning Commission, Report and Recommendations by the Environmental Protection Authority, Bulletin 263, Environmental Protection Authority, Western Australia.

Environmental Protection Authority (1987), A Baseline Biological Monitoring Programme for the Urban Wetlands of the Swan Coastal Plain,Western Australia, Bulletin 265, Environmental Protection Authority, Western Australia.

Appendix A

Commitments

Sherwood Overseas Co Pty Ltd (Sherwood) makes the following commitments relating to the proposed Floreat Lakes residential development:

1. To complete the land transactions necessary and to develop a high quality residential area in the north west sector of Herdsman Lake.
2. To allocate land in accordance with Table 1 and Figure 3 of the PER. The areas allocated to Parks and Recreation will be planted with appropriate vegetation cover and provided with appropriate services and facilities.
3. To complete the proposed protective moat between the development and the central conservation zone, under supervision by the State Planning Commission (SPC).
4. To construct the new drainage system according to the directions of the SPC, including stop-log structures.
5. To use peat from the development area for landscaping parklands and foreshores to SPC requirements.
6. To dispose of metals and toxic material found in the excavated areas during development at an approved disposal point.
7. To install and maintain suitable sediment controls and environmental protective measures during the construction phase by isolating the dredge pond from the rest of Herdsman Lake Regional Park.
8. To maintain dust levels below accepted standards during construction.
9. To provide stormwater and drainage discharge facilities in accordance with SPC policy.
10. To provide suitable road access to the residential development.
11. To retain liability for defects in open space construction for a period of 12 months until management is fully taken up by the SPC.
12. To fulfil agreements between Sherwood and the SPC including adherence to a $150,000 bond negotiated between them.
13. To comply with all statutory requirements and agreements as listed in Section 2.3 of the PER. Specifically Sherwood will comply with the provisions of Sections 79 and 84 of theEnvironmental Protection Act 1986 with respect to noise emission and in particular the Noise Abatement (Neighbourhood Annoyance) Regulations, 1979 and all other statutes.
14. The SPC and Sherwood will prepare a water management and monitoring programme in consultation with the EPA, CALM, WA of WA and CoS for the period from commencement, until handover to the SPC. The SPC and Sherwood will be collectively responsible for management and monitoring until handover to the SPC.
15. To manage peat in accordance with the Peat Management Plan.
16. To retain an environmental consultant to oversee the project and provide appropriate advice when required, with the power of direction to stop work. Sherwood has nominated Dr David Bennett to perform this task.
17. To remove no more than 850 000 cubic metres of sand fill from the moat.
18. To continue to bid competitively for sand to be imported to the site for fill.

The SPC is responsible for development control of subdivision matters at Herdsman Lake, and for administering Improvement Plan 21. Also, the SPC has the role of acquiring land reserved in Improvement Plan 21 for Parks and Recreation. As a reflection of its involvement in Herdsman Lake, the SPC makes the following commitments:

1. To complete Improvement Plan 21 by replanning the North West Sector including the relocation of Stephenson Highway.
2. To complete the amalgamation of lands for Herdsman Lake Regional Park for vesting in the National Parks and Nature Conservation Authority.

3. To fulfil agreements between the SPC and Sherwood, including supervision of the construction of the moat, which will not extend beyond the limit of dredging line in Improvement Plan 21.

4. The SPC and Sherwood will prepare a water management and monitoring programme in consultation with the EPA, CALM, WA of WA and CoS for the period from commencement of construction until handover to the SPC. The SPC and Sherwood will be collectively responsible for management and monitoring until handover to the SPC.

Appendix B

Review and Summary of Submissions for the Proposed Floreat Lakes Residential Development

Review of Submissions

The PER was released for public comment for an eight week period from 21 May 1988 until 18 July 1988.

A total of 140 submission was received, and 122 of these were opposed to the development, 3 supported it and 6 provided technical comment only. Of the 122 submissions opposed to the development, 88 were letters in one of three standard formats to which a signature and address were added.

	Total	For	Against	Information	Stephenson Hwy Only
Standard (1)	32	-	32	-	-
Standard (2)	41	-	41	-	-
Standard (3)	15	-	15	-	-
Individual	41	3	29	-	9
Non-govt. organisation	6	-	5	1	-
Government	5	-	-	5	-
	140	**3**	***122**	**6**	**9**

***Of the 122 submissions opposed to the development, 114 also raised the issue of the proposed realignment of Stephenson Highway.**

Opposition to the Proposal

The majority of submissions received expressed opposition to the proposal in one of three standard formats. All three standard letters identified a number of issues relating to the development, some of which were of a non- environmental nature. However, the main issue of concern, but which is not being addressed by the EPA in its assessment of the proposed development, was the proposed realignment of Stephenson Highway.

Issues raised in individual submissions included limited access to the foreshore, high density of the development, impact on Herdsman Lake as a result of an increase in people, pets, fire and stormwater discharge, uncertainty regarding the impact of a deep moat, loss of habitat and loss of public open space.

Inaccuracies and an overall lack of detail in the PER were also identified as limiting the degree to which the proposal could be assessed. Also, advertising the MRS amendment to realign Stephenson Highway after the review period for the PER had closed was seen as denying the public the opportunity to comment constructively on related issues.

The majority of individual submissions also raised the issue of the proposed realignment of Stephenson Highway.

Support for the Proposal

Three submissions received supported the proposal in principle, although concerns were raised regarding the density of development, access to facilities and potential dust problems during development.

Information Only

Six submissions were received providing technical information only from 5 Government Departments and 1 non-government organisation. Overall the submissions accepted the principle of developing a moat within a reserve and providing fill for a residential development. There was also general support for the SPC's

intention to prepare a Water Management Plan for Herdsman Lake. The Water Authority of WA (WAWA) found the proposed drainage system (Option B) to be acceptable, and requested that Sherwood consult with WAWA during the preparation of the monitoring programme.

Stephenson Highway Realignment

Nine of the submissions received did not address the proposed development at all, but only the proposed realignment of Stephenson Highway.

Summary of Issues

Presented below is a summary of the issues raised in the submissions received.

General Comments about the Proposed Development

It is not appropriate that the SPC is a joint proponent with a private developer.

The status and management of Herdsman Lake should be finalised before the environmental acceptability of the proposed Floreat Lakes development is determined.

The proposed agreement between the SPC and Sherwood Overseas Co Pty Ltd should recognise the need for public participation in planning and development, establish an appropriate management body, provide for an independent consultant and state a date from when it will be in effect.

Approval to strip and stockpile peat and to fill with imported fill should not have been given prior to assessment of the PER.

To demonstrate the need for the development by stating that it will bring about more efficient use of public and community facilities ignores the fact that residential areas change over the years.

General Comments about the PER

The various studies which have been conducted at Herdsman Lake, including water quality, have been treated superficially in the report.

The PER does not give adequate consideration to the value of Herdsman Lake as a wetland of international significance.

The diagrams presented in the report do not allow an accurate assessment of the changes in boundaries and proposed uses.

The plans which accompany the text of IP21 (Appendix B of the PER) are unsigned and do not bear the same plan numbers as those quoted in the text. Also, their reproduction is poor.

The PER refers to the Central Conservation Zone. However, the management plan being prepared for the A Class Reserve does not yet propose any zoning. It is the boundary of the A Class Reserve which should be referred to.

All references to Stephenson Avenue should be changed to Stephenson Highway.

Review Procedure

By closing the public submission period for the PER before release of the MRS amendment for relocation of Stephenson Highway, the public has been denied the opportunity to comment on related issues such as noise, access and impact on residential development.

Physical Environment

The water quality data for the development area mentioned on page 21 (para 7) should be provided.

What levels of nitrogen and phosphorus "might be anticipated" in Floreat Waters and drains (page 21, last paragraph)?

Are there any other effects of the climate in addition to those regarding pollutants (page 23, para 4)? What about groundwater? What is the evidence for nutrient loss from the Hertha Road tip?

The proposed reduction in fertiliser and pesticide use as a result of urban development has not been substantiated.

Biological Environment

The information presented in the EPA System 6 Report (1983) is out of date. Also, more recent information than Curry (1981) is available. A current vegetation map of the north west sector should be provided, along with percentages of existing and proposed habitats for the area (in addition to the information provided in the PER for the whole of Herdsman Lake). Also, a current and complete list of wildlife species found at Herdsman Lake should be provided.

What arrangements will be taken to ensure there will be the minimum possible disturbance of birds during development?

How will the proposal increase the conservation value of the north west sector?

In response to specific information provided in the PER, the following points were made:

- Herdsman Lake is also used by transequatorial migratory wading bird species;
- the existence of *Typha domingensis* as well as *T. orientalis* should be confirmed;
- the little egret *(Egretta garzetta)* is considered to be rare in its occurrence at Herdsman Lake;
- in comparison to other wetlands the variety of invertebrate fauna at Herdsman Lake is known to be reduced;
- it is stated that tiger snakes and dugite occur in the area, however, the reptile list on page 25 lists the dugite as probable only; and
- the development will result in a reduction in feeding areas available to various populations of waterbirds including swans and coots.

Sociological Environment

The statement that the north west sector requires caution to negotiate is subjective and potentially misleading. The hazards in negotiating natural environments are not necessarily any more than the hazards in negotiating urban environments.

The educative function of Herdsman Lake and also the need for passive recreation pursuits such as walk trails should be considered. The need for a dual use path linking areas to the north and south should also be considered.

What is the expected impact of increased traffic and increased people and pets as a result of the development?

The common measure to describe traffic noise is the L10 (18 hour) index, and noise levels quoted in the report should be in accordance with this index. Also, the quoted noise level should be in the same year as the quoted traffic volume.

Housing

Is the area on the west side of the realigned highway (Stage 4, 3.353 ha) included in the 31 ha of residential development referred to in the PER.?

The area affected by the Stephenson Highway reserve (existing alignment) should not be developed for housing, but included in the Public Open Space.

The proposed residential development is too dense, and is out of character with the area.

Drainage

There has not been an adequate assessment of alternatives for drainage options.

The impact of the proposed drainage system on Herdsman Lake has not been adequately addressed.

Have variations in climate been considered in the design of the drainage system?

Vehicular access along the proposed main drain described in Option B will be necessary for maintenance purposes.

Page 6 (para 2) states that "Sherwood will construct the main drains, but not the stop logs". However, page 11 (para 3) states that "Sherwood will fill the subsidiary drain and move the Osborne Main drain to the east of the moat and will install stop-log structures in the drain system to permit diversion of water".

In regard to drainage associated with the subdivision:

- drainage waters should not be disposed of directly to the moat;
- information on the number and location of drains and silt traps should be provided; and
- consideration should be given to controls which would be necessary to respond to pollution events.

Moat

Contrary to what is stated in the PER, the moat agrees with IP21 in concept only - that is that there should be a moat. The design is substantially different.

The size and shape is determined by the need for fill and not the needs of conservation.

The dimensions of the moat given in the text are different to that indicated in Figure 3.

From where does the SPC specification of "no deeper than RL -1.0 (7.4 m in summer)" originate? A depth of R.L.-1.0 is inappropriate for much of the wildlife that use Herdsman Lake. Diving birds do not use deep lakes in anoxic conditions.

The optimum conditions for waders usually occur at very shallow depths just as areas are in the process of drying out, so depths of less than 30 cm favour use by waders. There should be at least 10 metres of foreshore associated with the moat to create 'mudflats'.

The 1 in 5 slopes within the bank zone of the moat would be steeper than the normally accepted slopes in areas which will be accessible to the public. This may be particularly hazardous at low water summer levels in the moat.

How narrow will the moat be between Floreat Lakes and Floreat Waters?

There should be a commitment to the construction of islands within the moat.

What does "not only has design topograpy been levelled and lowered" on page 14 (last paragraph) refer to?

What bathymetric measurements are referred to on page 15 (para 4), and what planning team? Also "No peculiarities . . ." is too much of a generalisation. For example, Herdsman lake has a low invertebrate diversity. Also, it is known that water at Herdsman Lake is stratified, and that oxygen reduction and high concentrations of nutrients occur below the thermocline. The "peculiarities" need to be placed in the context of discussion about whether Herdsman Lake only is being considered or in comparison to a range of wetlands.

No justification for reducing the depth of the Industrial Lake has been provided.

A bond should be placed on the developers, to be released when a bathymetric survey has been conducted demonstrating the correct depth of the moat.

Major algal blooms have occurred at the deep lake at Floreat Waters for a number of years.

The implications of stratification occurring in the moat should be discussed.

Is the extent of light penetration in the water known? The occasionally collected data for Herdsman Lake indicate a photic depth of 0.5 - 3 m. Lakes deeper than this will, unless vertically mixed, have anaerobic surface sediments.

The statement on page 15 (last para) attributed to Vollenweider must be taken in context because the depths referred to are "shallow" in relation to that analysis.

The role of peat in buffering the nutrient content of the water requires clarification. Organic-rich sediments generally have much higher nutrient concentrations than sandy sediments, and under certain conditions release these nutrients to the overlying water.

The alternative argument to dilution of intermittent flows by a large volume of water is that the smaller the volume of water in the lake, the less possibility there is for retention of large volumes of nutrient-rich water.

Who has decided that the moat will not be part of the designated conservation area?

Dredging a substantial part of the moat within Government land has not been justified. The foreshore/moat should not impinge on Crown land or SPC freehold.

The claim that the moat will improve protection of the reserve should be substantiated.

Public Open Space

Maps of the same scale, and tables, showing clearly ownership and reservation of the land, and the land to be provided for Public Open Space should be provided. Why is there a discrepancy between the figure shown in Table 1 (5.36 ha) and the figure stated in the text (8.8 ha)? How is the 35% made up? Will there by a difference to the boundary of the A Class Reserve as a result of the development? A ratio of housing to parkland to open water should be provided.

Lots should not directly abutt areas of Public Open Space because this can lead to the expansion of people's gardens, give an impression of private ownership of what is public land, and discourage public access to the area. There should be a continuous road along the full length of the subdivision abutting the Public Open Space.

The strip of Public Open Space between the subdivision and the lake shown on Figure 3 does not serve the recreation needs of the development and should be modified to accommodate a wider swathe in some areas and a larger area centrally for use as a neighbourhood park.

Figure 3 suggests that the lot subdivision south of the existing development called "The Lane" impinges on the area to be set aside as the A Class Reserve defined in IP21.

Figure 3 gives the impression that the "Recreation and Leisure" and "Tree Protection" areas have resulted from activities of the proponent. The Tree Protection Area is mostly very degraded.

Is it safe to use the peat for landscaping?

Stripped peat in "undiluted" form is not suitable as a growing medium on the recreation areas.

Any waste material deposited and buried in Public Open Space must have a cover of 600 mm of sand or sand/peat mix.

Liability for defects in open space construction (page 44, no. 11) should include all associated facilities.

Management and Monitoring

There should be firm commitments regarding the preparation of monitoring programmes and the reporting of results.

More recent documents on management should be put forward than 6 year old EPA reports.

Is it intended that the use of the stop logs will be used as a result of continual monitoring, or only on a seasonal basis?

The impact of the water in the moat on the groundwater should be considered, and the results of groundwater monitoring should be examined to determine whether the private use of groundwater should be permitted.

Sherwood Co Pty Ltd failed to control dust last summer associated with the stripping and filling operation being undertaken.

The filling of land will not, in the long-term, destroy argentine ant habitat although the moat will make containment easier.

Fire will continue at present level because access to the central area would not be controlled.

The fill being imported should be screened for toxic substances.

Realignment of Stephenson Highway

Various issues associated with the proposed realignment of Stephenson Highway were raised in a number of the public submissions, but which are not relevant to the proposed residential development.

Appendix C

Response to Submissions

Prepared by Sherwood and SPC

General Comments about the Proposed Development

Comment:

It is not appropriate that the State Planning Commission (SPC) is a joint proponent with a private developer.

Response:

The SPC owns land within the urban subdivision.

Comment:

The status and management of Herdsman Lake should be finalised before the environmental acceptability of the proposed Floreat Lakes development is determined.

Response:

The Floreat Lakes development has been designed to conform to the Herdsman Lake Improvement Plan. As such these works are completing the basic construction over which the management plan will function.

Comment:

The proposed agreement between the SPC and Sherwood Overseas Co. Pty Ltd should:

- recognise the need for public participation in planning and development;
- establish an appropriate management body;
- provide for an independent consultant; and
- state a date from when it will be in effect.

Response:

Public participation has been achieved through this environmental assessment process. In the PER paragraphs 8 and 9 on page 39; 1,2 and 5 on page 40; 2,4,5 and 7 on page 41 and 2 on page 42 give details of the liaison and negotiation that the proponents intend to perform. Public participation is further achieved through theHerdsman Lake Management Advisory Committee. Sherwood and its consultants are currently making arrangements to improve its liaison with that Committee. Sherwood and its consultants are currently making arrangements to improve its liaison with that Committee.

The SPC is the current management body.

In W.A. environmental works and supervision are carried out at the expense of the developer under the supervision of a government department. In this case the consultant, if dismissed, must be replaced by another consultant, first approved by the SPC (para 3 page 70 of the PER).

To nominate a date of effect would usurp the development approval process, since would assume the development could proceed and the date on which it would be approved.

Comment:

Approval to strip and stockpile peat and to fill with imported fill should not have been given prior to assessment of the PER.

Response:

The earthworks were part of the private, and currently zoned urban land for which rezoning is not necessary. The SPC had no reason to refuse the application.

Comment:

To demonstrate the need for the development by stating that it will bring about more efficient use of public and community facilities ignores the fact that residential areas change over the years.

Response:

These changes have a direct impact on the utilisation of public and community facilities. Woodlands, which abuts the project area, is a case in point where the ageing population is placing less demand on educational and community facilities.

Examination of the following statistics for the Woodlands Primary School supports this point.

Total capacity of existing buildings :

12 permanent rooms = 380 students

Year	Actual Enrolments
82	331
83	255
84	250
85	211
86	189
87	179
88	183

Year	Projections by Ministry of Education
89	182
90	199
91	206

The Floreat Lakes development will generate approximately 100 primary school children who will attend Woodlands Primary School. The 1990 - 1991 increases in the Ministry of Education projections reflect the anticipated impact of Floreat Lakes. The above demonstrates that the Floreat Lakes development will maintain demand for education facilities, which are currently underutilised due to the current ageing phase in the life cycle of the Woodlands suburb.

Other facilities in the area are similarly affected by the ageing of the existing community.

General Comments about the PER

Comment :

The various studies which have been conducted at Herdsman Lake, including water quality, have been treated superficially in the report.

Response :

Information on water quality in other parts of the moat at Herdsman Lake have been collected over a number of years. At about the same time as the PER was written, the SPC, through CALM, contracted Dr Jenny Davis of Murdoch University to carry out an analysis of the accumulated data. This will be completed by October 1988 and will be used to improve the monitoring and management programme to be conducted under the supervision of SPC.

Comment :

The PER does not give adequate consideration to the value of Herdsman Lake as wetland of international significance.

Response :

The international significance of Herdsman Lake has not been established. Only two of eleven wetland experts rated Herdsman of international significance (W.A. Water Resources Council (1988) "Environmental Significance of Wetlands in the Perth to Bunbury Region" Vol 1 pages 2 and 4). Very low numbers of international migratory birds were recorded by Curry (1981). Most were of the family Scolopadacidae (the whimbrels, sea curlews, godwits, turnstones, sandpipers, knots and stints). These normally inhabit coastal areas and offshore islands and can be seen in large numbers on Rottnest. The sightings were mostly on the shores at Floreat Waters. One could conclude that the international significance of Herdsman Lake is the result of dredging the moat. No species which are rare everywhere were recorded by Curry, though there were a number which are rare at this location.

Comment :

The diagrams presented in the report do not allow an accurate assessment of the changes in boundaries and proposed uses.

Response :

Land use data included in the PER was prepared from 1:2000 development plans.

Comment :

The plans which accompany the text of IP21 (Appendix B of the PER) are unsigned and do not bear the same plan numbers as those quoted in the text. Also, their reproduction is poor.

Response :

The plans appear to be incorrect and poorly reproduced. The correct drawings have been provided to the EPA.

Comment :

The PER refers to the Central Conservation Zone. However, the management plan being prepared for the A Class Reserve does not yet propose any zoning. It is the boundary of the A Class Reserve which should be referred to.

Response :

IP21 is the statutory document for Herdsman Lake and specifies a conservation area in the central part of the lake. An 'A' Class Reserve will be established over Government lands reserved for Parks and Recreation when current amendments are finalised. The CALM management plan will have to recognise the conservation area, which is delineated by the moat, because IP21 prescribes the purposes of the lake. The management plan is to develop management polices and techniques for the established uses specified in IP21. The description of the central area as the CCZ was for clarity only and did not indicate any official zoning.

Comment :

All references to Stephenson Avenue should be changed to Stephenson Highway.

Response :

Accepted.

Review Procedure

Comment:

By closing the public submission period for the PER before release of the MRS amendment for relocation of Stephenson Highway, the public has been denied the opportunity to comment on related issues such as noise, access and impact on residential development.

Response:

Attempts were made by the EPA and the SPC and Sherwood to release both the PER and the MRS amendment for public comment concurrently. Unfortunately, last minute problems delayed the release of the MRS amendment.

Physical Environment

Comment:

The water quality data for the development area mentioned on page 21 (para 7) of the PER should be provided.

Response:

There are some data from the Osborne Main Drain (discussed below). For Herdsman Lake see above. The data is available in the following public documents:

- The State Planning Commission of Western Australia "Herdsman Lake Water Analysis 1982-86"
- ERSI - Australia Pty Ltd "Herdsman Industrial Estate Western Australia Phase 1 Environmental Monitoring Report September 1982-June 1983"
- Collins P (Edit) "Herdsman Industrial Estate - Environmental Monitoring Report Phase 1 September 1982 - June 1983 Summary" Metropolitan Region Planning Authority September 1984

Comment:

What levels of nitrogen and phosphorus "might be anticipated" in Floreat Waters and drains (page 21, last paragraph of the PER)?

Response:

Herdsman Lake and its catchment have had a longer period of disturbance by human activities than Thomson's, and North Lake. One might therefore anticipate that Herdsman would have similar or worse levels than these two lakes (ie more than 200 mg/1 Total P and more than 2000-3000 mg 1 Total N). In fact Herdsman Lake has lower levels than either of these two.

Comment:

Are there any other effects of the climate in addition to those regarding pollutants (page 23, para 4 of the PER)? What about groundwater? What is the evidence for nutrient loss from the Hertha Road tip?

Response:

Hydrographs for the lake from the Water Authority and the monitoring bore maintained by the Water Authority close to Herdsman Lake are attached (see Figure C1). Water quality records for site 2 (Osborne Main Drain) are given in ESRI Australia Pty Ltd "Herdsman Industrial Estate Phase 1 -Environmental Monitoring Report September 1982 - June 1983".

The discussion on pages 9 - 14 of that document concludes that drain water is poorer in quality than lake water.

Data from Hertha Road Tip was published by Bestow T.T" The influence of sanitary land-fill on groundwater quality at Hertha Road, Stirling" in "Groundwater Resources of the Swan Coastal Plain (1981)" published by CSIRO, pages 295-308. The major pollutants entering the groundwater were chloride, bicarbonate, sodium, potassium, ammonia, phosphorus, phenols and surfactants. Monitoring of the site ceased when extensions to the freeway destroyed the monitoring bores.

Comments:

The proposed reduction in fertiliser and pesticide use as a result of urban development has not been substantiated.

Response:

Nutrient input from any given land-use will depend upon:

- Crop type being grown, eg. fruit trees, vegetables, residential lawn.
- The species specifically being cultivated, eg potatoes, carrots, cucumbers (in the case of a market garden).
- Nutrient holding properties of the soil types present. In the case of Herdsman Lake north-west, a mixture of highly leached sands, iron-bearing sands, peats and marls.
- Water availability in terms of deliberate application, mean annual rainfall, rate of interstitial soil water movement, etc.

Despite these complexities it is possible to provide an estimate of an order of magnitude of nutrient input from various land-uses. The figures presented in the table below are obtained from the numerous sources listed. Actual nutrient input levels recorded by several different sources have been averaged and converted to an index of nutrient input. Although there is considerable variation in actual amount of fertiliser added, a useful rule of thumb is that a factor of 1 on the index is roughly equivalent to 6kg/ha/yr of elemental nitrogen or phosphorus.

Land Use and Nutrient Contribution

(indexed)

Land Use	Nitrogen	Phosphorus
Market gardens	50	23
Golf courses	3	18
Orchards	1.5	3
Public parks	1	3
Residential	1	1.5

Sources

Personal communications were obtained from: Horticultural Section of the Department of Agriculture, Orchard Section of the Department of Agriculture, Environmental Section of the Water Authority and CSBP and Farmers.

The following references were also used:

Dames & Moore (1987) Point Grey Development Project ERMP. Mallina Holdings Ltd.

Yeates, J.S., Arkell, P.T., Russell, W.K. Deeley, D.M., Peek, C.and Allen, D. (1985).

Management of Agriculture Phosphorus Losses from the soils of the Peel Harvey Catchment. In DCE Bulletin 195.

The table assumes that the residential land is deep sewered, thus there is no nutrient contribution from septic tanks.

The information clearly shows that market gardens contribute about 50 times more nitrogen and about 15 times more phosphorus than does residential land. The data also suggests, in terms of nutrient input, that residential land may even be better than parks or recreation facilities if groundwater quality is to be maintained.

Pesticides

Information similar to nutrient input is not available for pesticides. The potential reductions in pesticide input are therefore based on the following logic:

- an agricultural or horticultural crop will require pest control on a broad scale and regular basis.
- residential land requires little or no pest control except on a very localised and infrequent scale; for example, control of lawn beetles.
- under current land use, Argentine Ant spraying includes an area outside the proposed moat.
- after residential land is established, the moat completed and the ants outside the moat controlled, there will be no further need for regular pesticide spraying in the northwest sector.

The natural extension of this logic is therefore that pesticide input to the environment from the northwest sector of Herdsman Lake is likely to decline following development.

Biological Environment

Comment

The Information Presented in EPA System 6 Report (1983) is out of date. Also, more recent information than Curry (1981) is available. A current vegetation map of the north west sector should be provided, along with percentages of existing and proposed habitats for the area (in addition to the information provided in the PER for the whole of Herdsman Lake). Also, a current and complete list of wildlife species found at Herdsman Lake should be provided.

Response:

There has been no comprehensive government review of reserves since the System 6 report. The most recent record (August, 1988) of bird sightings at Herdsman Lake is attached (see Table C1), as is a vegetation map of the NW Sector (see Figure C2). The species of plants present were listed in Appendix D of the PER and animals in Section 6.3.1. to 6.3.4. of the PER.

Comment:

What arrangements will be taken to ensure there will be the minimum possible disturbance of birds during development?

Response:

See para 4 page 30 (Section 7.2) of the PER. "This will include searches to be made for nests in the affected area before dredging commences. Dredge patterns will be modified if it can be shown that by doing so a significant reduction in bird disturbance can be achieved"

Comment:

How will the housing development increase the conservation value of the north west sector?

Response:

The proponents do not claim that the housing development itself will increase the conservation value of the area. It is the associated works which will increase the conservation value of area. These are listed on page 35 of the PER.

Comment:

In response to specific information provided in the PER, the following points were made:

- Herdsman Lake is also used by transequatorial migratory wading bird species;

Response:

See Table C1

- existence of *Typha domingensis* as well as *T. orentalis* should be confirmed;

Response:

See Appendix D Reference D of the PER, which is: Dames & Moore (1985) "Preparation of Concept Plans - Glendalough Reserve No 28366."

- the little egret *(Egretta garzetta)* is considered to be rare in its occurrence at Herdsman Lake;

Response:

By comparison of the data in Curry (1981) with the information in Storr and Johnstone (1985) "A field Guide to the Birds of Western Australia", Western Australian Museum, Perth, the list of species recorded at Herdsman which are rare in Perth, but common elsewhere contains twelve species. Sightings of many more species of birds which are rare at Herdsman Lake, but common elsewhere have been recorded by the RAOU and the Gould League.

- in comparison to other wetlands the variety of invertebrate fauna at Herdsman Lake is known to be reduced;

Response:

Statement accepted, but ascribing the cause is difficult.

- It is stated that tiger snakes and dugites occur in the area, however, the reptile list on page 25 lists the dugite as probable only.

Response:

No comment.

The development will result in a reduction in feeding areas available to various populations of waterbirds including swans and coots.

Response:

Even the most casual observer would contest this statement. Human disturbance and human presence appears to have encouraged the use of Herdsman Lake, especially Floreat Waters lagoon, by some species of birds, especially swans, coots and black ducks.

Sociological Environment

Comment:

The statement that the north west sector requires caution to negotiate is subjective and potentially misleading. The hazards in negotiating natural environments are not necessarily any more than the hazards in negotiating urban environments.

Response:

The skills required to negotiate long grass, swamps, disturbed terrain and bulrush thickets are different to those required to negotiate a central business district.

Comment:

The educative function of Herdsman Lake and also the need for passive recreational pursuits, such as walk trails should be considered. The need for a dual path linking areas to the north and south should also be considered.

Response:

These matters will be addressed in discussions with CALM, CoS and the other parties.

Comment:

What is the expected impact of increased traffic and increased people and pets as a result of the development?

Response:

The sociological impacts of increased traffic and increased people and pets are expected to be the same here as elsewhere. Completion of the moat is expected to reduce the impact of people and their pets on the CCZ.

Comment:

The common measure to describe traffic noise is the L10 (18 hour) index, and noise levels in the report should be in accordance with this index. Also, the quoted noise level should be in the same year as the quoted traffic volume.

Response:

The use of standard noise measuring techniques is acknowledged. The results quoted are actual readings taken by the CoS, and as such record the available data. The quoted noise readings were taken during October 1981. The available records show the average weekday traffic on Pearson Street south of Liege Street during December 1981 was 21,250 vehicles. The traffic volumes have thus remained constant.

Housing

Comment:

Is the area on the side of the realigned highway (Stage 4, 3.353 ha) included in the 31 ha of residential development referred to in the PER?

Response:

The area west of the realigned highway (3.353 ha) is included in the 31 ha of residential development, as shown on Table 1 (page 11 of the PER).

Comment:

The area affected by the Stephenson Highway reserve (existing alignment) should not be developed for housing, but included in the Public Open Space.

Response:

Stephenson Highway alignment as per the Metropolitan Region Scheme has a land area of 7.77 ha. Utilisation of this land in the Floreat Lakes proposal is as follows:

	Area	Percentage
New Stephenson Highway	0.24	4
Parks and Recreation	3.01	38
Residential	4.52	58
	7.77 ha	100%

Whilst 4.52 ha of the current Stephenson Highway alignment has been assigned for residential purposes in the Floreat Lakes subdivision proposed, the revised alignment for Stephenson Highway requires Sherwood Overseas to give up 5 ha of land previously zoned urban for the new reserve. The difference in land taken for Stephenson Highway on the existing MRS alignment and that on the Floreat Lakes proposed subdivision is a reduction of

2.53 ha. The total land saving on the Stephenson Highway realignment has been given over to Parks and Recreation.

Referring to the System 6 recommendations (M43 Herdsman Lake) the clear intent is that land east of the proposed road (Stephenson Highway) was included in the Herdsman Lake Area. Stephenson Highway land is outside the System 6 area. Accordingly the inclusion of any part of the existing Stephenson Highway alignment in the Parks and Recreation reserve is an addition to that originally proposed.

Comment:

The proposed residential development is too dense, and is out of character with the area.

Response:

The Metropolitan Region Scheme and CoS District Planning Scheme No 2 (prior to the proposed Floreat Lakes subdivision) show two urban areas located between Stephenson Avenue, Hale Road Extension and Pearson Street. These areas are zoned R20 in the CoS District Zoning Scheme. This permits single, grouped and attached houses with a minimum lot size of 450 m2 and an average lot size of 500 m2.

Within Floreat Lakes it is proposed to create a diversity of housing types and a variety of lot sizes ranging between 450 m2 and 1000 m2.

It is proposed to integrate two areas of 450 m2 - 600 m2 lots, each with approximately 15 - 20 lots. The small development would be totally preplanned and sold as total packages including land, house, driveway, brick-paving, fencing and landscaping. Sherwood Overseas is currently discussing the principles of a joint venture on the small lots with A V Jennings, who have considerable experience with this form of development at Underwood Avenue, Floreat Park, "The Landing" within the waterside canal estate at Mandurah and Somerset Estate, Morley.

Inspection of the small lot concept at Floreat Park shows that the streetscape within these developments is no different to that of a conventional residential street.

ingle residential lots within the Floreat Lakes Development will range between 700 m2 and 1000 m2.

Examination of plans for the surrounding areas show the following lot sizes.

Floreat Waters Estate	generally 700 - 800 m2
The Lane	generally 700 - 800 m2
Churchlands Estate	generally 700 - 1000 m2
Churchlands	generally 700 - 800 m2
Woodlands	generally 700 - 850 m2

The proposed lot sizes within Floreat Lakes development are generally consistent with lot sizes prevailing in surrounding areas and are larger than the existing code permits.

Drainage

Comment:

There has not been an adequate assessment of alternatives for drainage options.

Response:

Feasible alternatives acceptable to the parties involved (WA of WA, MRD, CALM, SPC, CoS) have been assessed and are shown in Figure 4. The alternatives have been developed to provide the containment and control objectives of the management plan.

Comment:

The impact of the proposed drainage system on Herdsman Lake has not been adequately addressed.

Response:

The existing system of control drains will be maintained. The compensating basin characteristics of Herdsman Lake will be maintained. The major impact will be the construction of the last section of the moat system to protect the CCZ.

Comment:

Have variations in climate been considered in the design of the drainage system?

Response:

The drainage design will be in accordance with "Australian Rainfall and Runoff - A Guide to Flood Estimation Vol 1" Pilgrim DH [Edit] Institution of Engineers, Australia. This was revised in 1987 to incorporate improved methods of storm analysis and the expected change in weather patterns.

Comment:

Vehicular access along the proposed main drain described in Option B will be necessary for maintenance purposes.

Response:

Vehicular access will be maintained along the drains for maintenance purposes. This will be similar to the existing drain access. Access across the moat will be provided by a removable structure to maintain the integrity of CCZ.

Comment:

Page 6 (para 2) of the PER states that "Sherwood will construct the main drains, but not the stop logs". However, page 11 (para 3) of the PER states that "Sherwood will fill the subsidiary drain and move the Osborne Main Drain to the east of the moat and will install stop-log structures in the drain system to permit diversion of water".

Response:

Sherwood will construct stop logs as well as drains.

Comment

In regard to drainage associated with the subdivision

- the drainage waters should not be disposed of directly to the moat.;
- information on the number and location of drains and silt traps should be provided; and
- consideration should be given to controls which would be necessary to respond to pollution events.

Response:

Silt traps will be installed. Drainage waters are disposed into the moat in all other sectors of the lake without any apparent distress. This also fits the containment policy of the management plan. Information on the number and location of drains and silt traps should be provided.

The drainage design has not been finally completed, however the preliminary design requires two connections to the moat and four connections to the outlet drain. Consideration should be given to controls which would be necessary to respond to pollution events.

Consideration has been given to controls for pollution events and these comprise silt traps, biological filters and the moat containment structures. The water management plan will cover responses planned for pollution events.

Moat

Comment:

Contrary to what is stated in the PER, the moat agrees with IP21 in concept only - that is that there should be a moat. The design is substantially different.

Response:

IP 21 comprises a text, a certificate and several plans. The text clearly states the intentions to facilitate the dredge and fill for the North West sector urban area. The Development Plan (Plan No 4.O831) clearly shows the northwest sector as an area to be replanned, and is in no way a design. The moat shown is the minimum requirement should development of the urban area not proceed. Development of the moat by dredge and fill techniques involving the private sector is a long standing policy of the government and the SPC.

Comment:

The size and shape is determined by the need for fill and not the needs of conservation.

Response:

The size and shape is determined by nine considerations set out in the PER (page 15). Certainly the need for fill is a major factor (see above). The "needs of conservation" are considered to be:

- the moat itself, as a protective device for the CCZ;
- the moat's role in water quality maintenance and compensation of drainage waters; and
- the moat's role as a landscape element, a loafing area for birds, and in providing edge habitats for other bird species.

Comment:

The dimensions of the moat given in the text are different to that indicated in Figure 3 of the PER. How narrow will the moat be between Floreat Lakes and Floreat Waters?

Response:

The moat fronting Floreat Lakes varies between 120-200 metres in width. This is consistent with para 5 on page 17. The scale bar on Figure 3 is incorrect. A copy of the revised figure 3 is attached (see figure C3). The moat between Floreat Lakes and Floreat Waters is proposed to be constructed to the minimum width which can be dredged, currently 50 metres. The last 50 metre section near Floreat Waters will be two five metre channels, creating an island. Discussion on this design is continuing.

Comment:

From where does the SPC specification of "no deeper than RL-1.0 (7.4 m in summer)" originate? A depth of RL -1.0 is inappropriate for much of the wildlife that use Herdsman Lake. Diving birds do not use deep lakes in anoxic conditions.

Response:

RL -1.0 (7.4 m in summer) was adopted as SPC policy on the advice of EPA during consideration of a development by Rental and Investments Pty Ltd in the South Sector of Herdsman. That EPA advice was apparently based on its assessment of SPC monitoring data. Of course a depth of RL - 1.0 is inappropriate for much of the wildlife of Herdsman, but that statement assumes that all dredging is for wildlife habitat - which it is not. Diving birds do use deep lakes, anoxic or not. Deep lakes often have low oxygen levels at depth. There is no record of any water body at Herdsman being anoxic in its upper layers, or of being continually anoxic at depth.

Comment:

The optimum conditions for waders usually occur at very shallow depths just as areas are in the process of drying out, so depths of less than 30 cm favour use by waders. There should be at least 10 metres of foreshore associated with the moat to create 'mudflats'.

Response:

Mudflats should be on the inner side of the moat to avoid predation and disturbances. SPC policy is to complete the moat as a protective device, not to create specific wildlife habitat, unless CALM or EPA so recommends, subject to cost. Mudflats are also susceptible to typha invasion and are suitable habitats for mosquito breeding.

Comment:

The 1 in 5 slopes within the bank zone of the moat would be steeper than the normally accepted slopes in areas which will be accessible to the public. This may be particularly hazardous at low water summer levels in the moat.

Response:

The moat areas are not intended to be used for recreational swimming. The bank zone slope has been derived so that should someone wade into the water then they will be in a minimum 1.5 metres depth of water when 10.0 metres from the water line. Sherwood believes that this provides adequate safety for the public. The bank zone slope has also been set to minimise the width of the seasonally inundated portion as at Floreat Waters it has proved difficult to maintain the grass and to control the typha growth.

Comment:

There should be a commitment to the construction of islands within the moat.

Response:

The issue of the islands has been extensively discussed by the government departments and Sherwood. There appears to be confusion whereby the moat as a protective device to the CCZ is now considered by some to be primarily a habitat. Consideration has been given to constructing the section of moat between Floreat Lakes and Floreat Waters as a delta (See above). However the performance of the two channels in the south east sector is still being evaluated. The proposed drainage system, Option B will create an island on the eastern side of the moat.

Comment:

What does "not only has design topography been levelled and lowered" on page 14 (last paragraph) of the PER refer to?

Response:

The reference to the design topography is that the preferred design increased the elevation of the lots away from the moat edge. To reduce the sand requirement the design levels have been lowered to the minimum consistent with sound drainage design practices

Comment:

What bathymetric measurements are referred to on page 15 (para 4) of the PER and what planning team? Also "No peculiarities..." is too much of a generalisation. For example, Herdsman Lake has low invertebrate diversity. Also it is known that water at Herdsman Lake is stratified, and that oxygen reduction and high concentrations of nutrients occur below the thermocline. The "peculiarities" need to be placed in the context of discussion about whether Herdsman Lake only is being considered, or in comparison to a range of wetlands.

Response:

The depths of different parts of the moat at Herdsman Lake have been measured by different organizations at different times. These are the measures referred to in the PER. Wood and Grieve Pty Ltd are under a current contract to the SPC to measure the depths of the whole

moat more precisely. "No peculiarities" was a term to cover observations on bird and fish deaths, algal blooms and other problems of wetlands.

The only data that have come to the attention of the planning team are those from the Waterbird Conservation Group. That data, which has been provided to the EPA, indicates that bird deaths are not a feature of Herdsman Lake. From these results we conclude that Herdsman is a very healthy environment for waterbirds.

Comment:

No justification for reducing the depth of the Industrial Lake has been provided.

Response:

The reduction in depth of the Industrial Lake was part of the overall plan for developing the moat. It is not a necessary component of the proposed development.

Comment:

A bond should be placed on the developers, to be released when a bathymetric survey has been conducted, demonstrating the correct depth of the moat.

Response:

The bond specified in the agreement will cover this and other issues.

Comment:

Major algal blooms have occurred at the deep lake at Floreat Waters for a number of years.

Response:

No official record has been located. Microcystis is present all around Herdsman Lake all the time. Some greening of the water has occurred, more in shallow areas than deep. No smelly, decaying blooms have been recorded.

Comment:

The implications of stratification occurring in the moat should be discussed.Is the extent of light penetration in the water known? The occasionally collected data for Herdsman Lake indicate a photic depth of O.5 - 3.0 m. Lakes deeper than these will, unless vertically mixed, have anaerobic surface sediments.

Response:

The records of the degree and persistence of stratification are poor, in that continuous or frequent measurements under varying climatic conditions have not been made. It appears that wind has a strong influence on the persistence of stratification. A gale may break down existing stratification to a depth of five or more metres. An afternoon sea breeze may do so for the top two metres. Stratification leads to anoxia, which in turn leads to nutrient release from surface sediments. The concentration of nutrients will depend on the amount held on the sediments. More mobile nutrients will be the first to be released eg Cl, Na, N, CO3. Stratification can be exploited for management purposes, as has been done in the case of the Collie Dam.

Comment:

The statement on page 15 (last para) of the PER attributed to Vollenweider must be taken in context because the depths referred to are "shallow" in relation to that analysis.

Response:

Statement accepted.

Comment:

The role of peat in buffering the nutrient content of the water requires clarification. Organic-rich sediments generally have much higher nutrient concentrations than sandy sediments, and under certain conditions release these nutrients to the overlying water.

Response:

The peats of Herdsman Lake are naturally low in nutrients and have high adsorptive capacities. Reactive iron levels of around 3000 ppm have been measured in samples analysed by CSBP. They are therefore more likely to adsorb rather than release nutrients. This viewpoint appears to be the basis for the statement in paragraph 3.6 (p2) and Recommendation No 2 of EPA Bulletin 263 "Herdsman Lake South East Sector Proposals State Planning Commission" 1986.

Comment:

The alternative argument to dilution of intermittent flows by a large volume of water is that the smaller the volume of water in the lake, the less possibility there is for retention of large volumes of nutrient-rich water.

Response:

The water management plan is designed to remove any accumulation of large volumes of nutrient-rich water. Also our discussions with Dr Robert Gerritse of CSIRO Division of Water Research indicates that, at least for pesticides, a large volume of water in contact with peat is likely to have lower pesticide levels than a small volume of water.

Comment:

Who has decided that the moat will not be part of the designated conservation area?

Response:

The government on the advice of the SPC.

Comment:

Dredging a substantial part of the moat within Government land has not been justified. The foreshore/moat should not impinge on Crown land or SPC freehold.

Response:

The comment is based on an ideology, not on law. Mineral rights on Crown land are held by Mallina Holdings and assigned to Sherwood. The Hon Minister for Environment advised Hon Minister for Mines that the proposal to dredge for sand was consistent with IP21.

Comment:

The claim that the moat will improve protection of the reserve should be substantiated.

Response:

Since three quarters of the moat has been completed no fire has occurred in Herdsman Lake. With the completion of the moat further protection will reduce the possibility of fire. Access to the CCZ will be limited to swimming, use of illegal boats, or crossing the stop log structures which will be made even more hazardous by the use of barbed wire or other devices.

Public Open Space

Comment:

Maps of the same scale, and tables, showing clearly ownership and reservation of the land, and the land for Public Open Space should be provided. Why is there a discrepancy between the figure shown in Table 1 (5.36 ha) and the figure stated in the text (8.8 ha)? How is the 35% made up? Will there be a difference to the boundary of the A Class Reserve as a result of the development? A ratio of housing to parkland to open water should be provided.

Response:

The land ownership Map (figure 2 of the PER) and the development proposals (figure 3 of the PER) are the same scale and allow comparison.

Table 1 of the PER compares the land use allocation as per the existing Region Scheme and the Floreat Lake proposal. With respect to Parks and Recreation, Table 1 shows the existing Region Scheme zones 11.40 ha of land in private and SPC ownership for Parks and Recreation whilst the Floreat Lakes proposal provides 16.76 ha. Accordingly the Floreat Lakes proposal will provide an additional 5.36 ha of land for Parks and Recreation over and above that proposed under the existing Region Scheme configuration.

The 8.8 ha figure stated in para 2 of page 11 of the PER is that portion of the 16.76 ha Parks and Recreation within the Floreat Lakes proposal which will be landscaped for parks and passive recreation.

The 35% open space figure stated in para 2 page 11 is calculated from the attached land allocation assessment as follows.

Total development area = Title area	52.7697 ha
Less Other Major Highway	5.0034 ha
	47.7663 ha
Parks and Recreation =	(16.7586 ha) 35%
Urban =	(31.0011 ha) 65%
	(47.76632) 100%

Negotiations are continuing between the SPC and CALM as to the boundary of the A Class Reserve. It will not be the same as the boundary of IP21. Adoption of the Floreat Lakes proposal provides an additional 5.36 ha of Parks and Recreation land, over and above that land previously proposed for inclusion in the A class Reserve.

As requested an assessment has been made of housing to parkland and open water. The assessment area is land in private and SPC ownership as shown in the attached land allocation schedule.

Use	Area	Percentage
Housing	31.0077	65%
Parklands	14.7723	31%
Open Water	1.9800	4%
	47.76 ha	100%

Comment:

Lots should not directly abut areas of Public Open Space because this can lead to the expansion of people's gardens, give an impression of private ownership of what is public land, and discourage public access to the area. There should be a continuous road along the full length of the subdivision abutting the Public Open Space.

Response :

A dedicated and constructed public access walkway (PAW) will be located between the private lots and Parks and Recreation reserve. A continuous foreshore road, as at Floreat Waters, causes traffic problems for residents.

The proposed subdivision layout has been designed to permit vehicular access for people residing outside the area. At the same time it will create quiet, safe residential streets within the development. These will permit the movement of the majority of the residents to the foreshore/recreation area without conflicting with vehicle movements. The current layout provides a balance of vehicular access and unencumbered pedestrian access for the majority of residents.

Comment:

The strip of Public Open Space between the subdivision and the lake shown on Figure 3 of the PER does not serve the recreation needs of the development and should be modified to accommodate a wider swathe in some areas and a larger area centrally for use as a neighbourhood park.

Response:

The foreshore area in the Floreat Lakes development will be varied in width, but be not less than 30 metres as required by SPC policy. North of the drain reserve the open space area varies between 50 and 80 metres in width. The principles used in the Floreat Lakes proposal are consistent with the situation at Floreat Waters.

In addition to the foreshore area, which is included in the 16.76 ha of Parks and Recreation area shown in Table 1 of the PER, the development plan provides a 3100 m2 area of open space which projects westerly from the foreshore area to the main internal loop road. This area of open space is generally centrally located and can be developed as a neighbourhood park to serve the recreation needs of residents.

The State Planning Commission has agreed that no further open space is required other than that shown on the development plan (figure 3 of the PER).

Comment :

Figure 3 of the PER suggests that the lot subdivision south of the existing development called "The Lane" impinges on the area to be set aside as the A Class Reserve defined in IP21.

Response :

IP21 does not define the boundaries of an A Class Reserve. On both the Metropolitan Region Scheme and CoS District Zoning Scheme No 2 there is an area of residentially zoned land between Floreat Waters Estate and the Stephenson Highway alignment. The proposed subdivision extends eastwards beyond the residentially zoned land by some 34 metres along the Halcyon Way frontage and is consistant with the zoning adjacent to "The Lane". The area of Parks and Recreation deleted as a result of this subdivision south of "The Lane" is approximately 3000m^2. This has been taken into account in the overall calculation of Parks and Recreation land in the Floreat Lakes proposal, which is shown on Table 1 of the PER.

Comment :

Figure 3 of the PER gives the impression that the "Recreation and Leisure" and "Tree Protection" areas have resulted from activities of the proponent. The Tree Protection Area is mostly very degraded.

Response :

Tree protection areas are an SPC requirement - degraded or not they are a useful asset in an area short of trees.

Comment :

Is it safe to use the peat for landscaping?

Response :

Peat has been used for landscaping in both the SW and NE Sections of Herdsman Lake. The peat is derived from market gardens which have grown vegetables, so it will be safe to grow grass. Further monitoring is proceeding to ensure that no harmful residue are present in the landscaped areas or the moat.

Comment:

Stripped peat in "undiluted" form is not suitable as a growing medium on the recreation areas.

Response :

Peat material will be stripped from market gardens and the lake surface which currently supports growth. Sherwood intends to complete surfacing with a sandy peat mixture, which will provide a satisfactory surface.

Comment :

Any waste material deposited and buried in Public Open Space must have a cover of 600 mm of sand or sand/peat mix.

Response:

Sherwood intends to cover buried waste in this manner.

Comment:

Liability for defects in open space construction (page 44, Commitment No 11) should include all associated facilities.

Response:

The draft agreement for the control, management and development of the site in the PER will provide a defects liability period on all works.

Management and Monitoring

Comment:

There should be firm commitments regarding the preparation of monitoring programmes and the reporting of results.

Response:

Sherwood will provide an annual report to the EPA on progress and monitoring and a final report on handover.

Comment:

More recent documents on management should be put forward than 6 year old EPA reports.

Response:

Bulletin 111 was the last which covered the activities of a non- government agency at the level of an ERMP. It was 34 pages long. It was also a more detailed report than Bulletin 263 which was three pages long and covered a Notice of Intent.

Comment:

Is it intended that the use of the stop logs will be as a result of continual monitoring, or only on a seasonal basis?

Response:

More details of the use of stop logs will be provided in the water management plan. Essentially the stop logs will be removed or replaced when water is flowing (ie winter and early spring) and left alone for the rest of the year, unless a polluting event occurs.

Comment:

The impact of the water in the moat on the groundwater should be considered, and the results of groundwater monitoring should be examined to determine whether the private use of groundwater should be permitted.

Response:

Currently Woodlands is not within a gazetted Groundwater Management Area, so there is no requirement to license bores. Even if an area is gazetted the government has not required the metering of domestic bores. Constraints are difficult to enforce without legal controls.

Comment:

Sherwood Overseas Co Pty Ltd failed to control dust last summer associated with the stripping and filling operation being undertaken.

Response:

The dust problem will be minimized, particularly during high winds, by the presence, at all times of earthmoving activities, of water trucks and spraying equipment.

Comment:

The Filling Of Land will not, in the long-term, destroy argentine ant habitat, although the moat will make containment easier.

Response:

Argentine ants are swamp inhabiting species. The filling of the urban area will destroy habitats, as has occurred at Floreat Waters, the Industrial Estate and elsewhere.

Comment:

Fire will continue at its present level, because access to the central area would not be controlled.

Response:

The moat is designed to protect the reserve.

Comment:

The fill being imported should be screened for toxic substances.

Response:

Sherwood, through its site manager, controls all imported materials and is rejecting any material containing toxic substances and other deleterious materials.

Realignment of Stephenson Highway

Comment:

Various issues associated with the proposed realignment of Stephenson Highway were raised in a number of the public submissions, but which are not relevant to the proposed residential development.

Table C1. Bird Sightings at Herdsman Lake

Bird Sightings at Herdsman Lake taken from the RAOU Computer Files, August 1988.

Great Crested Grebe
Hoary-headed Grebe
Australasian Grebe
Australasian Pelican
Darter
Great Cormorant
Pied Cormorant
Little Black Cormorant
Little Pied Cormorant
Pacific Heron
White-faced Heron
Curlew Sandpiper
Oriental Pratincole
Silver Gull
Yellow Wagtail
Clamorous Reed-Warbler
Little Grassbird
Great Egret
Cattle Egret
Little Egret
Eastern Reef Egret
Rufous Night Heron
Little Bittern
Australasian Bittern
Glossy Ibis
Sacred Ibis
Straw-necked Ibis
Yellow-billed Spoonbill
Wandering Whistling-Duck
Black Swan
Freckled Duck
Australian Shelduck
Pacific Black Duck
Grey Teal
Chestnut Teal
Australasian Shoveler
Pink-eared Duck
Hardhead
Blue-billed Duck
Musk Duck
Marsh Harrier
Buff-banded Rail
Spotless Crake
Black-tailed Native-hen
Dusky Moorhen
Purple Swamphen
Eurasian Coot
Red-kneed Dotterel
Red-capped Plover
Black-fronted Plover
Black-winged Stilt
Banded Stilt
Wood Sandpiper
Common Sandpiper
Greenshank
Sharp-tailed Sandpiper
Pectoral Sandpiper
Red-necked Stint
Long-toed Stint

Possible Sightings

Maned Duck
Baillon's Crake
Australian Crake
Grey Plover
Red-necked Avocet
Ruddy Turnstone
Marsh Sandpiper
Godwit
Ruff
Whiskered Tern
White-winged Tern

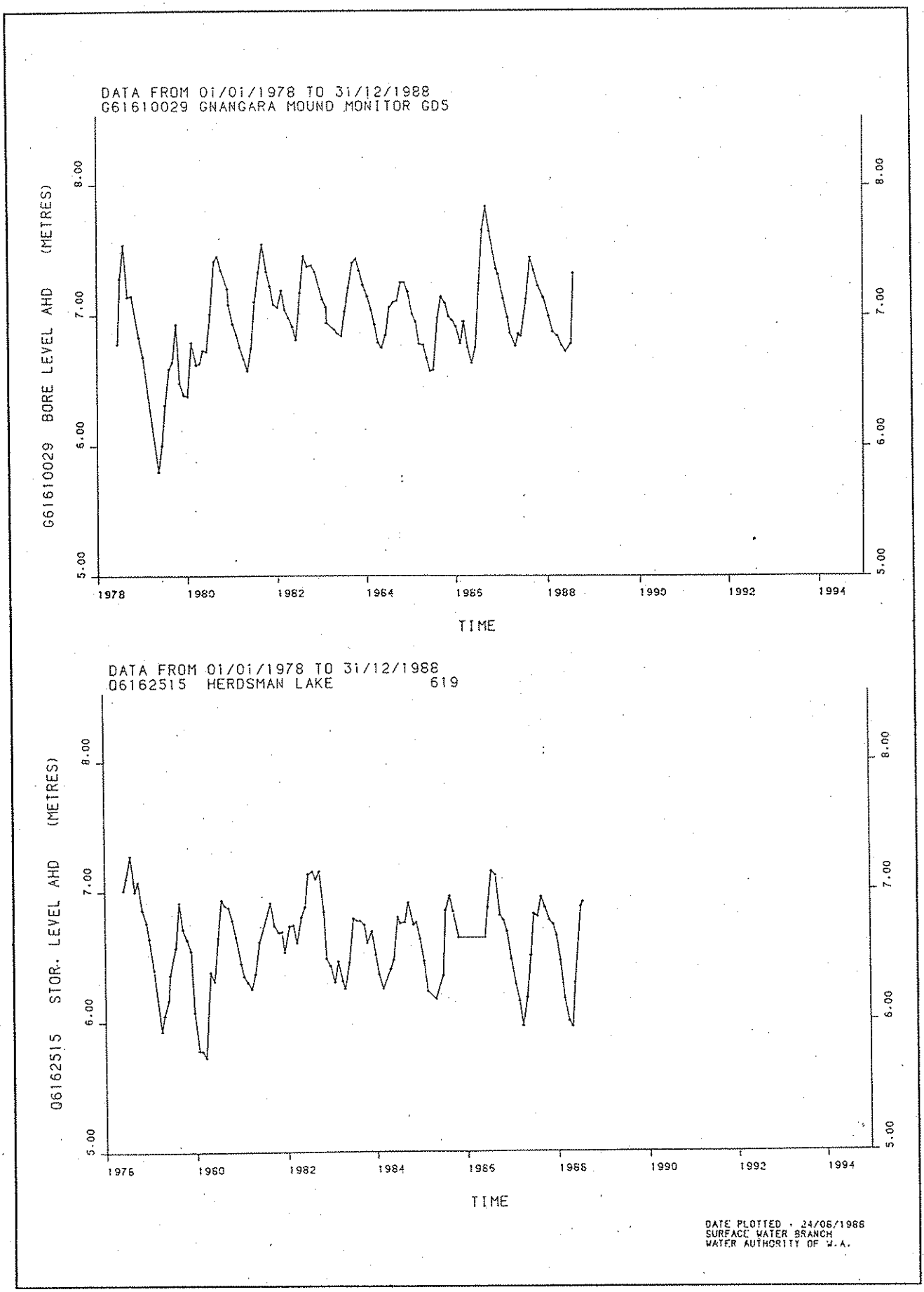

Figure C1 : Hydrographs for Herdsman Lake.

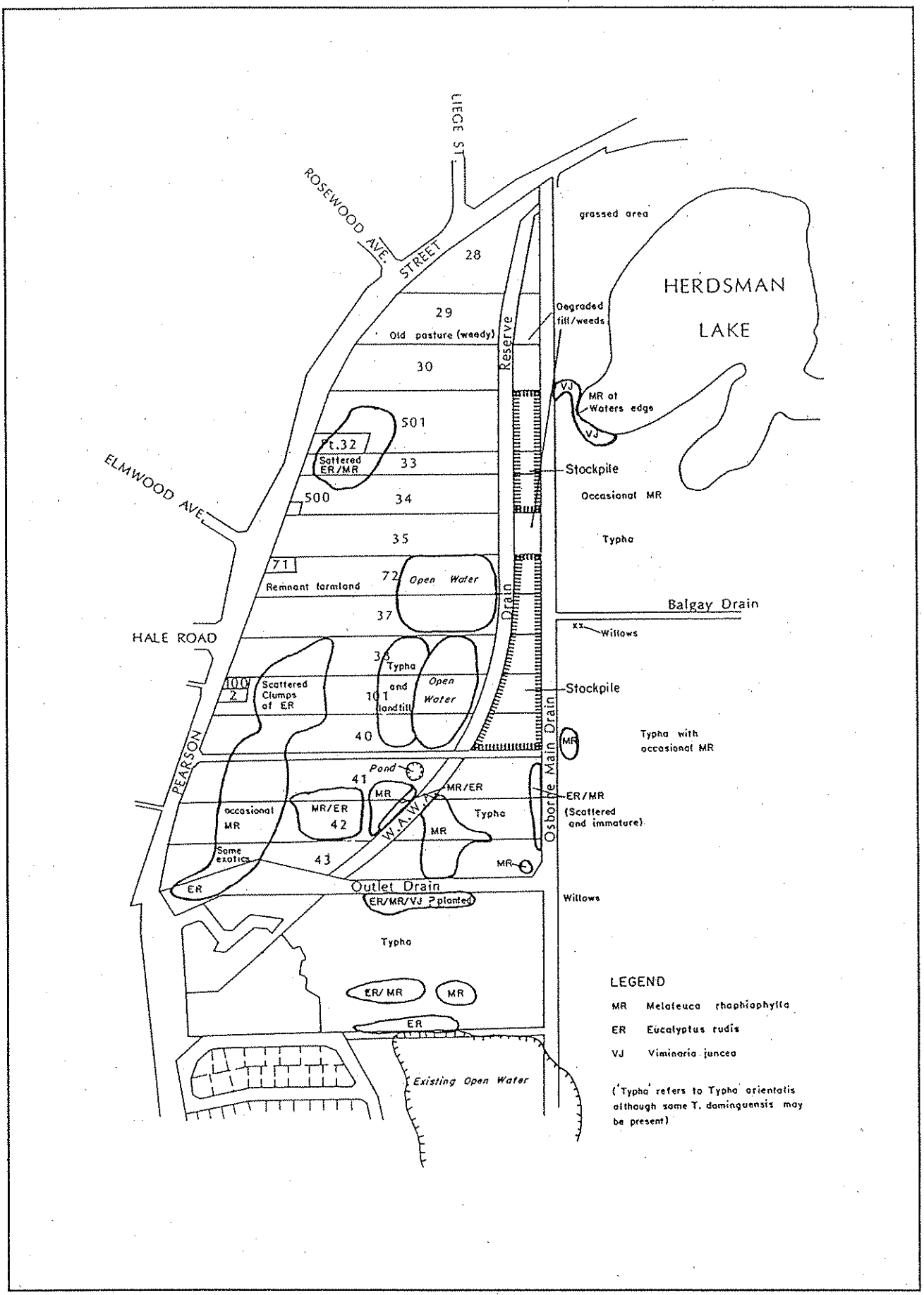

Figure C2 : Vegetation Map

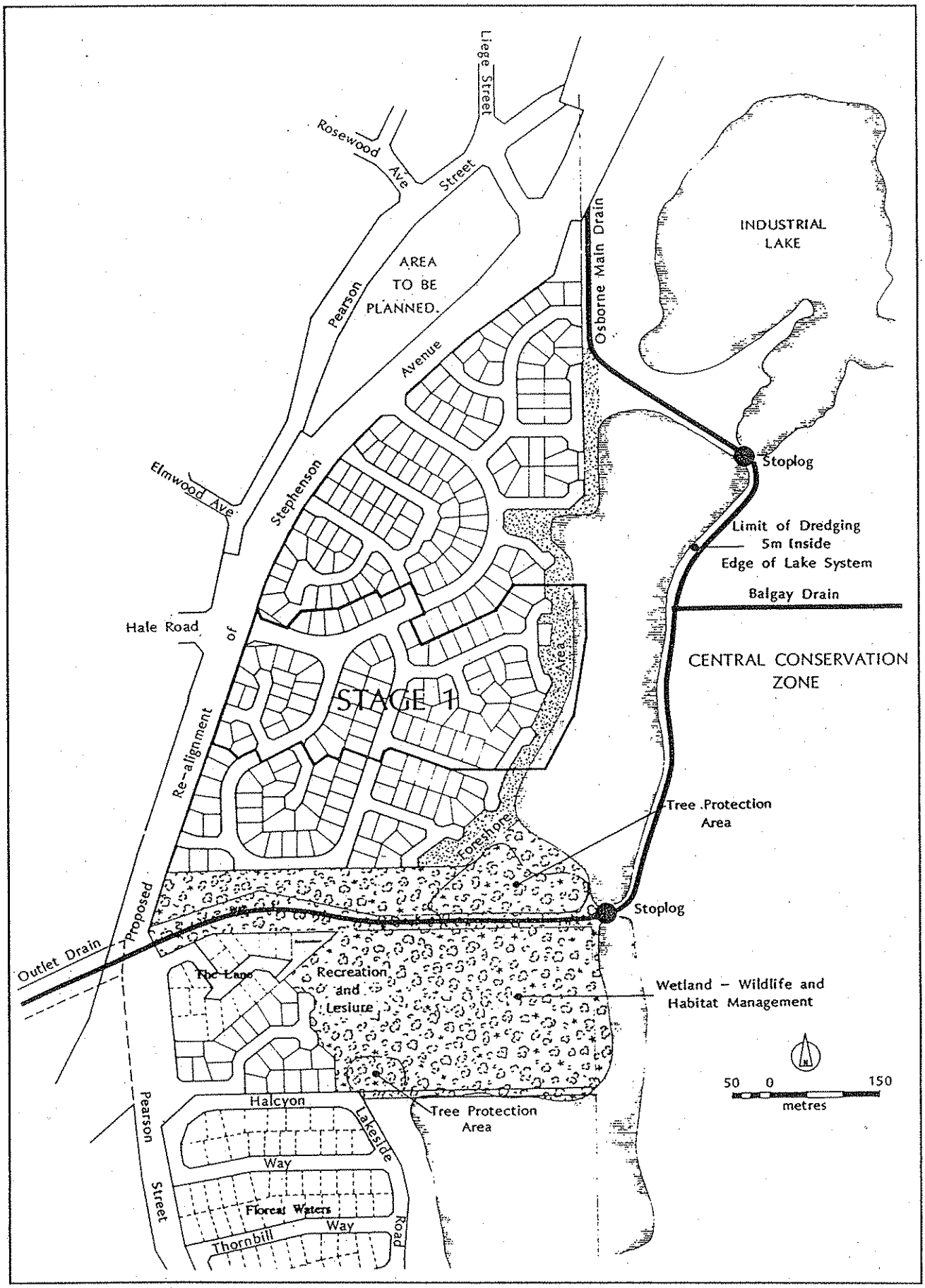

Figure C3 Revised figure of Structure Plan.

Appendix D (i)

Outline of a Water Monitoring And Management Programme

1. Introduction

The following constitutes a summary of information after discussions with the EPA, Murdoch University, University of WA and reading EPA Bulletins 103 and 227.

The variables of greatest concern to humans are:

- bird deaths, both numbers and species;
- fish kills;
- algal blooms;
- odours; and
- midge and mosquito plagues.

The process of dredging produces a soup of material which needs to be contained. While the material is in suspension a large adsorptive area is exposed and most of the chemicals in solution will be adsorbed onto these particles. When dredging ceases and the particles in suspension settle, a large amount of these chemicals will settle out as well. So the situation during the dredging process is quite distinct from the conditions subsequently. It could provide an interesting research project but this is not a necessary, nor probably a useful, part of the environmental management of the works.

It is necessary to diagnose parameter levels which may cause concerns at high levels and rectify them as they arise.

2. Procedures

2.1 Background

Water and sediment sampling has commenced as outlined in the Peat Management Plan. For the purposes of monitoring change, it will be necessary to establish baseline reference points for comparison and existing data will be used where possible. Since Industrial Lake will be disturbed during dredging, the existing situation at that site will be investigated. At the same time reference sampling sites will be established in Floreat Waters and in Powis Street Lakes. It is proposed to monitor the sampling sites previously used by Murdoch University.

The intention of this plan is management and not data collection per se. It is therefore important to have flexibility in the plan since the approach will be adaptive management. To this end the plan will involve a collection of baseline data at commencement followed by some regular sampling of parameters which are likely to cause or indicate concerns.

Significant climatic events eg opening winter storms, summer thunderstorms, heatwaves etc may precipitate important events and will be monitored where possible.

Results of drain flow rates and contaminant concentrations are important to establish total loads and these will be measured where required.

2.2 Parameters To Be Measured

2.2.1 At commencement and at quarterly intervals (October, January, April, July) and on completion and handover. (Reference sites,Dredge Pond and OMD)

Water
Flow rates (OMD, Balgay Drain)
Chlorophyl a
Temperature
pH
Salinity (conductivity)
Ions (Total N, Total P)
Organochlorides
Heavy Metals (Pb, Zn, Cr, Mn, As, Cu, Cd, Ni, Hg)
Dissolved oxygen

Sediments
- Ions (Total N, Total P)
- Organochlorides
- Heavy metal
- Ion exchange capacity

Aquatic Biota Analyses
- Organochlorides
- Heavy Metals

2.2.2 A Monthly Intervals (Reference sites, OMD and Dredge Pond).

Water
- Total N, Total P
- Organochlorides

2.2.3 At Weekly Intervals (Reference site, Dredge Pond only)

Water
- Total N, Total P
- A water sample will be taken and sorted for analysis, if required.

2.2.4 Before Handover (Reference site, Dredge Pond only)

Water
- Macroinvetebrates

Notes

1. Climatic Data will be taken from the University of WA Field Station site at Floreat Park.

2.Water Depth will be taken from the gauge at the Wildlife Centre.

3.Aeration appears to be one of the few successful management tools and will be considered.

4. Liaison with the HLMAC Technical subcommittee will help coordinate monitoring in this plan.

Appendix D (ii)

Draft Peat Management Plan

1 Introduction

The soils of Herdsman Lake were described by Teakle and Southern (1937). Peat overlies the Bassendean dune system. Peat is unsuitable as a base for houses or roads, as is evident on John Sanders Drive and the Mitchell Freeway. Peat is quite suitable for Parks and Recreation areas and for lining lakes. TheEPA has strongly supported this latter use (EPA Bulletin 263 [June 1986] Para 3.1, p2).

With increased concern about the effects of pesticides and nutrients on lake water concentrations it has become necessary to examine the consequences of placing peat in contact with water bodies.

The attitude that we have adopted is that, provided the earthworks proposed will not cause a significant increase in nutrient or pesticide levels above those inthe Osborne Main Drain, then there will be no need to adopt specific stategies to avoid contamination of the waters of Herdsman Lake. If it is possible to separate "contaminated" and "clean" peat without adding significantly to the cost of the earthworks to further improve water quality, then Sherwood will endeavour to do so. If the research currently being undertaken indicates that the earthworks will contaminate Herdsman Lake water above the levels in the waters of the Osborne Main Drain, then Sherwood will undertaken to manage the peat so that this background level is not exceeded.

2 Background

2.1 Available Data

Ten samples of marl collected in December 1987 from both undisturbed market gardens and from stockpiles established by Sherwood have been analysed both for nutrients and for pesticides. The location of the sampling points (no's 1-9) are given in Figure D1. The results obtained to date are given in Table D1. Levels of nitrogen, phosphorus and potassium are not high for soils of this origin and with this history. Organic carbon levels indicate that the soil is a marl rather than a peat. Reactive iron, which is an index of adsorptive capacity, indicates a high buffering capacity. Salt levels are high in some samples. pH levels show alkaline soils, which are unusual in WA and for peats. Nitrogen, phosphorus and potassium levels are low for market garden soils.

The pesticides present are generally breakdown products of the original material applied. Because of lack of knowledge the toxicities of these products is poorly known, but not necessarily less than the original compounds. The duplicate of sample 5 indicates reasonably small within sample variation, but the variation between sites is quite large.

Derived solution concentrations indicates that water in contact with these samples should meet drinking standards. (0.05 mg/1 for most compounds).

2.2 Further Data

Samples of peat were collected on 9 September 1988 from the area to be dredged east of the Osborne Main Drain (OMD). As far as is known this area has not been farmed since the Second World War, so pesticides should be absent from these soils. Samples of the sediments within OMD and Balgay Drain (BD) were also collected as were samples of water. The OMD, the Sand Drain and the water body within the development area will be sampled at weekly intervals from now on. The waters of Industrial Lake and Floreat Waters will be sampled at the same time. A grid sampling of the undisturbed peat on the development area will also be performed.

3.Discussion

As soon as the results from the current samples are available then it will be known whether the concentrations of nutrients and pesticides vary from one part of the development to another. If this is so, and if the derived solution concentrations are higher than the solution concentrations for the waters in the adjacent lakes then a plan will be formulated to separate "contaminated" from "clean" peats. The whole development area including the stockpiles will be extensively sampled and locations of heavily "contaminated" peats will be marked out. These will be buried in the area designated for Parks and Recreation and covered with 600 mm of sand and clean peat mix. It is unlikely that much of the peat will be contaminated, but if it is, then greater provision for isolating it will have to be made.

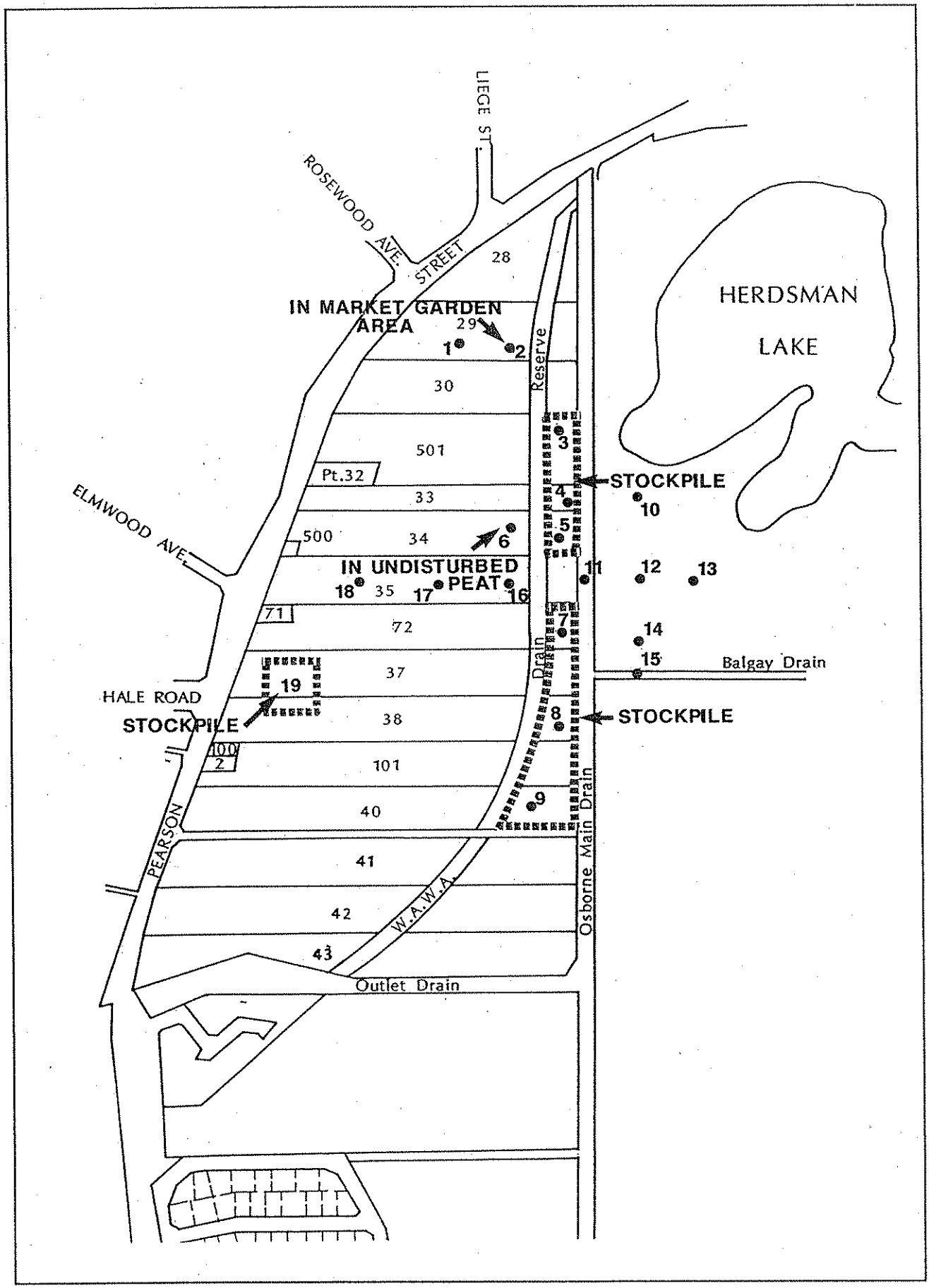

Figure D1 : Sampling sites for chemical analysis

Table D1. Analysis of Samples of Peat and Marl Herdsman Lake North West Sector

	Analysis by CSBP and Farmers (January 1988)								Analysis by ANALABS (May 1988)						
SAMPLE NO	N Nitrate ppm	N Ammonia ppm	+ P ppm	K ppm	Organic Carbon %	Reactive Iron ppm	Salt E.C d/Sm	pH 1:5 water	Heptachlor Epoxide mg/kg	gamma Chlordane mg/kg	alpha Chlordane mg/kg	pp DDE mg/kg	Dieldrin mg/kg	op DDD mg/kg	pp DDD mg/kg
1	25	4	200	195	4.16	3000	.96	7.6	0.04	0.28	0.04	0.18	0.02	0.10	0.20
2	27	8	57	122	4.51	2719	3.50	7.6	0	0	0	0.04	0	0	0
3	30	4	178	305	3.62	3000	4.28	8.1	0	0.02	0	0.15	0.14	0.04	0.05
4	10	8	50	307	4.04	3000	2.75	7.6	0	0	0	0.11	0.03	0.02	0
5	10	7	96	173	4.17	2929	1.82	7.8	0.01*	0.12*	0.02*	0.29*	0.06*	0.11*	0.20*
6	14	6	200	233	4.08	2863	3.19	7.7	0	0	0	0.08	0.07	0.03	0
7	5	3	20	174	3.46	1806	1.90	7.9	0	0.01	0	0	0.04	0	0
8	14	5	40	137	4.18	1956	2.62	7.8	0	0.02	0	0.03	0.29	0.03	0
9	17	6	11	143	4.40	2065	4.14	7.7	0	0.02	0	0	0.03	0	0
Mean	16.9	5.67	92.4	185	4.07	2593	2.80	7.75	0.0055	0.052	0.0066	0.098	0.075	0.037	0.05
+Bicarbonate soluble phosphorus							Kp's(l/Kg)		-	2000	2000	5000	1000	5000	5000
							Solution concentration (mg/l)		-	0.07	0.01	0.06	0.05	0.02	0.04
							*Duplicate of sample 5		0.01	0.15	0.02	0.32	0.05	0.10	0.21

Appendix E

Precis Of The Water Management Plan For Herdsman Lake

1. Background

Herdsman Lake is the compensating basin for an existing natural catchment area, extending some 10 km in a north easterly direction, of approximately 3000 ha. The outfall from the basin consists of a piped drain to the ocean. The inflowing drainage system consists of a series of gazetted main drains and a number of local authority drain connectors.

Over the years the Herdsman Lake area has been successively used for agriculture, recreation, drainage, human habitation and conservation. The lake surface currently comprises some constructed open drains, a moat system and conservation zone.

The lake forms the compensation basin for the drainage system and the whole of the lake area is used for water storage during the design runoff occurrence.

2. Management Plan Objective

The plan is being developed to provide a system of monitoring, reporting and containment of pollution events. It is proposed that a handbook will be developed detailing likely events and associated management procedures.

The principle of the plan is the containment of the event within the immediate locality. Remedial measures can then be applied and the extent of pollution is contained.

3. Methods Of Containment

The containment of any pollution event is based on three factors.

Firstly, that all responsible authorities have a detailed knowledge of the system. It is proposed that the system be fully described in the handbook.

Secondly, that the necessary materials be available, or structures constructed, to block off piped or open drains when required anywhere within the catchment.

Thirdly, that a coordinating and reporting system be established.

4. Management Within Herdsman Lake

The management of any event within the lake continues the policy of containment, either in the drains or the moat areas.

The drains and moat will be physically divided into cells. At the connection points structures of the stop log type, having adjustable boards will be constructed. The structures will permit the control of the water within any cell or between any cell. Thus any pollution event can be contained or directed to an appropriate area for remedial treatment.

During maximum runoff events the whole of the lake acts as drainage compensation and the lake surface will be inundated and that maximum dilution of any pollution event will occur. Currently this aspect is being reviewed to determine whether the open drain banks should be raised to contain any pollution flows during a maximum runoff event.