

**Rehabilitation of sand mine for golf course and
Well Licence Application within Priority 2
Groundwater Protection Area**

City of Canning and Sunstate Pty Ltd

**Report and recommendations
of the Environmental Protection Authority**

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Summary and recommendations

This report is to provide the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment, about the proposal by the City of Canning and Sunstate Pty Ltd to rehabilitate the silica and concrete sand mine pit at Lot 166 Clifton Road, Canning Vale by establishing a golf course and recreation park. The proposal also includes an application to the Water and Rivers Commission for a well license to irrigate the proposed golf course.

The site is located within the proclaimed Priority 2 Underground Water Pollution Control Area (UWPCA) of the Jandakot Water Mound and is within a Public Water Supply well field.

The proponents of the Livingstone Golf and Recreation Park, the City of Canning and Sunstate Pty Ltd, propose to manage the possible environmental impacts on the groundwater quality through the implementation of a Nutrient and Irrigation Management Plan (NIMP). The NIMP is designed to achieve reduced levels of nutrient input in comparison with usual practices on golf courses and consequently reduce the levels of contamination of the groundwater that are likely to occur.

Relevant Environmental Factors

In the EPA's opinion, the following environmental factor is relevant to the proposal:

- groundwater quality - protection from nutrient and chemical contamination

Conclusion

The establishment of a golf course at Lot 166 Clifton Road, Canning Vale is inappropriate due to the sensitivity of the site - the low retention capability of the Bassendean sands, the small depth to water table, and the importance of the area for the provision of public water as it is within a proclaimed Priority 2 UWPCA area. Notwithstanding the management measures proposed by the proponents, there is still a high probability that contaminated groundwater would result as a consequence of establishing a golf course on this site.

The Water and Rivers Commission and the Water Corporation are opposed to the approval of the proposed Livingstone Golf and Recreation Park as they consider it represents an unacceptable contamination risk to public drinking water supplies.

The proponents have not adequately demonstrated that the management strategies proposed in the CER and the NIMP will meet the objective of the EPA. Thus the EPA advises that the proposal to rehabilitate the sand mine site and establish a golf course and recreation park at Lot 166 Clifton Road, Canning Vale, together with the application for a bore licence should not be approved.

Recommendations

The EPA recommends that:

1. The Minister for the Environment considers the report on the relevant environmental factor, groundwater quality, and the EPA objective set for that factor.
2. The Minister for the Environment, when deciding on the proposal, takes into account the fact that the EPA has concluded that the proposal cannot be managed to meet the EPA's environmental objective and is likely to pose an unacceptable impact on the environment.
3. The Minister for the Environment notes that the EPA has not included in this Bulletin "conditions and procedures to which the proposal should be subject, if implemented" because the EPA holds the view that the proposal should not be implemented.
4. The Minister for the Environment not issue a statement that the proposal may be implemented.

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1. Introduction and background

This report is to provide the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment on the environmental factors relevant to the proposal by the City of Canning and Sunstate Pty Ltd to rehabilitate a former sand mine at Lot 166 Clifton Road, Canning Vale.

The site is within a designated Priority 2 Underground Water Pollution Control Area (UWPCA). The rehabilitation of the sand mine is to establish a golf course and recreation park, and prior to commencing works, the proponents applied to the then Water Authority of Western Australia (WAWA) for a licence to abstract groundwater. The application and rehabilitation proposal was referred to the EPA on 13 January 1995 and the level of assessment was set at Consultative Environmental Review.

The Consultative Environmental Review report titled "Livingston Golf and Recreation Park; Consultative Environmental Review", referred to here after as the CER, was made available for public review between 18 September and 16 October 1995. Three submissions were received.

Background

Prior to 1996, the boundaries of the Water and Rivers Commission (WRC) UWPCAs predominantly followed cadastral boundaries and Lot 166 Clifton Road was wholly included in the Priority 2 Protection area within the Jandakot UWPCA. In 1994, the Select Committee on Metropolitan Development and Groundwater Supplies recommended to the Western Australian Legislative Assembly, among other things, that a study be undertaken to review the protection area boundaries to ensure that they are based on rigorous scientific evidence.

The study by Dames and Moore was completed in 1996 and new boundaries were determined. The progress of this proposal was suspended until the new boundaries were defined. The results of the study included the majority of the site within the new boundary (Figure 1).

The portion of the site remaining within the Jandakot Groundwater Mound UWPCA has been proposed to be included in the Water Catchments Reservation as part of the Metropolitan Region Scheme (MRS Amendment 981/33). The purpose of the amendment is to give statutory effect in the MRS to some of the recommendations of the Select Committee on Metropolitan Development and Groundwater Supplies through the introduction of a new 'Rural Groundwater Catchment Protection' Zone. The amendment also extends the 'Water Catchments' Reservation to include Crown land located over the capture areas of the existing wellfield and within the defined area of the Jandakot Groundwater Mound UWPCA. After the finalisation of this amendment, the priority classification of the land will be amended to Priority 1 and land use will be required to conform with the relevant objectives outlined in Western Australian Planning Commission Statement of Planning Policy No 6. This policy was released for public comment on 12 September 1997 by the Ministry for Planning in support of MRS Amendment 981/33.

In compiling this report, the EPA has considered the information provided in the CER, issues raised by the public, specialist advice from government agencies, the proponents' response to issues raised, the EPA's own research and, in some cases, research provided by other expert agencies.

Further details of the proposal are presented in Section 2 of this Report. Section 3 discusses environmental factors relevant to the proposal. Section 4 presents the EPA's conclusion and Section 5 the EPA's recommendations.

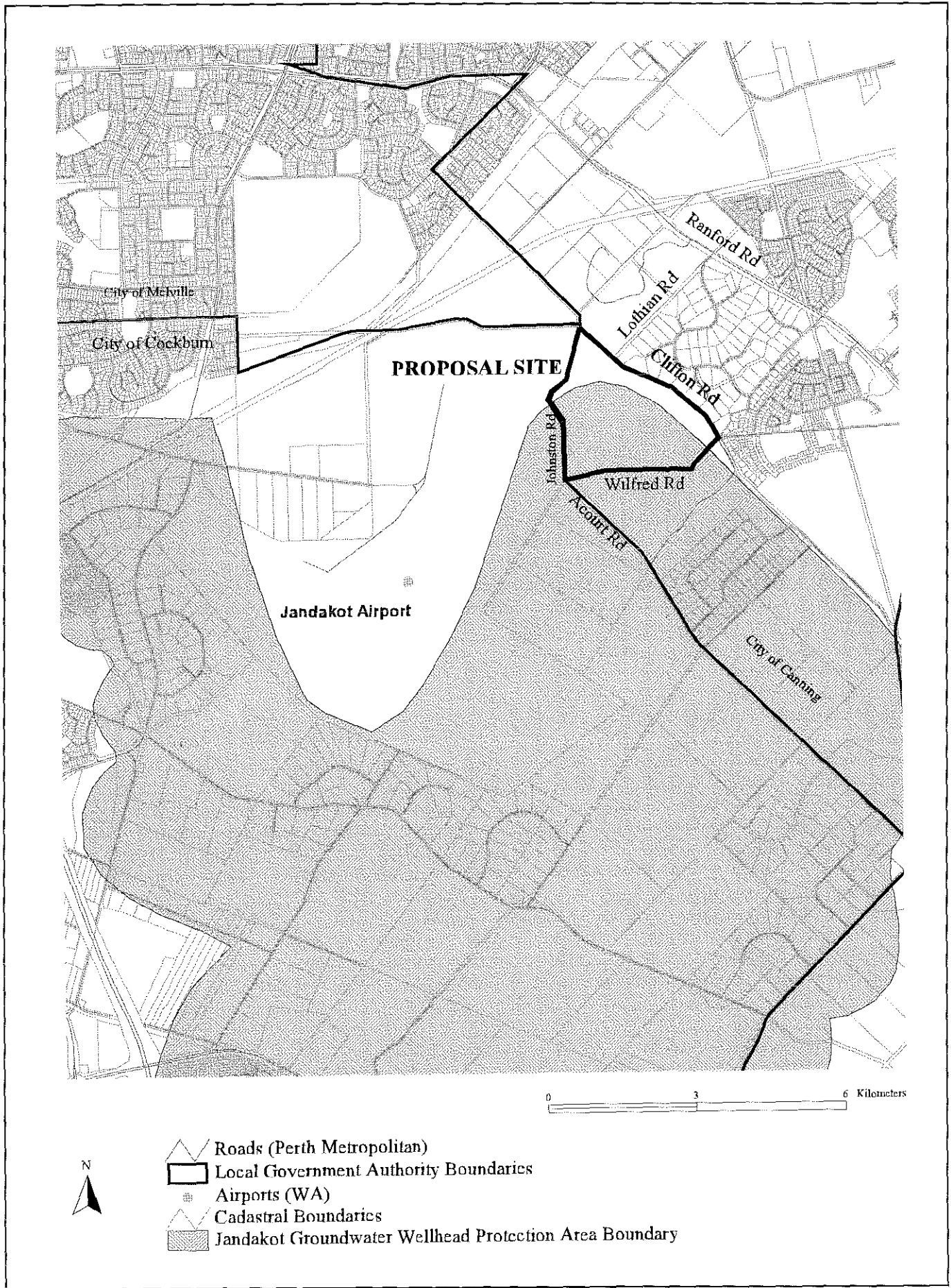


Figure 1. Revised Jandakot UWPCA boundary.

Appendix 1 provides a list of people and organisations that made submissions. A list of references is contained in Appendix 2 and the proponents' commitments are provided in Appendix 3.

The DEP's summary of submissions and the proponents' response to those submissions has been published separately and is available in conjunction with this report.

2. The proposal

The proposal is to rehabilitate the former silica and concrete sand mine pit on Lot 166 Clifton Road, Canning Vale, with the aim of building a golf course. The proposed Livingston Golf and Recreation Park is a recreation facility that will incorporate a links style 18 hole golf course, a golf driving range and a clubhouse.

The fairways are designed to wind through artificial wetlands and unwatered native grass areas. The clubhouse will be located in the north-east portion of the lot, on an elevated site with views across the golf course to the city of Perth. It will be located outside the main flight path of the Jandakot Airport. The driving range will be positioned near the clubhouse and will include open and covered areas for teeing off. A perimeter fence will be erected for protection from golf balls.

The subject land comprises 61.8 hectares and is vested in the City of Canning. A location map is shown in Figure 2. The land is bounded by Jandakot Airport to the west, City of Canning waste management site to the north, semi-rural and residential developments to the east and vacant free-hold land to the south.

The site is partially located within a designated Priority 2 UWPCA (Figure 1) (previously known as the Water Authority Priority 2 Source Protection Area - Jandakot) of the Jandakot Water Mound and is within a Public Water Supply well field (Figure 3). The groundwater beneath the site flows in a northerly direction and Water Corporation (WC) Production bore J150 is located adjacent to the site boundary on Acourt and Johnston Roads, "upstream" of the site.

The site has been almost totally cleared of vegetation although some remnant vegetation exists on adjacent Lot 167. The surrounding area suggests that the site would have originally supported banksia woodland.

The site has been used for the purposes of extractive sand mining and the operator was required to rehabilitate the site with appropriate contours for the golf course as a condition of the mining licence. The site has been extensively mined, in some areas to within 1 m of the highest known water table. The depth to water table varies from about 30 m to around 1 m in some areas. The sandy soil types present are of the Bassendean association and are highly permeable with low ability to retain nutrients.

The key environmental issue of this proposal is the protection of the groundwater from nutrient contamination, particularly nitrates, as it is used for the supply of public water.

A submission from the former WAWA highlighted a number of concerns regarding the proposed management and the level of information contained within the CER. This led the proponents to prepare a Nutrient and Irrigation Management Plan (NIMP) which expanded on the environmental management provisions identified in the CER. A revised summary of commitments was also supplied (Appendix 3). The NIMP was not made publicly available, however, it was submitted to the WRC, WC and the DEP.

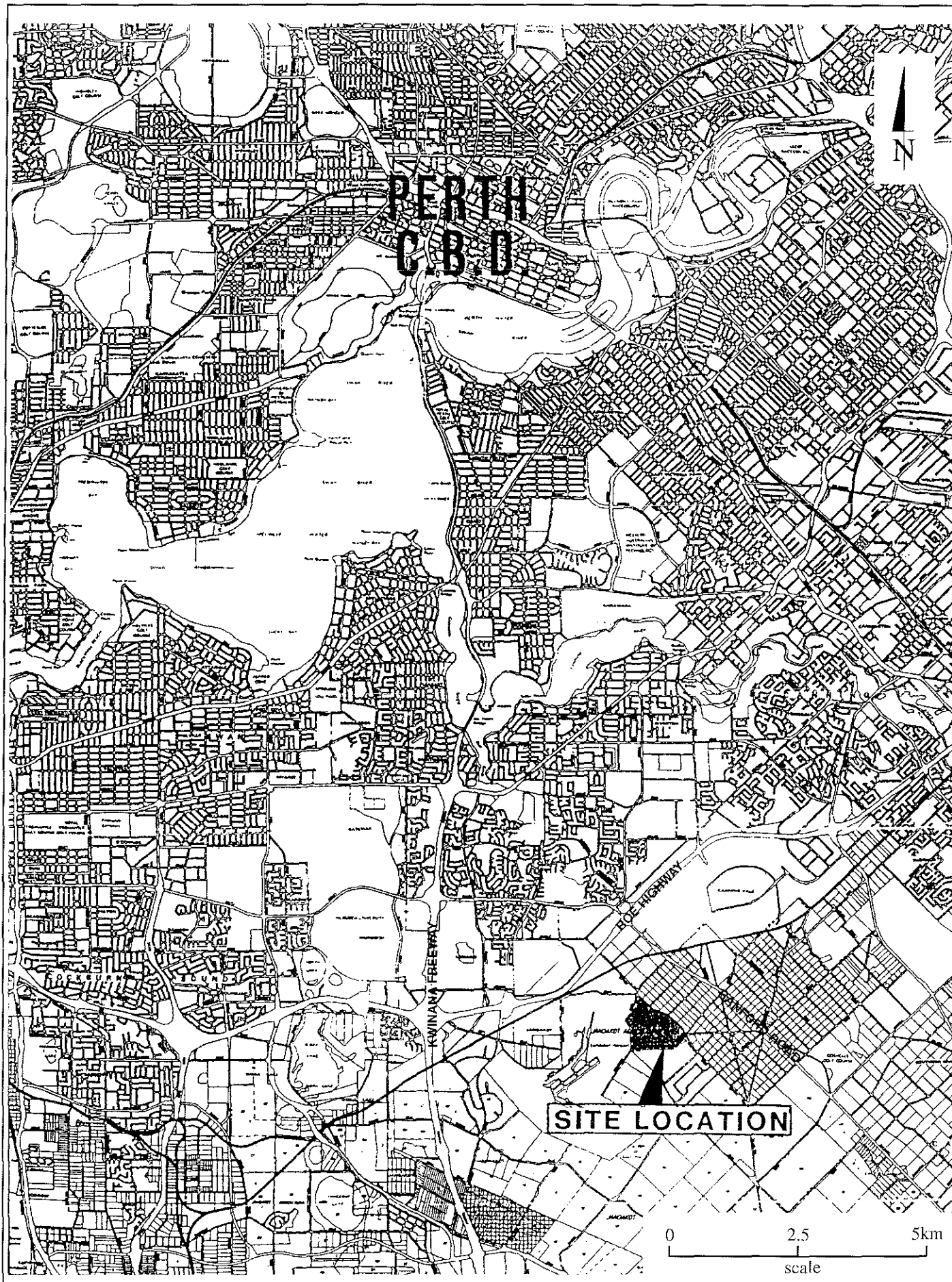


Figure 2. Livingston Golf and Recreation Park location plan.

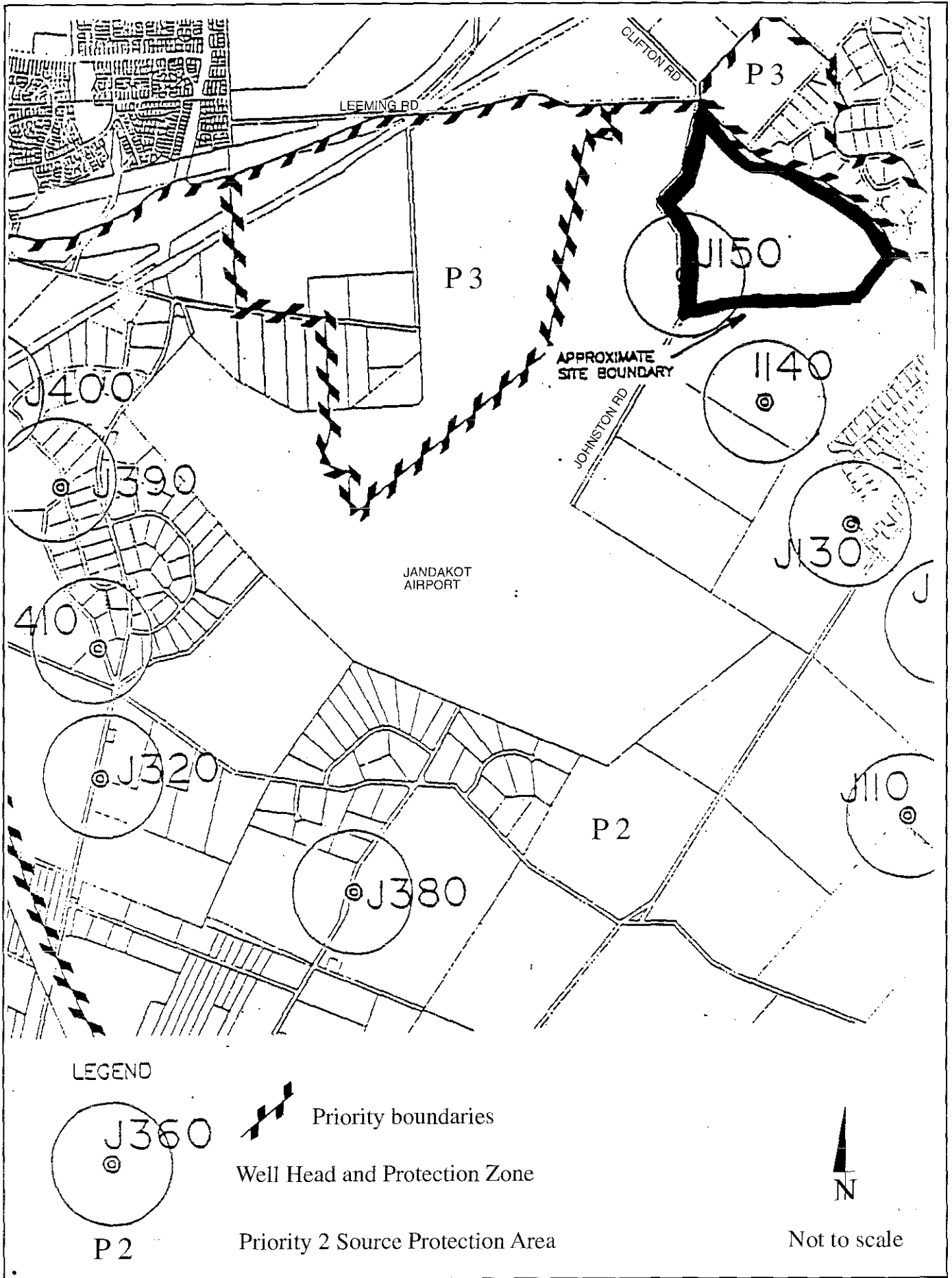


Figure 3. Part of Jandakot water pollution control area prior to 1996 (adapted from Water Authority of WA drawing number PO33184).

The NIMP was prepared in consultation with the newly formed WRC (a sector of the former WAWA), and was designed to achieve reduced levels of nutrient input in comparison with usual practices on golf courses, and consequently reduce the likely contamination of the groundwater. The management plan is also designed so that mitigating measures would be undertaken if and when impacts arise.

In addition to various management strategies proposed, the proponent has committed to designing and constructing a sub-surface drainage system that would drain irrigation water from the putting greens to provide a safeguard against nutrient losses to the groundwater and to aid in the recycling of water resources. Nutrient stripping basins and an irrigation lake would be incorporated into the drainage and lake design with the aim of reducing the amount of nitrogen and phosphorus reaching the water table. The irrigation storage lake would consist of a lined lake with a surface area of 5 000 sq m to maintain a low evapo-transpiration rate and reduce the likelihood that the salinity of the groundwater would increase as a consequence of evaporation from the lake. The nutrient stripping basins will be planted with wetland plants to aid in the filtering of run-off water.

The earthworks phase of the golf course construction, would involve raising the fairways to a minimum of one metre above the highest known water table level, which varies between 26m (northern end) and 27m AHD (southern end). Although the water table on this site can be quite high during extended periods of rainfall, the sandy nature of the soils allows water to seep through quickly.

Nutrients are proposed to be managed through the following actions:

- nutrients will be applied in micro quantities in liquid form and delivered via the fertigation irrigation system. Fertigation refers to the application of fertilisers by injection of defined quantities into the irrigation system;
- when necessary, slow release fertilisers would be applied to supplement the fertigation program;
- the application of pesticides would be minimised;
- regular soil sampling and tissue testing would be undertaken to assess soil nutrient levels and determine fertiliser requirements;
- the adherence to nutrient management principles outlined in the CER and the NIMP; and
- the implementation of a nutrient monitoring program including the monitoring of nutrient levels in the main ponds; water quality in the bores on-site and public production bore J150; and the leachate leaving the sub-surface drains.

The proposed fertiliser regime as described in the NIMP includes limiting the application of nitrogen to 120 kg/ha/year for the first year during the establishment period, then reducing the application rate to 100 kg/ha/year for subsequent years. Phosphorus (P) applications will be limited to 40 kg/ha/year for the first year, 10 kg/ha/year for year 2 and 5 kg/ha/year for subsequent years. The application of potassium (K) will be limited to 100 kg/ha/year. The calculated nitrogen (N) loading as stipulated in the CER is 220 kg/ha.

Irrigation of the golf course would also be managed in order to reduce environmental impacts, as it would be designed to enable:

- separate watering of turf with different water demands;
- watering time windows that minimise losses due to wind drift and evaporation;
- the avoidance of excess watering that may result in water accumulating below the plant root zone which is then unable to be utilised by the plant; and

- sprinklers with uniform distribution of water dispersion and a high degree of similarity in performance. The scheduling of irrigation would be controlled by an extensive soil moisture monitoring system.

The proponent has prepared an ongoing monitoring program for water supply. The program consists of five parts; operational water usage; water level monitoring; discharge, lake storage and irrigation monitoring; annual water quality monitoring; and an annual monitoring review.

The NIMP also included minor modifications to the project to aid in the protection of WC Production bore J150. These include:

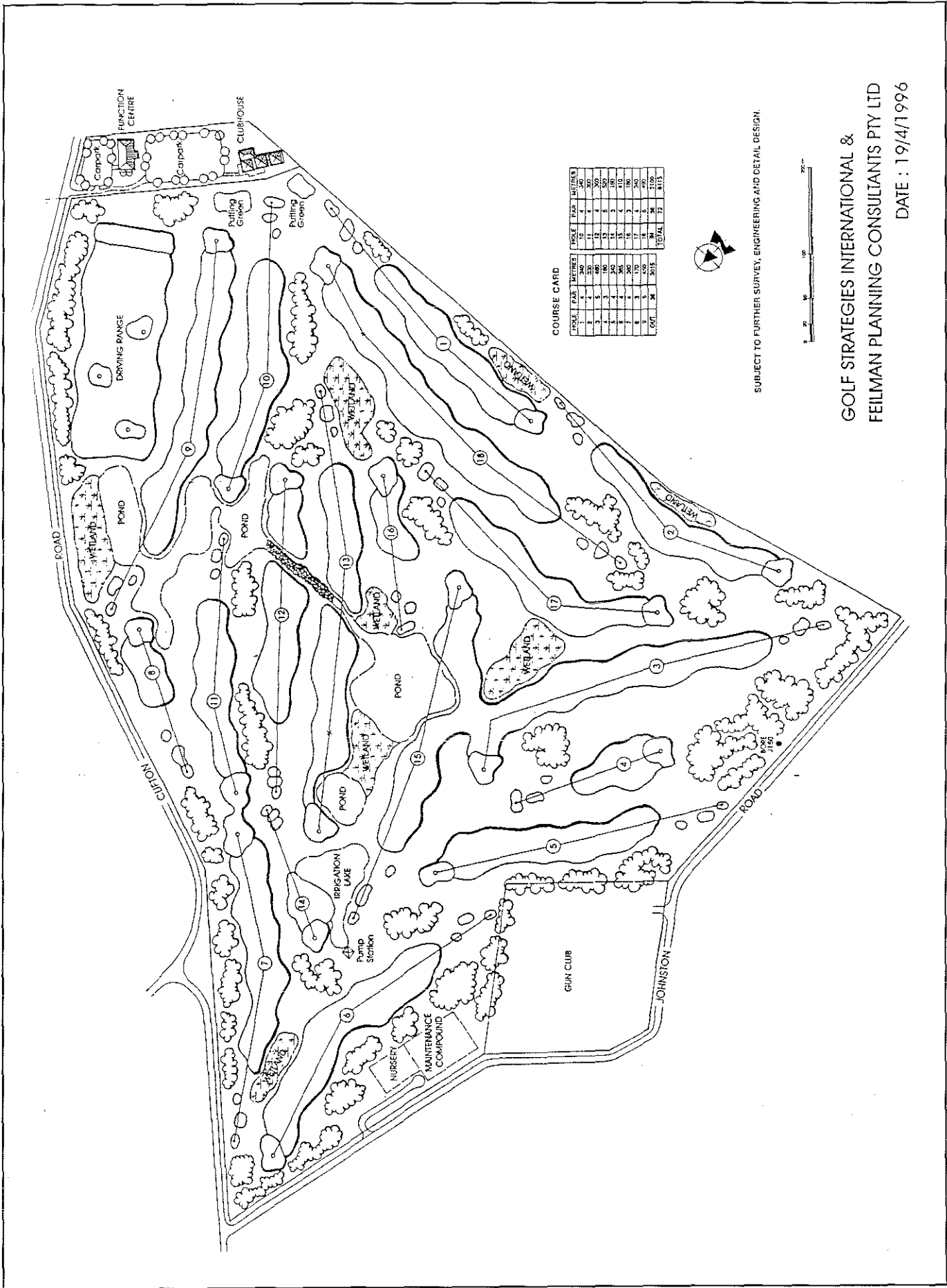
- the re-design of the golf course to recognise the 300 m radius protection zone around the WC Production bore J150;
- fairways, greens and tees within the wellhead protection zone will be shaped to direct surplus nutrient and pesticide away from WC Production bore J150;
- the relocation of the driving range; and the relocation of the clubhouse.

The modified golf course design is shown in Figure 4.

The proposal includes an application to the former WAWA for a well licence to abstract groundwater to provide irrigation for the proposed golf course. This application has now been submitted to WRC. The proponents agreed to locate the borefield closer, than originally proposed, to Ranford Road in the Perth Groundwater Area on advice from WRC. This will allow the borefield to intersect additional groundwater resources provided by the urbanisation of the Ranford subdivision.

Table 1. Summary of Proposal

Element	Description
area of former sand mine	61.8 hectares
existing environment	<ul style="list-style-type: none"> • cleared of nearly all remnant vegetation • extensively mined to within 1m of the highest known water table • soil is highly permeable, sandy, Bassendean association • site is within Priority 2 UWPCA
proposed remediation of site	18 hole golf course and recreation park with driving range, clubhouse, "Pro Shop" and function centre.
groundwater quality	golf courses typically introduce high levels of nutrients into the groundwater.
proposed management	<ul style="list-style-type: none"> • implementation of a staged management plan (NIMP) designed to achieve reduced levels of nutrient input into the groundwater in comparison with usual practices on golf courses and to undertake mitigating measures if and when impacts arise • fertilisers in the form of N, P & K will be applied at an initial annual rate of 120, 40 and 100 kg/ha/year respectively • monitoring of nutrient input into the groundwater and the supply of water for irrigation • nutrient stripping basins and a storage lake for the irrigation system are to be located in the golf course area, fed by the proposed sub-surface drainage system



COURSE CARD

POLE	PAR	METRES	YARDS	PAR	METRES
1	4	240	260	4	360
2	4	180	200	4	300
3	5	480	520	5	720
4	3	180	200	3	300
5	4	240	260	4	360
6	4	240	260	4	360
7	4	240	260	4	360
8	3	180	200	3	300
9	4	240	260	4	360
10	4	240	260	4	360
11	4	240	260	4	360
12	4	240	260	4	360
13	4	240	260	4	360
14	4	240	260	4	360
15	4	240	260	4	360
16	4	240	260	4	360
17	4	240	260	4	360
18	4	240	260	4	360
CUT	4	170	180	4	240
TOTAL	72	2515	2715	72	2115



SUBJECT TO FURTHER SURVEY, ENGINEERING AND DETAIL DESIGN.



GOLF STRATEGIES INTERNATIONAL &
 FEILMAN PLANNING CONSULTANTS PTY LTD
 DATE : 19/4/1996

Figure 8. Livingston Golf & Recreation Park (Source: Feilman Planning Consultants Pty Ltd (1996)).

3. Environmental factors

3.1 Relevant environmental factors

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

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

- groundwater quality - protection from nutrient and chemical contamination

The above relevant factor was identified from the EPA's consideration and review of all environmental factors (preliminary factors) generated from the CER document and the submissions received, in conjunction with the proposal characteristics (including significance of the potential impacts), the adequacy of the proponents' response and commitments and the effectiveness of the proposed management. On this basis, the EPA considers that the System 6 vegetation community, terrestrial fauna, groundwater quantity, public safety, visual amenity and other issues raised in the submissions do not require further evaluation by the EPA. The identification process is summarised in Table 2.

The environmental factor and its assessment is discussed in Section 3.2 of this report.

3.2 Groundwater quality

Description

The majority of the site is located within the proclaimed Priority 2 UWPCA of the Jandakot Water Mound and is within a Public Water Supply well field (Figure 1 and Figure 3). WC Production bore J150 is situated on the site's western boundary and the majority of the site is located within the capture zone of this bore.

Concerns were expressed in the public submissions in regard to the levels of fertiliser proposed to be used on the golf course, as the nitrogen loading in the CER of 220 kg/ha is well in excess of the former WAWA's criteria of 40 kg/ha. The effectiveness of the subsurface drainage system was also questioned as experience by the then WAWA suggests that the drains will not perform adequately in similar circumstances. The impact of the proposed bore on the groundwater table was also of concern, as modelling by the former WAWA suggested that the proposed production bore will lower the water table around WC Production bore J150 by 0.35 m after 200 days of pumping.

In response to the environmental submissions, the proponents prepared a NIMP, as detailed in the proposal description in the previous section, which proposed reduced amounts of fertiliser application. The proponents also agreed to locate the proposed bore further from WC Production bore J150, near Ranford Road in the Perth Groundwater Area.

Table 2: Identification of Environmental Factors Requiring EPA Evaluation

Preliminary Factor	Proposal Characteristic	Government Agency and Public Comments	Identification of Relevant Factors
Biophysical			
Vegetation Community - System 6	The proposal site is adjacent to the System 6 Area M 94 - Jandakot Airport.	Groundwater abstraction may be detrimental to the Banksia woodland on nearby Systems 6 area which is susceptible to changes in water levels. A contingency plan should be formulated in case the surrounding vegetation shows any signs of stress if the water table falls (CCWA).	The proponent will locate the production bores at a maximum distance from the Jandakot Airport land and monitor the groundwater levels. The groundwater abstraction from bores located near Ranford Road, in the Perth Groundwater Area, is unlikely to have a detrimental effect on woodland areas within the System 6 area at Jandakot Airport. <i>Factor does not require EPA evaluation.</i>
Terrestrial Fauna	Artificial wetlands which may attract birds will be constructed as part of the proposal.	Waterbirds may be attracted to the artificial wetlands so a commitment should be given not to shoot them (CCWA).	The proponents have noted this commitment in their response to submissions. <i>Factor does not require EPA evaluation.</i>
Groundwater Quantity	The site is located within the Jandakot Public Water Supply Area and Wellfield; is a nominated Priority 2 UWPCA; and is also proposed to be included in the Water Catchments Reservation which is required to conform with the objectives of Priority 1 source protection.	Production bores may have a 0.35 m impact on public supply bore J150 after 200 days of pumping (WAWA). There may be a loss of groundwater through evaporation from the proposed lakes on the golf course and a subsequent increase in salinity (WAWA). Long term pumping in hot, dry conditions may influence groundwater levels in a nearby private bore (P & R Webster).	The proponent states that “The drawdown from extraction bores located in the Perth Groundwater Area will not adversely impact on WRC Production Bore J150”. The NIMP details the projected evapo-transpiration rates and irrigation storage has been reduced to one lined lake of 5 000 sq m of surface area. WRC can determine the quantity of groundwater available to the golf course so as to minimise impacts on bore J150. <i>Relevant aspects of this factor are considered in the EPA evaluation of the factor groundwater quality.</i>

Pollution Management			
Groundwater quality	<p>The site is located within the Jandakot Public Water Supply Area and Wellfield; is a nominated Priority 2 UWPCA; and is also proposed to be included in the Water Catchments Reservation which may be required to conform with the objectives of Priority 1 source protection.</p> <p>The Wellhead Protection Zone of public production bore J150 comprises all land within a 300 m radius of the bore. This includes the majority of the site.</p> <p>Nutrient stripping basins are to be located in the golf course area, fed by the sub-surface drainage system proposed.</p>	<p>The proposal is inconsistent, even with the implementation of the NIMP, with the objectives of Priority 1 or 2 Source Protection areas, as significant groundwater contamination risks still remain (WRC).</p> <p>Approval of the proposal would be inconsistent with the proposed amendment of the Metropolitan Region Scheme to include a Rural Groundwater Catchment Protection Zone and Water Catchments Reservation to protect groundwater quality in the important recharge areas of the Jandakot Mound (WRC).</p> <p>There should be a commitment from the proponent not to use pesticides and herbicides due to the proximity of the production bore J150 (CCWA). The proponent is also not justified in using such high levels of fertilisers as the proposed nitrogen loading stated in the CER is well in excess of the Water Authority's criteria for nitrogen loadings for Jandakot soils (WAWA).</p> <p>The effectiveness of the subsurface drainage system proposed is questionable as experience shows that they work only when at the same level as the water table (WAWA).</p> <p>Nutrient stripping basins should not be allocated within the 300 m radius of the Wellhead Protection Zone of bore J150 (WAWA) and the effectiveness of the nutrient stripping lakes treatment system has not been quantified (WAWA).</p>	<p><i>Considered to be a relevant factor.</i></p>

Social Surroundings			
Public safety - road traffic	The clubhouse will be provided with separate road access from Clifton Road utilising the existing Wilfred Road reservation.	The construction of another road, even though Nicholson Rd provides available access, will increase the traffic flow in the area (P & R Webster).	Entry to the golf course will be from Ranford Rd via a realignment of Lothian Rd to Clifton Rd. Lothian Rd will be constructed to engineering standards and verges landscaped to act as a buffer. No study or modelling of expected increases in traffic flow was performed. This matter can be dealt with through the planning process. <i>Factor does not require EPA evaluation.</i>
Visual amenity	The golf course will be fully landscaped.	There should be a commitment to landscape with endemic species. This should be overseen by a botanist (CCWA).	The proponent has stated that a qualified landscape architect will be engaged to select the species and oversee the implementation of the project. <i>Factor does not require EPA evaluation.</i>
Other			
Management plans		There should be a groundwater monitoring program to assist with the management of fertilisers, pesticides and soil moisture content (WAWA).	The proponent is committed to preparing and implementing an Environmental Management Plan. The groundwater monitoring program is outlined in the NIMP and includes monitoring of nutrient levels and water supply. <i>Factor does not require EPA evaluation.</i>
Parks and Recreation zoning		The land was identified as Parks and Recreation in the Jandakot Land Use and Water Management Strategy and consequently the community will have an expectation that this land will be used for passive recreation (ie. Nature conservation appreciation and education) (CCWA).	The rehabilitation of the sand mine area into a public golf course is of benefit to the community as a recreational facility, however the site will be unable to fulfil a passive recreation function. This is not an environmental matter as it should be dealt with through planning processes. <i>Factor does not require EPA evaluation.</i>

Assessment

The area considered for assessment of this environmental factor is the Jandakot UWPCA as defined by Dames and Moore (1996) (Figure 5). The majority of the proposal site is located within the Jandakot UWPCA.

The EPA's environmental objective in regard to this factor is to maintain or enhance the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA 1993) and the NH&MRC/ARMCANZ Australian Drinking Water Guidelines - National Water Quality Management Strategy.

In undertaking this assessment, the EPA has sought and received expert advice from both the WRC and WC.

Golf courses represent a significant groundwater contamination risk by increasing the possibility of pollution from nitrate, herbicide and pesticide contamination. Nitrogen loadings and pesticide application to golf courses are generally high. This is likely to be unacceptable in areas where the underlying groundwater requires a high level of protection, as there is the potential for the fertilisers and pesticides to leach into the groundwater. This potential is further influenced by the small depth to the water table and the low nutrient retention capability of the Bassendean Sands on site.

At its meeting on 10 March 1995, the Environmental Protection Authority resolved to advise the proponents that proposals such as golf courses which are likely to introduce high levels of nutrients to the groundwater are considered to be inconsistent with the protection of important groundwater areas and are therefore considered unacceptable. The proponent and Council were advised to consider alternative land uses which are low in nutrient and water usage and which are consistent with the existing Parks and Recreation zoning under the current MRS, and the site's location within the groundwater mound and public extraction well field.

In addition, Recommendation No 24.2 of the Report of the Select Committee on Metropolitan Development and Groundwater Supplies (1994) recommends that within Priority 2 areas, any activity with the potential to further degrade the groundwater quality is unacceptable. This report was given endorsement in principle by the Western Australian Government on 10 May 1995.

The limit for nitrogen in drinking water is stated at 10 mg/L in the CER, however for Priority 2 UWPCA, the former WAWA advised that the level of non-carcinogenic parameters should be maintained below 50% of the NH&MRC limit. The proposed nitrogen loading of 120 kg/ha for the first year and 100 kg/ha for subsequent years as detailed in the NIMP is in excess of the former WAWA's criteria of 40 kg/ha for nitrogen loading for the Jandakot soils. The WC is therefore opposed to the development.

Calculations by the WRC indicate that nitrate loadings required for adequate maintenance of a golf course may result in nitrate concentrations in groundwater in excess of health guidelines for drinking water. The WRC advises that even with the reduced nitrate loadings stipulated in the NIMP, these will still fail guidelines for both groundwater recharge in Priority 1 areas and drinking water quality in Priority 2 areas. This would occur during the summer months when concentrations of nitrates beneath the greens and fairways would exceed NH&MRC guidelines.

The WRC has classified golf course developments as an unacceptable land use in both Priority 1 and Priority 2 UWPCA areas. This is supported in overseas literature as Horsley and Moser (1990) state that "contamination of groundwater by pesticides or fertilisers from golf courses intuitively seem to be a likely occurrence."

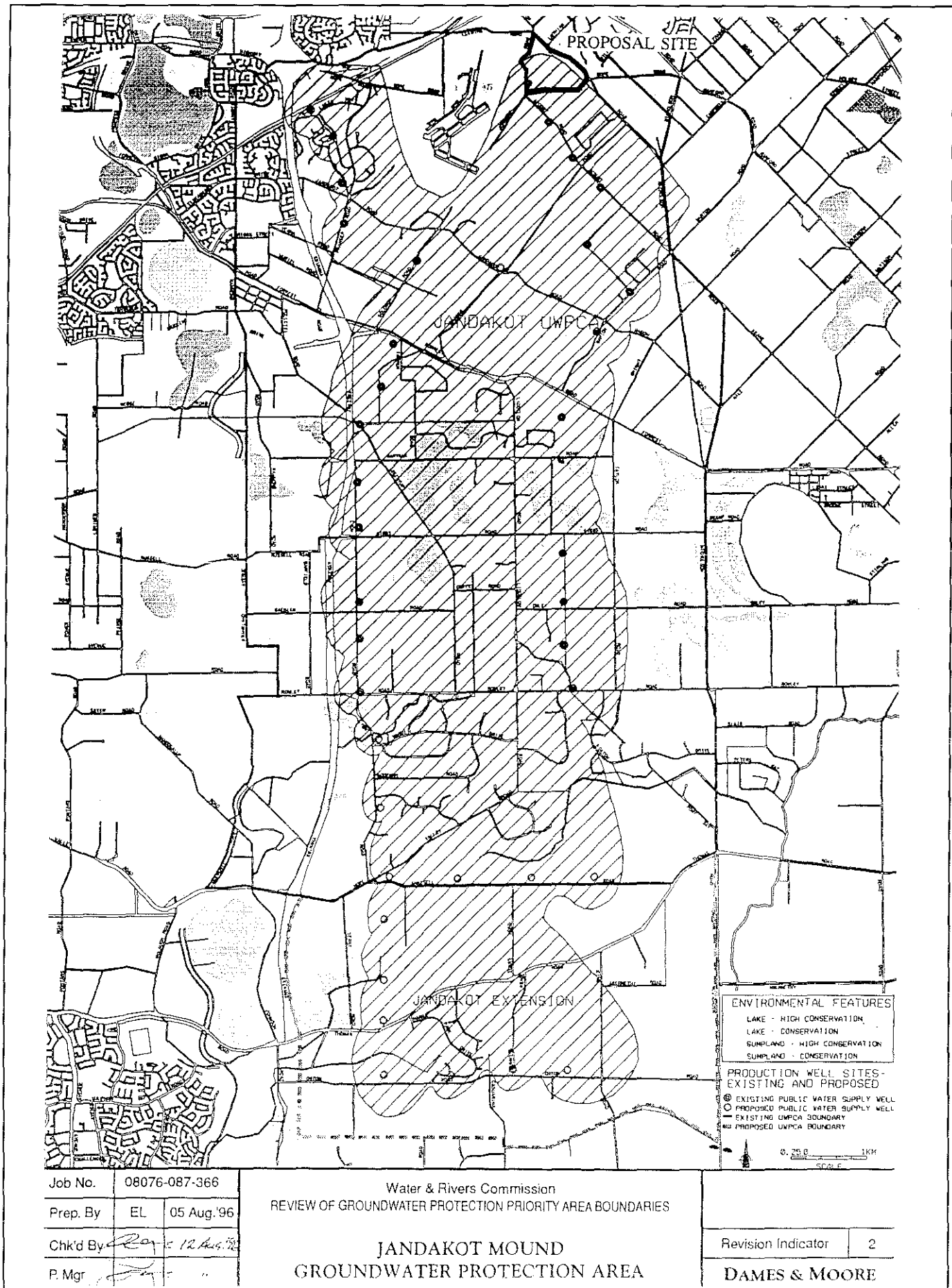


Figure 5. Jandakot Mound Groundwater Protection Area.

The proponent has made a commitment to prepare an Environmental Management Plan with compliance audits, including annual reviews of borefield performance, and the implementation of the Nutrient and Irrigation Management Plan (Feilman Planning Consultants, 1995, 1996). This includes the use of a "Fertigation" irrigation system that allows for the application of small, regular amounts of fertiliser and pesticides. The use of strict water practices, including soil moisture sensors to prevent excessive irrigation and the limitation of the use of fungicides and pesticides to turf areas of the golf course and to chemicals with little chance of reaching the groundwater, would aid in the reduction of possible groundwater contamination (Feilman Planning Consultants, 1996).

The proponent has also made a commitment to construct a drainage system for irrigation water from putting greens and a comprehensive stormwater run-off system. Stormwater would be collected in detention basins for treatment and recharge into the ground or to the grassed areas of the golf course. The location of production bores would be at a maximum possible distance from WC Production bore J150 (Feilman Planning Consultants, 1996).

The effectiveness of the subsurface drainage is considered by the WRC to be questionable and experience with similar systems by WRC has shown that they only work when the water table rises to the level of the drains. When the water table is below the drains, water would only be expected to enter the pipe if it percolated through the soil directly above the perforations in the pipe. It is doubtful whether the subsurface drainage would intercept the bulk of the groundwater recharge because of the high porosity of the soils and consequently the majority of recharge (containing contaminants) from the golf course will pass by the drainage system and reach the groundwater table. Furthermore, if the subsurface drainage was completely effective, it would not be supported by the WRC as groundwater recharge to the Jandakot Groundwater Scheme would then be unacceptably reduced.

Both the CER and the NIMP give no indication of the effectiveness of the proposed nutrient stripping basins and this should be quantified with evidence from other recently constructed golf courses. The WRC advises that it is undesirable to have nutrient stripping basins within the Wellhead Protection Zone of public production bore J150.

Neither the CER or the NIMP specifies the brand or quantity of organic chemicals such as pesticides, herbicides and fungicides, that will be used on the golf course. The WRC thought that a detailed assessment of the site specific constraints in regard to the use of organic chemicals should have been undertaken by the proponents, as these types of chemicals are toxic in extremely low concentrations. Consequently, it is highly likely that potential contamination levels will fail water quality objectives.

There are other risks of contamination or increased pollution associated with the development. Carpark areas could cause significant loadings of hydrocarbons and other products from minor leaks to be directed via stormwater drainage to the groundwater table, and increased numbers of people visiting the area may increase the risk of pollution occurring from sources such as traffic accidents and vehicle emissions.

In relation to water supply for the development, the proponents have agreed to relocate the borefield closer to Ranford Rd, which is well away from WC Production bore J150. The borefield would therefore be located within the Perth Groundwater Area and consequently not be expected to significantly impact the operation of WC Production bore J150.

Having particular regard to:

- (a) the classification of the majority of the site as Priority 2 UWPCA and the expectation that it will be reclassified as Priority 1 after the finalisation of MRS amendment 981/33;
- (b) the questionable effectiveness of the subsurface drainage system to reduce the amount of nutrient contaminated water reaching the groundwater table;
- (c) the sensitivity of the area to contamination by nutrients, pesticides and herbicides due to the poor retention capacity of the Bassendean sands and the small depth to the water table; and
- (d) the advice of the WRC and WC that the proposal is likely to result in unacceptable contamination of the groundwater aquifer,

it is the EPA's opinion that the proposal to establish a golf course on Lot 166 Clifton Road Canning Vale will not meet its objective.

4. Conclusion

The establishment of a golf course and recreation park at Lot 166 Clifton Road, Canning Vale is considered not to be an appropriate way of rehabilitating the former sand mine. Golf courses represent a substantial risk in regard to the contamination of groundwater due to the leaching of fertilisers, pesticides and herbicides. Notwithstanding the management measures proposed by the proponents, there is still a high probability that contaminated groundwater would result as a consequence of establishing a golf course on this site.

The majority of Lot 166 Clifton Road, Canning Vale is within the proclaimed Priority 2 UWPCA of the Jandakot Mound and within the capture zone of WC Production bore J150. The site has also been proposed to be included in the Water Catchments Reservation in the Metropolitan Region Scheme Amendment 981/33. After the finalisation of this amendment, the priority classification of the land is likely to be amended to Priority 1 and land use would be required to conform with the objective of Priority 1; that any risk of groundwater pollution must be avoided.

The WRC and WC are opposed to the approval of the proposed Livingston Golf and Recreation Park as they consider it represents an unacceptable contamination risk to public drinking water supplies. The proposal is inconsistent with the objectives of Priority 1 or Priority 2 source protection and the approval of this proposal would also be inconsistent with the proposed amendment of the Metropolitan Region Scheme to include a Rural Groundwater Catchment Protection Zone and Water Catchments Reservation to protect groundwater quality in the important recharge areas of the Jandakot Mound.

The potential for groundwater contamination as a result of the golf course is further increased due to the low retention capability of the Bassendean sands and the small depth to the water table.

The proponents have not adequately demonstrated that the management strategies proposed in the CER and the NIMP can meet the objective of the EPA.

The EPA advises that approval for the rehabilitation of the sand mine site to establish a golf course and the application for a bore licence at Lot 166 Clifton Road, Canning Vale should not be given.

5. Recommendations

The EPA recommends that:

1. The Minister for the Environment considers the report on the relevant environmental factor, groundwater quality, and the EPA objective set for that factor.
2. The Minister for the Environment, when deciding on the proposal, takes into account the fact that the EPA has concluded that the proposal cannot be managed to meet the EPA's environmental objective and is likely to pose an unacceptable impact on the environment.
3. The Minister for the Environment notes that the EPA has not included in this Bulletin "conditions and procedures to which the proposal should be subject, if implemented" because the EPA holds the view that the proposal should not be implemented.
4. The Minister for the Environment not issue a statement that the proposal may be implemented.

Table 3: Summary of Assessment of Relevant Environmental Factors

Environmental Factor	Relevant Area	EPA Objective	Assessment	EPA advice
Groundwater quality	Jandakot UWPCA.	Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993) and the NH&MRC / ARMCANZ Australian Drinking Water Guidelines - National Water Quality Management Strategy.	<p>The proposed management will reduce the impact on groundwater quality as compared to standard practice however it will not ensure that the EPA's objectives are met as a result of the sensitivity of the area to groundwater contamination (ie Priority 2 UWPCA). Areas of the proposal determined not to meet the desired standards and criteria include:</p> <ul style="list-style-type: none"> • Nutrient loadings: WRC has undertaken an analysis of the possible nutrient loadings to groundwater from the proposed NIMP. Leaching of nitrates will occur and are predicted to exceeded the NH&MRC guidelines for nitrate concentrations. • The subsurface drainage: The effectiveness of the subsurface drainage is questionable and experience with similar systems has shown that they only work when the water table rises to the level of the drains. It is doubtful whether the subsurface drainage would intercept the bulk of the groundwater recharge because of the high porosity of the soils and consequently the majority of recharge (containing contaminants) from the golf course will pass by the drainage system and reach the groundwater table. • Organic chemicals: The CER or NIMP does not specify make or quantity of organic chemicals to be used (ie pesticides, herbicides and fungicides). Such chemicals are toxic in extremely low concentrations and it is highly likely the potential contamination levels will fail water quality objectives. • Nutrient stripping basins: The CER gives no indication of the effectiveness of the nutrient stripping basins. • Other contaminants: Carpark areas could cause significant loadings of hydrocarbons and other products from minor leaks to be directed via stormwater drainage to the groundwater table. • Increased numbers of people visiting the area will increase the risk of pollution occurring from sources such as traffic accidents and vehicle emissions. 	<p>Having particular regard to:</p> <ol style="list-style-type: none"> (a) the classification of the majority of the site as Priority 2 UWPCA and the expectation that it will be reclassified as Priority 1 after the finalisation of MRS amendment 981/33; (b) the questionable effectiveness of the subsurface drainage system to reduce the amount of nutrient contaminated water reaching the groundwater table; (c) the sensitivity of the area to contamination by nutrients due to the poor retention capacity of the Bassendean sands and the small depth to the water table; and (d) the advice of the WRC and WC that the proposal is likely to result in unacceptable contamination of the groundwater aquifer, <p>it is the EPA's opinion that the proposal to establish a golf course on Lot 166 Clifton Road Canning Vale will not meet the EPA's objective.</p>

Appendix 1

List of Submitters

State and local government agencies:

- Water Authority of Western Australia

Organisations:

- Conservation Council of Western Australia Inc

Members of the Public:

- P. R. & R. A. Webster

Appendix 2

References

- Dames & Moore (1996). *Review of Groundwater Protection Priority Area Boundaries Jandakot Mound*. Report for Water and Rivers Commission of Western Australia.
- Environmental Protection Authority (1993). *Draft Western Australian Water Quality Guidelines for Fresh and Marine Waters*. Environmental Protection Authority Bulletin 711, October 1993.
- Feilman Planning Consultants (1995). *Livingston Golf and Recreation Park Consultative Environmental Review*.
- Feilman Planning Consultants (1996). *Livingston Golf and Recreation Park Nutrient and Irrigation Management Plan*.
- Horsley, S. W. & Moser, J. A. (1990) Monitoring groundwater for pesticides at a golf course - case study on Cape Cod, Massachusetts. *Groundwater Monitoring Review*. Winter 1990: 101 - 108.
- Legislative Assembly Western Australia (1994). *The Select Committee on Metropolitan Development and Groundwater Supplies Report*.
- National Health and Medical Research Council / Agriculture and Resource Management Council of Australia and New Zealand (1996). *Australian Drinking Water Guidelines - National Water Quality Management Strategy*.
- Western Australian Planning Commission (1997) *Jandakot Groundwater Protection Policy Draft Statement of Planning Policy No 6*. Western Australian Planning Commission.
- Western Australian Planning Commission (1995) *Jandakot Land Use and Water Management Strategy*. Quality Press, Perth.

Appendix 3

Proponents' commitments



SUMMARY OF ENVIRONMENTAL COMMITMENTS

ISSUE	OBJECTIVE	COMMITMENT NO.	COMMITMENTS	PHASE	TO THE SATISFACTION OF
Pollution	Minimise Nitrate and Pesticide movement into the drainage system from putting greens.	10	Construct putting greens to guidelines established by the U.S.Golf Association (USGA). The surface 30cm of the profile will be a Zeolite or peat modified sand rooting medium.	Construction & Post Construction	DEP & WRC
		11	Apply nutrients in micro quantities (liquid form) delivered via the irrigation system.		
		12	Limit use of Pesticides to those with little chance of reaching groundwater, and restrict use to turfing areas of the golf course.		
		13	Limit use of Fungicides to putting greens, when required.		
	Minimise contamination of groundwater from applied Nitrogen leached as Nitrate (N) and Phosphorus (P).	14	Modify the soil of all fertilised areas, including fairways and tees, by importing spreading and incorporating a 10cm layer of specially selected sand with a Phosphate Retention Index (PRI) of 14-15.	Design, Construction & Post Construction	DEP & WRC
		15	Apply nitrogen in small regular quantities through the irrigation system.		
		16	Implement strict water practices to prevent excessive irrigation of fertilised areas..		
		17	Design and construct a drainage system for irrigation water from putting greens to provide a safeguard against nutrient losses and for recycling water resources.		
	Minimise contamination of groundwater from stormwater run-off from hard-stand areas within the project site.	18	Design and construct a comprehensive stormwater run-off system. Stormwater from the hard stand areas , including roads, within the site, will be collected in detention basins for treatment and recharge into the ground or to the grassed areas.	Design, Construction & Post Construction	DEP & WRC

SUMMARY OF ENVIRONMENTAL COMMITMENTS

ISSUE	OBJECTIVE	COMMITMENT NO.	COMMITMENTS	PHASE	TO THE SATISFACTION OF
Management of Impacts	Minimise the impacts of the project on the existing environment and effectively manage the implementation of the commitments.	1	Prepare and implement an Environmental Management Plan (EMP). Undertake compliance audits at the completion of each stage.	Design, Construction & Post Construction	DEP & WRC
Hydrology	Minimise the impact of abstraction on WRC production bores and other users.	2	Locate production bores maximum possible distance from WRC Production bore J150.	Design, Construction & Post Construction	DEP & WRC
		3	Use strict water practices including use of soil moisture sensors to prevent excessive irrigation.		
		4	Record volumes of water abstracted from irrigation bores, rates and distribution of irrigation water. Monitor levels in the storage lakes.		
		5	Carry out annual reviews of borefield performance to the satisfaction of the Water and Rivers Commission.		
	Minimise the impact on existing groundwater quality.	6	Implement a Nutrient Input Management Plan (NIMP) to achieve suitable turf coverage to meet stress, appearance and low nutrient and water use requirements.	Design, Construction & Post Construction	DEP & WRC
		7	Design and implement a "Fertigation" irrigation system for application of small, regular amounts of fertiliser and pesticides.		
		8	Establish groundwater bores to monitor leaching of nutrients from the golf course.		
		9	Collect and analyse an annual sample from each production bore to monitor water quality.		

SUMMARY OF ENVIRONMENTAL COMMITMENTS

ISSUE	OBJECTIVE	COMMITMENT NO.	COMMITMENTS	PHASE	TO THE SATISFACTION OF
Biology	Minimise impact on System Six terrestrial vegetation on adjoining FAC land.	19 20 3	Locate production bores maximum distance from FAC Land. Carry out regular inspection and monitoring of groundwater levels. Use strict water practices including use of soil moisture sensors to prevent excessive irrigation.	Construction & Post Construction	DEP & WRC
Construction	Minimise the impact of construction on local residents.	21 22 23	Limit construction vehicle movements to times approved by the City of Canning. Fence the development site and post appropriate signs to inform the public. Provide water trucks on site during earthworks to damp down exposed sand surfaces until irrigation is installed.	Construction	DEP & CITY OF CANNING
Services	Eliminate contamination of groundwater from sewage and other services.	24 25	Locate all services within the complex underground. Design and implement the disposal of sewage by reticulated sewer directed to a pump station within Lot 167, for discharge to the Minister's trunk sewer.	Design, Construction & Post Construction	WESTERNPOWER TELSTRA & WRC