Seawall construction, land reclamation and dredging adjacent to Lots 165 & 167, including Lots 166 & 168, and management of shipbuilding, repair and maintenance activities at Cockburn Sound, Cockburn Road, Henderson.

LandCorp

Report and Recommendations
of the Environmental Protection Authority

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Summary and recommendations

This report provides the Environmental Protection Authority's (EPA's) advice to the Minister for Environment on the proposal by LandCorp to dredge, reclaim land and create up to three level lots at Lots 165-168, Henderson Road Cockburn for use by shipbuilding industry within the Northern Harbour of Jervoise Bay, which may include a ship-lift facility.

Phase 1 of the LandCorp proposal consists of construction activities associated with dredging and land reclamation activities. These activities include earth works, construction of a seawall and deposition of fill behind the seawall to reclaim part of the seabed. Phase 2 of the proposal consists of the construction of hardstand areas, sheds, jetties, ship-lift, and the installation of heavy equipment associated with the construction, repair and maintenance of steel and aluminium hulled vessels.

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

Relevant environmental factors

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

a) Groundwater quality – nutrients as a source of harbour water quality impairment;

b) Marine water quality – effects of dredging, seawall, changes in bathymetry and flushing characteristics;

c) Recreation – restriction on beach access;

d) Recreation – conflicts with recreational boating use; and

e) Management responsibility – adequacy of environmental management framework.

Conclusion

The EPA has considered the proposal by LandCorp to dredge, reclaim land and create up to three level lots for use by shipbuilding industry within the Northern Harbour of Jervoise Bay, and the comments raised by government agencies and public submissions.

The EPA notes that:

- the proposal is consistent with the City of Cockburn Town Planning Scheme No.2 and the Metropolitan Region Scheme;
- the marine water quality in the Northern Harbour is degraded due to high nutrient levels and poor flushing, and experiences algal blooms from time to time;
- the major source of nutrients entering the harbour is associated with the nutrient-rich groundwater plumes emanating from Woodman Point WWTP and Weston Bioproducts facility;
- dredging and land reclamation activities associated with the development of Lots 165-168 for future industrial use may slightly modify the flow path of groundwater in some areas however these activities are not likely to result in a change to the total load or concentration of nutrients in the groundwater;
- although some short-term localised effects may be apparent from time to time, the implementation of Phase 1 of the proposal is not likely to lead to a decline in the overall water quality of the Northern Harbour;

- implementation of Phase 2 of the proposal can be adequately managed under Part V of the *Environmental Protection Act (1986)* and City of Cockburn Town Planning Scheme No.2; and

- a commitment has been made to undertake an information and consultation program to ensure recreational boat owners in the Northern Harbour are aware of issues and requirements associated the use of the Northern Harbour as a recreational and commercial boating facility.

The EPA has therefore concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the proponent's commitments and the recommended conditions set out in Appendix 3 and summarised in Section 4.

Recommendations

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

1. That the Minister notes that the proposal being assessed is for LandCorp to dredge, reclaim land and create up to three level lots at Lots 165-168, Henderson Road Cockburn (Phase 1) for use by shipbuilding industry within the Northern Harbour of Jervoise Bay (Phase 2), which may include a ship-lift facility;
2. That the Minister considers the report on the relevant environmental factors as set out in Section 3;
3. That the Minister notes that the EPA has concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 3, and summarised in Section 4, including the proponent's commitments.
4. That the Minister imposes the conditions and procedures recommended in Appendix 3 of this report.
5. That the Minister note the Other Advice provided in Section 5 of this report in relation to the location of the Water Corporation treated wastewater emergency outfall within the Northern Harbour.

Conditions and Commitments

Having considered the proponent's commitments and information provided in this report, the EPA has developed a set of conditions which the EPA recommends be imposed if the proposal by LandCorp to dredge, reclaim land and create up to three level lots for use by shipbuilding industry within the Northern Harbour of Jervoise Bay is approved for implementation. These conditions are presented in Appendix 3. Matters addressed in the conditions include the following:

(a) that the proponent be required to fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 3. These include the following:

- Dredging and Dredge Spoil Management Plan (DDSMP) to address issues associated with dredging operations and disposal of dredge slurry;

- Ship-lift Monitoring and Management Plan (SMMP) to address potential changes in water quality at the proposed ship-lift; and

- Marine Safety Management Plan (MSMP) to inform and consult with recreational boat owners to ensure they are aware of issues and requirements associated the use of the Northern Harbour as a recreational and commercial boating facility.

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1. Introduction and Background

The proponent, LandCorp, proposes to dredge, reclaim land and create up to three level lots at Lots 165-168, Henderson Road Cockburn for use by shipbuilding industry. Phase 1 of the LandCorp proposal constitutes construction activities associated with dredging and land reclamation activities. These activities include earth works, construction of a seawall and deposition of fill behind the seawall to reclaim part of the seabed. Phase 2 of the proposal constitutes the construction of hardstand areas, sheds, jetties, ship-lift, and the installation of heavy equipment associated with the construction, repair and maintenance of steel and aluminium-hulled vessels.

Once completed, the lots would be on-sold to industry for the purpose of establishing shipbuilding, maintenance and repair facilities for large vessels (up to 100m in length) which may include a ship-lift.

Amendments to rezone the subject land to Industrial under the City of Cockburn Town Planning Scheme (TPS) (Amendments 150 and 160) have already been considered by the EPA under Section 48A of the *Environmental Protection Act (1986)*. On both occasions the EPA set the level of environmental assessment at 'Not assessed'. The EPA has also assessed a Metropolitan Region Scheme (MRS) Amendment (986/33) under Section 48A of the *Environmental Protection Act (1986)* and again set the level of assessment at 'Not Assessed'. In determining the level of assessment rezoning of the lots under the planning scheme amendments, the EPA considered environmental factors, including the potential impacts on adjacent System 6 areas, but deferred consideration of pollution matters. This is because the EPA considered the potential impacts of shipbuilding industry on water quality of the Northern Harbour could be managed by licence under Part V of the *Environmental Protection Act 1986.*

Dredging on the Northern Harbour and land reclamation has not been previously assessed by the EPA. This assessment is being conducted under Section 38 of the *Environmental Protection Act (1986)*. Only the unassessed components of the proposal are being considered as it is not the intention of this assessment to revisit those aspects already considered under Section 48A (such as the appropriateness of 'Industrial' zoning at this location). Consequently this assessment is limited to the seawall construction, land reclamation and dredging adjacent to lots 165 and 167, including lots 166 and 168, and the management of pollution from shipbuilding, repair and maintenance activities on Lots 165-167.

In compiling this report, the EPA has considered the relevant environmental factors associated with the proposal, issues raised in public submissions, specialist advice from the Department of Environmental Protection (DEP) and other government agencies, the proponent's response to submissions and the EPA's own research and expertise.

Further details of the proposal are presented in Section 2 of this report while Section 3 discusses environmental factors relevant to the proposal. The Conditions and Procedures to which the proposal should be subject, if the Minister determines that it may be implemented, are set out in Section 4. Section 5 provides the EPA's Other Advice, Section 6 presents the EPA's Conclusions and Section 7, the EPA's Recommendations.

A list of people and organisations that made submissions is included in Appendix 1. References are listed in Appendix 2, and recommended environmental conditions and procedures and the proponent's commitments are provided in Appendix 3.

Appendix 4 contains a summary of the public submissions and the proponent's responses. The summary of public submissions and the proponent's responses is included as a matter of information only and does not form part of the EPA's report and recommendations. The EPA has considered issues raised in public submissions when identifying and assessing relevant environmental factors.

2. The proposal

The site at which the proposed development is to occur comprises industrial zoned waterfront land located at the north-eastern corner of the Northern Harbour in Jervoise Bay (see Figure 1). Jervoise Bay is located in the north-eastern reaches of Cockburn Sound, with the Northern Harbour approximately 10km south of Fremantle and 20km south-west of Perth.

The site is zoned 'Industrial' under the Metropolitan Region Scheme (MRS) and 'Industrial General (Restricted Use - Shipbuilding and the Manufacture, Fabrication and Assembly of Components for Use by the Offshore Petroleum Industry)' under the City of Cockburn Town Planning Scheme-District Zoning Scheme No. 2 (TPS). The Woodman Point Reserve located north of the proposed development is zoned 'Parks and Recreation'. The land immediately east of Cockburn Road is zoned 'Public Purpose', and is managed by the Water Corporation. The land immediately south of the proposed development supports an existing shipbuilding precinct.

The nearest area zoned for residential purposes is the suburb of Coogee, the southern boundary of which lies approximately 1.2km to the north of the proposed development. There is one residence located within the Woodman Point Reserve (adjacent to the Pleasure Boat Storage kiosk), approximately 350m to the north-west of the proposed development. The Woodman Point Caravan and Camping Resort is also located within the Woodman Point Reserve, approximately 1.0km north of the proposed development.

The proposal includes Lots 165 to 168, Cockburn Road, with an approximate area of 12.6ha, and rising up to RL 12.4m AHD in height due to the presence of vegetated dunes at its eastern extent . The Northern Harbour extends to a depth of 10m in the vicinity of the entrance, with a pocket of water approximately 8m deep lying directly offshore of Lot 165. This area is the remains of the dredging works undertaken for the Ocean Endeavour project. South of the dredged area, lying approximately 50m offshore, are the remains of two scuttled ships: the SS Alacrity and the SS Abemama (Garratt and Souter, 1997).

The site is traversed by an emergency sewage outfall from the Water Corporation's Woodman Point Wastewater Treatment Plant (WWTP), which lies between Cockburn Road and Lake Coogee to the east of the subject site. The outfall consists of a 1.2m diameter concrete pipe, terminating at a depth of approximately -6m CD within the Northern Harbour, and is protected with a 20m wide cleared easement (see Figure 1).

The main characteristics of the proposal are summarised in Table 1. A detailed description of the proposal is provided in Section 3 of the CER (BSD, 1999a).

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 the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

The process of identifying relevant environmental factors is summarised in Table 2.

Table 1 - Summary of key proposal characteristics

Element	Description
Phase 1 - Construction of Lots	
Seawall	Approximately 500 metres in length. Width of wall at top- approximately 4.5 metres. Width of wall at base- approximately 20 metres. Limestone construction of seawall: core: 78,500 tonnes; armour rock: 11,000 tonnes; filter rock: 8,000 tonnes.
Dredging	Approximately 2.6 ha; Generally from -4m to -9m CD final depth. Ship-lift surface area approximately 50m x 80m, down to -14m CD. Approximately 80,000 m3 of spoil.
Reclamation	Approximately 2.9 hectares
Area available for development	Lot 165 6.62 ha Lot 167 2.73 ha Reclamation 2.90 ha Top of seawall 0.22 ha TOTAL 12.47ha
Phase 2 - Establishment and Operation of Shipbuilding, Repair and Maintenance Facilities by Industry	
Future development by industry	Construction of hardstand areas, sheds, jetties and a ship-lift, and the installation of heavy equipment. Construction, repair and maintenance of steel and aluminium-hulled vessels.

Having considered appropriate references, public and government submissions and the proponent's response to submissions, in the EPA's opinion, the following are the environmental factors relevant to the proposal:

(a) Groundwater quality - nutrients as a source of harbour water quality impairment;

(b) Marine water quality - effects of dredging, seawall, changes in bathymetry and flushing characteristics;

(c) Recreation - restriction on beach access;

(d) Recreation - conflicts with recreational boating use; and

(e) Management responsibility - adequacy of environmental management framework.

Details on the relevant environmental factors and their assessment is contained in Sections 3.2 - 3.6 and summarised in Table 3. The description of each factor shows why it is relevant to the proposal and how it will be affected by the proposal. Submissions on the CER are summarised before the EPA assessment for each relevant factor.

In assessing each relevant environmental factor, the EPA determines whether or not the proposal can meet the objective set for that factor.

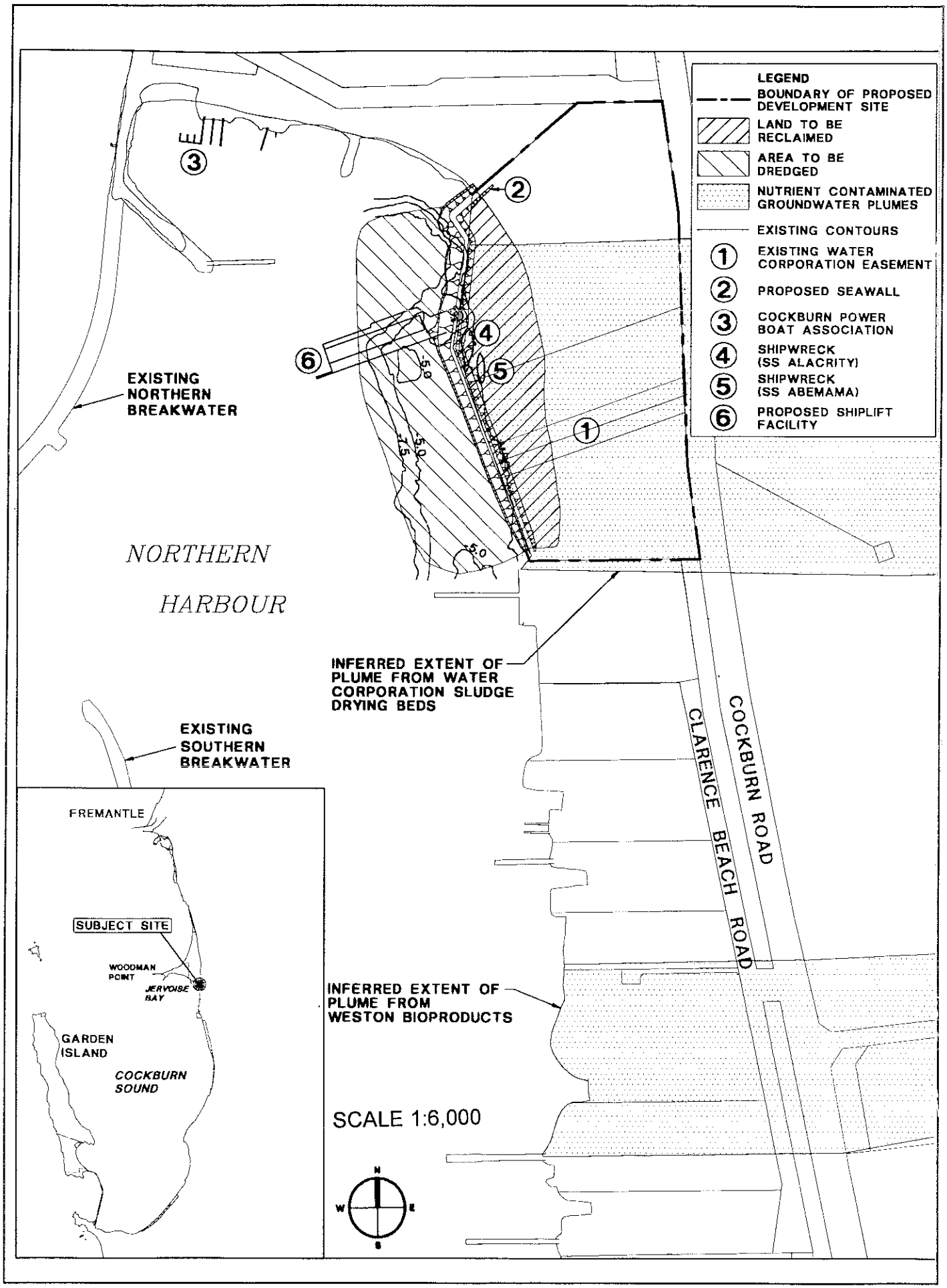

Figure 1. Location of the proposal.

Table 2 - Identification of Relevant Environmental Factors

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
BIOPHYSICAL			
Marine Biota - Seagrass, benthic and other marine flora and fauna	Dredging and reclamation of part of the seabed behind the seawall will result in the loss of isolated seagrass plants. Construction of the Seawall will also destroy the sessile communities associated with the shipwrecks as the seawall is constructed over the site.	• The CER does not appear to provide details on site specific surveys of the marine environment within the development area. What evidence is there that seagrass in not present in Northern Harbour? • The EPA Bulletin 907 stated quite clearly that dredging of the basins and shipping channels in the shallow margins of the Sound, where seagrasses once flourished but since have been lost, would create areas where bottom light levels would be greatly diminished. The construction of breakwaters and reclaimed areas would permanently cover additional areas of these shallow margins. The dredging effectively removes an area of possible seagrass habitat. If seagrass can be replanted then it is essential that all possible remaining habitats be retained. • Page 4-10 of the CER states that the blooms '...have been of non-toxic species, and there have been no reported incidents of public health problems or fish deaths (HGM, 1998).' This is not true as within weeks of the completion of the Breakwater crabs, fish, including starfish, and barnacles were lying dead on the seabed and shoreline. Are any of the algae species responsible for blooms toxic?	A seagrass and benthic survey conducted by HGM (1996) in adjacent areas found no seagrass meadows, however individual seagrass plants in the area are sparsely distributed (0-5% cover) and have low species diversity (predominantly genera *Halophila*). The survey by HGM (1996) also noted a lack of rhizome material in sediments (HGM, 1996). Spot dives conducted by MAFRL (Jan 1999) confirmed the HGM (1996) study for the proposal area that the seagrasses have limited ecological function and low conservation value. The EPA has considered the value of seagrass within the Northern Harbour (Bulletin 836) and concluded that '...the loss of seagrass within the proposed breakwater extension area is unlikely to compromise its objective to maintain the abundance, species diversity and geographic distribution of seagrass.' The MAFRL dives also identified a reef and two shipwrecks containing a high abundance but low diversity of sessile filter feeders. The Shipwrecks are addressed under the Preliminary Environmental Factor of 'Heritage - Maritime Wrecks'. **Not considered a relevant environmental factor.**
Terrestrial Flora - Vegetation communities	Management of stormwater drainage and construction activities associated with the development area may impact on the adjacent Woodman Point Reserve.	• The proponent are suggesting the creation of a buffer zone between industry and Woodman Point by utilising part of the reserve. We find this response unacceptable. One of the Lots in question was reserved as a buffer, this has been rezoned, and now they see the need to utilise a public area to develop a new buffer for the development. • A condition of approval for this proposal should be that the seawall and any associated facilities should be contained outside the Woodman Point Regional Park. • A condition of approval of the CER should be that an appropriate buffer zone is fully contained on the development site to separate Lot 165B from the Regional Park. The size and nature of the buffer zone (including appropriate landscaping) should be prepared to the requirements of the DEP, on the advice of CALM.	The EPA considered the significance of the vegetation at the site when assessing the planning scheme and Metropolitan Region Scheme amendments that rezoning the site for 'Industrial' purposes. The vegetation on the site was not considered significant and the EPA set the level of assessment at 'Not assessed' under Section 48A. The proponent has indicated that all development will be contained within the boundaries of the LandCorp land. The area of the proposal adjacent to the Woodman Point Reserve will be developed as a landscaped parking area fully contained within the development on the northern boundary of the site. All

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Terrestrial Flora - Vegetation communities (cont'd)			stormwater from the development site will be treated and contained within the proposal area (outside the Woodman Point Reserve). **Not considered a relevant environmental factor.**
POLLUTION MANAGEMENT			
Groundwater quality and surface water quality	Dredging for the ship-lift and construction of the seawall and associated land reclamation activities (including further dredging) may alter the characteristics of the groundwater flow into the Northern Harbour resulting in changes to the spatial distribution of nutrients entering the harbour via groundwater. Surface water runoff from the site during construction and following development of the site for ship building and maintenance activities may contain unacceptable levels of contaminants.	• A condition of approval should be that all drainage is fully treated and contained outside of the Woodman Point Regional Park. • The Water Corporation is concerned that the proponent has only elected to address the groundwater issues and not include the treated wastewater emergency outlet strategy in the CER. The Water Corporation considers both issues are equally important in terms of this development. Although the magnitude of the nitrogen load discharge by groundwater will not change, the land reclamation project may have an impact on the distribution of groundwater discharge, which may in turn affect the intensity of algal blooms in the harbour. This may occur because the dredged material will have a generally low permeability, and this may divert groundwater flow from the treatment plant to the north and concentrate discharge in the northern part of the harbour near the Cockburn Power Boat Association where blooms commonly occur. The change in the harbour bathymetry may also effect the location of the groundwater discharge into the harbour. Not enough is currently known about the distribution of groundwater discharge in the harbour to accurately predict the effect of the reclaimed land on groundwater flow in the area. • While the CER has recognised the possibility of a preferred flow path it has not addressed the possibility of intercepting a preferred flow path which could lead to an increase in the nutrient loading to the harbour. The CER does not provide sufficient detail to give confidence that this situation will not occur and does not provide detail on management strategies which could be implemented should this occur. • The CER has not addressed the nutrients moving west in groundwater from sources to the east of Lake Coogee. Nutrients from these sources are likely to continue moving west, and possibly increase, with future development. The CER has not considered the long-term consequences for the Northern Harbour of this continued nutrient inflow nor do any studies appear to have been undertaken in this regard. The CER assumes the proposed clean-up operation will successfully manage the eutrophication problem in the harbour. • If the proposed clean-up operation is not successful future drastic action, such as the removal of the Northern Breakwater, may be necessary. This possibility has a major bearing on the long-term viability of	**Groundwater Quality is considered a relevant environmental factor.** The Proponent has indicated that all surface water runoff would be fully treated and contained outside of the Woodman Point Regional Park. The Woodman Point outfall will require minor modification and is not expected to have any environmental impact. Discharge of contaminants from the ship building and maintenance activities can be adequately managed under Works Approvals, Licensing or Registration under Part V of the *Environmental Protection Act (1986)*. **Surface Water Quality is not considered a relevant environmental factor.**

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Groundwater quality and surface water quality (cont'd)		the proposed expansion to shipbuilding activities and should have been considered and evaluated in the CER. • The inference that wastewater discharge from the Woodman Point Treatment Plant is contributing to the degradation of water quality in Cockburn Sound and Jervoise Bay is not acceptable to the Water Corporation. The Water Corporation does not believe the Woodman Point Wastewater Treatment Plant has had a significant influence on the reduction in water quality in Cockburn Sound as, with the exception of minor and infrequent emergency flows, no waste waters have been discharged to Cockburn Sound since the mid 1980's. The old outlet that did discharge into Cockburn Sound was replaced in 1984 and the water quality issues in Cockburn Sound since that time would be due to other outside influences. The proposal in the CER must reflect the existing Department of Environmental Protection conditions on the Water Corporation wastewater emergency outlet from Woodman Point Wastewater treatment Plant. The imposition of further restrictions on the Water Corporation's ability to operate the approved outlet and meet the DEP conditions would not be acceptable. Although the Water Corporation has indicated the use of the wastewater emergency outlet is only likely to be used infrequently it is an essential asset that must be available for emergency situations. • The remediation strategy being developed by the Water and Rivers Commission, Department of Commerce and Trade, Water Corporation, Department of Environmental Protection, LandCorp and Weston Bioproducts is focussed on ameliorating the impact of groundwater discharge to the Northern Harbour from the Weston Bioproducts plume. This strategy may need to be re-evaluated and modified in the future to include clean up contamination from the Water Corporation site if land reclamation effects the groundwater flow. • The proponent should maintain an easement along the eastern boundary of the development to allow groundwater recovery bores and other infrastructure to be installed should a remediation strategy become necessary for the groundwater moving through this area. • The proposed groundwater remediation will most likely involve pumping of polluted groundwater, removal of contaminants and injection of the water back into the limestone aquifer. It should be noted that at this location the freshwater is floating on a tongue of intruding sea water (Figure C2) and pumping will cause a sharp up-coning of the saline water that can take years to subside once pumping ceases. In such circumstances it is necessary to pump at low rates, often intermittently and from several bores over the affected area. This takes	

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Groundwater quality and surface water quality (cont'd)		longer that is the case where such circumstances do not exist and it is expensive. This remedial action needs to be included in the CER.	
Marine water and sediment quality	Construction of the seawall and dredging associated with the proposal may alter the bathymetry and flushing mechanisms of the Northern Harbour leading to a decline in Marine Water Quality. Changes to the characteristics of the groundwater inflow, especially in the vicinity if the seawall and ship-lift. The excavation of a 14m deep hole for the ship-lift may also lead to stratification and anoxic conditions resulting in additional release of nutrients to the marine water column. Sediments in the vicinity of dredging and land reclamation activities may be contaminated with tin, polycyclic aromatic hydrocarbons and heavy metals.	The draft criteria referred to in the CER has been suggested so that an exceedence of the lower of the two criteria, the ERL, triggers a management response in the form of an investigation of elevated concentrations of contaminants, while exceedence of the ERM can require the immediate development and implementation of a remedial management plan should that be necessary. The purpose of the ERL criteria is to provide triggers for management action before the probability of unacceptable environmental impacts becomes significant. The ERLs have been developed from a database consisting of many individual sediment quality/eco-toxicity data sets and the ERL and ERM concentrations of contamination have been set such that approximately 10% and 50% respectively, of those data sets would demonstrate an unacceptable impact(mortality) on marine in-fauna. This means that maintaining the concentration of contaminants at the ERL level does not in itself guarantee that there will be no impacts and this is the basis for requiring investigations into the source and implications of the contamination at these concentrations. In relation to the ongoing sediment monitoring programme, the proponent makes a case for sampling to be scaled down to take place on a triennial basis as opposed to annually. This argument seems to rest on the proponent's assertion that "all sediments contaminant concentrations were well below the DEP (1996a) draft EQCs for Industrial Buffer Zones... and have not changed dramatically over three sediment monitoring surveys." The proponent has simply applied the EQCs for an EQO 2 Class III zone by comparing the survey data against the higher of the two criteria which are presented in the SMCWS. The results of the monitoring show one site exceeds the ERL (effects range low) for copper and two sites exceed the ERM (effects range medium) for TBT. This claim also contradicts the statement in Section 4.3.1.2 Release of Sediments "The Site...(Site 1, Figure 4.4) had an average concentration of 325 nano-grams of TBT per gram of sediment...which is seven times the draft EQC for industrial Buffer Zones. These statements need to amended in any future relevant documentation. • In light of this the sediment monitoring should be conducted annually for at least three years after which it should be reviewed. Annual sediment monitoring has been conducted for the last two years as part of a five year commitment made by the Department of Commerce and Trade (DCT) in relation to the Jervoise Bay Northern Harbour Management Plan. The monitoring programme required of LandCorp in this instance must be linked to that being conducted by DCT. This programme will also sample sediments	**Marine Water Quality is considered to be a relevant environmental factor.** Samples taken from the sediments during the preparation of the CER indicate the bulk of contaminants are the top 2-5cm of the sediment. Analysis of contaminates showed the level of contamination is below the draft EQC for Industrial Buffer Zones for industrial landuse. (BSD, 1999) The proposed management of mixing the top 2-5cm of sediment with the bulk of the dredge spoil excavated from the seabed and using it as fill behind the seawall will ensure the soil contamination within the reclaimed land is below limits set for industrial landuse. (BSD, 1999) Further sampling and testing of sediments is proposed as part of the Dredging and Dredge Spoil Management Plan included as Commitment 1.1. **Sediment Quality is not considered a relevant environmental factor**

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Marine water and sediment quality (cont'd)		annually for the next three years and linking and rationalising the two monitoring programmes, will effect efficiencies for both proponents, develop adequate information for assessment of potential and existing environmental threats and impacts and contribute to coordinated (between the existing proponents) environmental management of the whole of the Jervoise Bay Northern Harbour. • In using the EQC for Industrial Buffer Zones the CER has ignored that fact that people swim and fish in Northern Harbour and boat launching involves frequently entering the marine environment. A more strict criteria should be adopted. • It appears that the recommendations and comments from the EPA in Bulletin 907 have been ignored by this development. Bulletin 907 quite clearly states that : a) the cumulative effect of a number of large scale developments along the eastern margin is likely to be a reduction in the rate of exchange of water between the inner eastern margin and the remainder of the sound; and b) the spatial extent of changes will not be restricted to the areas enclosed by breakwaters but will also affect the inner harbour marine areas and may possibly affect the broader Cockburn Sound; and • To what extent will the increased depth affect flushing, and thereby water quality, in the Northern Harbour? The CER states that the Northern Harbour is mixed by tidal action, wind, waves and baroclinic motion. Observations of water mixing during the algal blooms clearly indicated poor mixing at the mouth of the harbour. Opposing winds moved the plume in a visible demarcation - out on the easterlies and in again with the sea breeze. The prevailing winds from the south west contain the water body. • The proponent claims that the groundwater pathway may change marginally but that there will be no change in the volume or form of the contaminated groundwater. The impact of the location of groundwater intrusion on the harbour flushing is not addressed. The additional limestone material may cause other undetermined changes to the plumes and flushing in the harbour. These possible effects should be evaluated before approvals for the project are considered. • It is proposed to create a 14m hole of 5000m^2 for a ship-lift. As indicated in the CER this may cause or trigger a number of water problems. A number of management measures are proposed. The proponent has already discounted 1 and 3 because they could release nutrients from the sediment into the water column. 2 and 4 have the potential to cause turbidity in the water and release silica, there by triggering algal blooms. No assessment has been made of	

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Marine water and sediment quality (cont'd)		the impact these activities would have on fauna, the affect of the organic matter released from the bottom, and recreational activities. • The management measures indicated do not show how the water quality problems will not arise from the ship-lift. • The water in the area of the CPBA marina and public facilities showed the greatest degree of deoxygenation during the algal blooms. Flows from the ship-lift will impact most heavily on this area. • The management proposals for the ship-lift area are complex and appear largely unproven in situations such as the Northern Harbour. • The turning of large craft in the region of the ship-lift will cause turbidity. What effect will this have on the water quality in the harbour?	
Marine water and sediment quality - Dredging	Dredging activities may intercept groundwater flow paths resulting in a change to the groundwater movement and quality characteristics	• It is quite likely that dredging adjacent to lots 165 and 167 will release contaminated sediments and could even increase the flow of contaminated groundwater into the Northern Harbour. No evidence is provided to refute this concern and no plan of action is provided to deal with it. • The CER does not fully address the issue of contingency plans with regards to the effects of dredging and construction work. These plans should be formulated and available for scrutiny before the project is given any endorsement. • The CER does not mention the possible return of the dredged slurry back into the harbour. From the CER this appears to be a likely scenario. If dredged material were to return to the harbour what would be the effect and how would it be managed? • While the Consultant readily agrees that dredging activities have the potential for impacts on water quality, no details of containment measures are specified. It is clear that it will be difficult to manage the construction of the seawall, dredging and reclamation in a manner, which will protect against short-term water quality impacts within the harbour. Rather than discuss the issue in detail up front the approach taken in the CER is to prepare a Dredging and Dredge Spoil Management Plan once approval is obtained. This approach is of concern as it does not allow proper public scrutiny of the proposed criteria or methods to manage water quality. In the absence of this detail it is difficult to have confidence in the assertion that this aspect of the proposal will not lead to a loss of water quality.	**Considered a relevant environmental factor and addressed under Marine Water Quality.**
Marine water and sediment quality - Dredging-turbidity	Dredging activities associated with the ship-lift and land reclamation activities may result in the release of nutrients and increase turbidity in the vicinity of the activities leading to reduced marine water quality.	• The proponent has failed to address the possible impact on water quality of suspended silt, sediments and silica in the water column around the dredge. • Fine silt, silica and sediments could be suspended in the water column. The CER management measures do not adequately address this problem. • No Dredge Spoil Plan is shown in the CER.	**Considered a relevant environmental factor and addressed under Marine Water Quality.**

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
		The plan should be part of the CER.	
Marine water and sediment quality - Discharge from shipbuilding, servicing and maintenance operations	Discharges from the site following development for ship building and maintenance activities may contain unacceptable levels of contaminants.	• On the basis of information in the Southern Metropolitan Coastal Waters Study, the future ship building operations associated with the development are likely to lead to a reduction in water quality and contamination of sediments within the harbour. Extremely rigorous management practices will need to be maintained for shipbuilding activities and stormwater control to minimise these impacts. While the CER outlines the broad practices and procedures that could be implemented it does not incorporate any commitments by the proponent in terms of monitoring changes in water quality following the commencement of operations, nor does it address the management impacts which may arise.	Discharge of contaminants from the ship building and maintenance activities can be adequately managed under Works Approvals, Licensing or Registration under Part V of the *Environmental Protection Act (1986)*. **Not considered a relevant environmental factor.**
Contamination - Dredge Spoil	Dredging operations for the associated with the construction of the ship-lift and dredging in the vicinity of the proposed seawall will include the removal of potentially contaminated sediments from the seabed. It is proposed that theses sediments be used as part of the fill behind the seawall for the land reclamation aspect of the proposal.	• It is recommended that a sampling program be established to confirm the suitability of the sediment as reclamation infill. If levels of contaminants remain within the background levels of the ANZECC/NHMRC (1992) Guidelines for the Assessment and Management of Contaminated Sites there would be negligible risk to public health. • It is not expected that TBT levels in the sediment spoil would constitute a public health problem given the degree of mixing that will occur during reclamation and the proposed landuse of the area. However, TBT levels should be included in any monitoring program that is implemented.	Samples taken from the sediments during the preparation of the CER indicate the bulk of contaminants are the top 2-5cm of the sediment. Analysis of contaminates showed the level of contamination is below criteria for industrial landuse. (BSD, 1999) The proposed management of mixing the top 2-5cm of sediment with the bulk of the dredge spoil excavated from the seabed and using it as fill behind the seawall will ensure the soil contamination within the reclaimed land is below limits set for industrial landuse. (BSD, 1999) Further sampling and testing of sediments is proposed as part of the Dredging and Dredge Spoil Management Plan included as Commitment 1.1. **Not considered a relevant environmental factor**

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Contamination - Solid waste	Solid wastes are likely to be produced as a result of the ship building and maintenance activities (hydrocarbons and chemicals) that will ultimately occur at the site.	No submissions were received on this Factor.	All other wastes from the site, including empty storage drums, scrap metal and domestic solid waste, will be minimised, recycled, treated or disposed of in an appropriate landfill site, in accordance with the waste management hierarchy. Solid waste associated with ship building and maintenance activities can be adequately addressed under Works Approvals, Licensing or Registration under Part V of the *Environmental Protection Act (1986).* **Not considered a relevant environmental factor.**
Air - Particulates/ Dust	Dust generation associated with the clearing and construction activities during development of the lots may impact on the adjacent recreation areas of the Marina and Woodman Point Reserve. Woodman Point Reserve also includes a Caravan Park.	• The City of Cockburn is likely to be involved in the management of any dust problems associated with the site and it is considered imperative that the City be listed as a referral agency for the Dust Management Plan.	The proponent has included a Commitment to prepare a Dust Management Plan prior to commencement of works that would adequately address this factor. The proponent has committed to liaising with the City of Cockburn (Commitment 5.1) **Not considered a relevant environmental factor.**
SOCIAL SURROUNDINGS			
Recreation - Beach access. Access to Woodman Point	Construction of the proposal would include the reclamation of a section of the beach for future development of ship building and maintenance activities. Construction of the lots may also restrict the availability of Cockburn Road for through traffic.	• The 'potential use of the southern breakwater for Northern Harbour activities' may conflict with the promised use of all the breakwaters by amateur fishermen and the public in general. The island breakwater precludes this activity for the western breakwater. • The proposal does not address the impact of the development on the existing use of the beach. It is anticipated that there will be substantial community outcry if the existing beach area is developed and the proposal does not provide any contribution to community facilities or other measures, which could compensate for impacts on current recreational uses.	**Considered a relevant environmental factor.**
Recreation - Boating **Recreation -**	Construction and operation of the ship building and maintenance facilities on the lots would result in some conflicts with recreational boating users.	Existing boat facilities in the region cannot cater for present recreational demand and yet the proposal has made no provision for the future growth of recreational craft in the region. The Northern Harbour should continue to be a shared facility, with more area set aside for recreational boating requirements The most deoxygenated water during the recent algae blooms was in the region occupied by recreational craft. The possible impacts on water quality will most directly impact on the amenity of the public areas. • The CER admits that there will be difficulties created by the proposal for present small boat users. It fails to identify any adequate way to address the problems that will be created. There will be a strong demand to expand the recreational boat use	**Considered a relevant environmental factor.** The proponent has committed to preparing as Marine Safety Management Plan to establish as commercial and professional working relationship between the recreational and commercial vessels using the entrance to and shared use of the waters of Jervoise Bay.

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Boating (cont'd)		in this area over time however this project precludes the expansion of present launching facilities for future use. The logical plan of development would be to use the site planned for commercial fishing to allow for future public launching facilities and retain the 'buffer' site for what it was intended - as a buffer between industry and other boat users.	
Heritage - Aboriginal culture and heritage	The proposed development site includes the registered site S02169, a number of potential burial sites, and the Boomerang/Spear and Fire Myth sites are also in the general area. Construction activities may adversely affect these features.	• The proponent has satisfied all obligations under the auspices of the Aboriginal Heritage Act 1972.	Advice from the Aboriginal Affairs Department indicates that all obligations of the *Aboriginal Heritage Act 1972* have been satisfied. **Not considered a relevant environmental factor.**
Heritage - Maritime shipwrecks	The shipwrecks of SS Alacrity and SS Abemama are where the seawall would be constructed. Construction of the seawall would bury these wrecks.	• The Federal Attorney's latest ruling regarding the shipwrecks in Jervoise bay is that, for the purposes of the Commonwealth Historic Shipwrecks Act 1926, the waters of Cockburn Sound come under Commonwealth jurisdiction. • The proposal will see the shipwrecks Alacrity and Abemama completely enclosed within the reclamation area. This is an inadequate response to the WA Museum's expressed concern about the damage to the fabric of the wrecks. • The measures suggested do not comply with the two requirements of the Museum as: a) the structure is permanent; and b) the fabric will be damaged through the weight of material. • How will placing soil over wrecks avoid destruction to wooden hulled Abemama?	A detailed survey was carried out by Garrett and Souter in 1997 which observed that the wrecks are subject to an accelerated rate of degradation. Consistent with the WA Museum recommendations (Garrett and Souter, 1997) the proponent proposes to bury the wrecks for preservation with no piles or foundations erected on the site. A plaque would also be erected to identify location of the wrecks under the seawall. The WA Museum has confirmed that the proposed management is appropriate. **Not considered a relevant environmental factor.**
Noise	Noise associated with the construction activities associated with the development of the lots may adversely affect recreational and residential users of the Woodman Point Reserve Caravan Park). Noise associated with the ship building and maintenance operations of future industry at the site may affect the amenity of residents in the nearby Woodman Point Reserve Caravan Park.	• The CER provides information that suggests noise from construction activities would not cause adverse impacts to the closest noise sensitive premises. However, it does not indicate that noise levels above those stipulated under the Environmental Protection Act could be associated with the operational phase of the project, particularly at the Woodman Point Caravan Park. A review of the noise assessment also highlights a number of points that have not been addressed including tonality, impulsiveness, frequency modulation and the assessment of noise sources outside the confines of buildings that may result in higher than expected noise levels at the Caravan Park. • The proponent does not intend to limit activities during the construction phase to between the hours of 0700 and 1900 on weekdays and not at all on Sundays and Public Holidays. Further commitments are required to address noise issues to prevent off site noise impacts.	Construction activities would be carried out in accordance with Section 6 of AS2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites" using equipment which is the quietest reasonably available. Construction noise would also be controlled under the ***Environmental Protection (Noise) Regulations 1997.*** Regulation 13 requires that construction activities (including pile driving) are carried out to reasonable standards between the hours of 7am and 7pm Monday to Saturday (excluding Sundays and Public Holidays). If the DEP is concerned about the effect of noise on the adjacent environment a Noise Management Plan may be requested. Although modelling by the Proponent has indicated that some noise impacts at the

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Noise (cont'd)			Woodman Point Reserve Caravan Park may be associated with the operational phase of the ship building and maintenance activities to be carried out in the future. The DEP is satisfied that this can be mitigated by reasonable noise management strategies. Future industry would also be required to comply with the ***Environmental Protection (Noise) Regulations 1997*** and conditions relating to noise mitigation requirements could be managed under Works Approvals, Licensing or Registration under Part V of the *Environmental Protection Act (1986)*. **Not considered a relevant environmental factor.**
Public health and safety	Movement of large vessels in and out of the ship building and maintenance facilities may result in conflicts with recreational boating traffic.	• The proponent should consider locating the ship-lift further to the south to maximise the separation between the ship-lift and the entrance to the recreational boat launching facility. There is no land planning shown to demonstrate why the ship-lift needs to be located midway along the lot. A 110m separation between the ship-lift and marina jetty is not sufficient for boating safety. Vessels leaving the public and CPBA ramps have to keep to starboard to avoid collision with vessels returning to the marina. These departing boats also need to keep to the port of the enormous boulders that are dangerously near the surface at the end of the marina. Given that the sea conditions change suddenly and many small craft will be returning to shore with those sudden changes a large number of boats could be within the area at the same time. Often drivers not only have the changing winds and waves to contend with but the ever present dangers of rocks on the groynes and the difficulty of manoeuvring around Cockburn's Sea Rescue vessel towing a stricken vessel back to safety. • There is very little room to manoeuvre vessels larger than 100 meters and the proposed management strategies of training operators are inadequate. Mistakes will occur and this poses a danger to the boating public in this area. The Cockburn Power Boat Association (CPBA) has been highly critical of the Northern Harbour breakwater construction and configuration. The Breakwater extension has created safety problems for small craft and contributed to water quality deterioration, despite the proponent's assertions to the contrary. • The only strategy the Proponent has identified to address safety issues in the marina is education of boat users. As there is no legislation that controls the handling of pleasure craft this is an inadequate response to a problem that will be created by the implementation of the proposal.	Issues associated with the safety of boating activities are addressed under the factor of Recreation - Boating. **Not considered a relevant environmental factor.**

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Public health and safety (cont'd)		• There is very little room to manoeuvre vessels • The proposed changes to the roads identified in the CER will have an adverse affect on the quality of life, safety and accessibility of recreation users of the whole Sound region. • Even though ongoing microbial monitoring may not provide results exceeding the 'Australian Guidelines for the Recreational use of Water (NHMRC, 1990) it would be prudent to exclude the public from swimming in the Northern Harbour during the seawall construction, land reclamation and dredging phase of the project	
European Heritage	Construction activities could impact on places of European heritage.	• The proposal does not affect any places that are currently on the Register of Heritage Places. However, it would be appropriate to check if there are any places listed on the relevant Local Government's Municipal Inventory of Heritage Places.	There are no places listed on the Register of Heritage Places or the Local Government's Municipal Inventory of Heritage Places. **Not considered a relevant environmental factor.**
Management Responsibility	Management responsibilities for the different phases of the total development (beyond the immediate construction activities) may result in unclear lines of responsibility.	• It is essential that LandCorp be held responsible for ongoing and upcoming problems. A continuation of the 'walk-in, walk-out' approach that has resulted in the present problems in the Sound is not acceptable. While it may be possible to attach adequate conditions to seabed leases and other arrangements with future operators it would be preferable that responsibility for the management of key water and operational impacts rest with a suitably resourced government agency or body. The current lack of a management framework or clear responsibilities for the management of water quality and other issues within the harbour heightens concerns in this regard. The resolution of this issue is seen as imperative should the proposal proceed. • There would be more confidence if the CER were to read "In accordance with Part V (Works Approval and Licensing) of the Environmental Protection Act (1986), the following generic licence conditions shall (instead of could) be applied...". What assurances can the proponent give that the suggested conditions will be applied to the Works Approvals and Licenses when they are issued? Concerns are also held in relation to the arrangements for long term responsibility for management of the stratification with the ship-lift facility. The long term viability and success of the proposed approach is questionable and it is considered more appropriate that if the proposal proceeds the management of the water quality aspects be the responsibility of a suitably resourced government agency. • When construction proceeds will an independent body manage daily construction related impacts? • If the EPA Water Quality Objectives are	**Considered a relevant environmental factor.**

PRELIMINARY FACTOR	PROPOSAL COMPONENT WITH POSSIBLE IMPACT	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Management Responsibility (cont'd)		not met who will have the authority to halt construction? • The proponent has made a welcome set of commitments but it is not clear that these commitments can be kept in the longer term unless a formal management body is established for the Northern Harbour and the body agrees to accept these commitments for Stage 2 and beyond. • It is mentioned that the planned activities be the subject of a Seabed Lease. The project requires reclamation of 2.9 hectares of seabed, dredging of 2.6 hectares, and 0.22 hectares of seawall. It is inappropriate that this area is leased to industry. Proper process requires that the area should be subject to a MRS Amendment to rezone the ocean bed. • Any Works Approvals, registrations and/or licences for industries that occupy the newly developed area need not be dealt with at this stage.	

Note: DAL - DA Lord and Associates
ERL - Effects Range Low
ERM - Effects Range Median
EQO - Environmental Quality Objectives
EQC - Environmental Quality Criteria
HGM - Halpern Glick Maunsell
MAFRL - Murdoch Analytical and Freshwater Research Laboratories
MRS - Metropolitan Region Scheme
SMCWS - Southern Metropolitan Coastal Waters Study
TBT - Tributyl Tin

Table 3 - Summary of Assessment of Relevant Environmental Factors

RELEVANT FACTOR	RELEVANT AREA	EPA OBJECTIVES	EPA ASSESSMENT	EPA ADVICE
Groundwater quality – nutrients as a source of harbour water quality impairment	Northern Harbour and up-gradient groundwater system	Ensure that the proposal does not result in reduction of the overall marine water quality of the Northern Harbour from either the nutrient load of groundwater, or its direction of flow.	The major sources of nutrients in the groundwater entering the Northern Harbour are associated with the groundwater plumes emanating from the Woodman Point WWTP and Weston Bioproducts facility. Dredging and land reclamation activities associated with the development of Lots 165-168 for future industrial use may slightly modify the flow path of groundwater in some areas however these activities are not likely to result in a change to the total load or concentration of nutrients in the groundwater. The DEP has advised that the total load of nutrients entering the Northern Harbour is the most significant factor governing marine water quality. Small changes to the location of the groundwater inflow to the harbour are not likely to result in detectable changes in the overall marine water quality of the Northern Harbour. Future development of industrial facilities on the newly created lots would be considered prescribed premises under Schedule 1 of the Environmental Protection Regulations (1987). As a result the environmental aspects if these activities would be subject to Part V of the Environmental Protection Act (1986) via works approvals, licences, registration and regulations as appropriate.	Having regard for: a) the presence of contaminated groundwater plumes from the Woodman Point wastewater treatment plant and Weston Bioproducts facility; b) construction activities which will not influence the groundwater quality; c) DEP's advice that any changes to the specific location of the groundwater plume entry to the Northern Harbour is not likely to affect the marine water quality in the harbour; and d) the ability of Part V of the Environmental Protection Act (1986) to manage future industrial development under Works Approvals, Licensing or Registration, it is the EPA's opinion that the proposal can be managed to meet the EPA's objective for this factor.
Marine water quality – effects of dredging, seawall and changes in bathymetry and flushing characteristics	The Northern Harbour	Maintain or improve marine water quality consistent with Environmental Quality Objectives (EQO's) and Environmental Quality Criteria (EQC's) defined in the Southern Metropolitan Coastal Waters Study (1996) within the Northern Harbour.	Possible impacts on marine water quality within the Northern Harbour as a result of the proposal include: • stratification and release of nutrients from the bottom of the hole dredged for the ship-lift; • changes to the flushing characteristics of the harbour due to changes to the bathymetry and shoreline; and suspension of nutrients, sediments and silica trapped in bottom sediments into the marine water column (either during dredging or because of ship movements). Construction of the ship-lift would result in a hole 50m x 80m in area 6m deeper than the rest of the harbour with no direct connection to the marine waters outside the harbour. The hole is likely to act as a sink accumulating sediment and other debris from the harbour that cannot easily flush to open water. Over time stratification of the water column would occur in the ship-lift hole which is likely to lead to anoxic conditions near the bottom. Anoxic conditions adjacent to sediments containing nutrients (particularly nitrogen) is likely to result in a change to the nitrification process leading to a greater release of nitrogen to the water column (approx 220kg/a).	Having regard for: a) the commitments to monitor and manage dredging operations to prevent a decline in marine water quality; b) the minor increase in flushing time of the harbour; c) the commitment to monitor and manage nutrient issues associated with the ship-lift; and d) the proposed Department of Commerce and Trade groundwater remediation program for the northern harbour, it is the EPA's opinion that the proposal will not unduly compromise the EPA's environmental objective for this factor.

RELEVANT FACTOR	RELEVANT AREA	EPA OBJECTIVES	EPA ASSESSMENT	EPA ADVICE
Marine water quality – effects of dredging, seawall and changes in bathymetry and flushing characteristics (cont'd)			LandCorp has included Commitments 3.1-3.4 as a means of managing the stratification and the potential release of additional nutrients to the marine water column. This commitment proposes to regularly remove sediment and debris build-up from the ship-lift hole and undertake measures to ensure the bottom layers are prevented from becoming anoxic. To prevent anoxia of the water at the bottom of the ship-lift LandCorp proposes to extract, re-oxygenate and re-inject water to the bottom of the ship-lift. The need to initiate the re-oxygenation activities would be based on a management plan developed as part of the commitment that would identify trigger criteria to initiate the re-oxygenation program. It should be noted that the ship-lift management measures may not be necessary if the DCT groundwater remediation is successful. Note: The physical machinery used at the ship-lift would be the framework to which the re-oxygenation equipment would be connected to implement the re-oxygenation program. LandCorp has indicated that the construction of the ship-lift hole would only be undertaken when there is a commercial arrangement in place for the construction of a ship-lift. Unless such an arrangement is in place the hole will not be constructed. Consideration of the potential changes to the flushing of the Northern Harbour as a result of the LandCorp proposal indicate that no discernible change to the flushing characteristics of the harbour are likely to occur. At present, the time to exchange the total estimated volume of water within the Northern Harbour is 18.5 days. After development, the total estimated flushing time is predicted to increase to 19.3 days, which is about a 5% change Dredging operations associated with the construction of the seawall and land reclamation works could result in the disturbance of sediment and release of nutrients to the water column. LandCorp has committed to preparing a Dredging and Dredge Spoil Management Plan (Commitment 1.1) to manage the dredging operations. DEP is satisfied that the proposed management plan would adequately manage turbidity and disturbance of sediments associated with the dredging operation at the dredge. The disposal of dredge spoil would be achieved by depositing it behind the seawall for use as a fill material. The water component of the dredge spoil would percolate back to the harbour through the seawall or via groundwater. The DEP is satisfied that the proposed method for disposing of	

RELEVANT FACTOR	RELEVANT AREA	EPA OBJECTIVES	EPA ASSESSMENT	EPA ADVICE
Marine water quality – effects of dredging, seawall and changes in bathymetry and flushing characteristics (cont'd)			the dredge spoil would not require discharge of the water component of the dredge spoil directly to the harbour where it would result in a loss of marine water quality. The DEP is of the view that dredging in summer is not necessarily a major issue. Previous investigations (HGM, 1998) have indicated that summer dredging may have contributed to algal blooms however significance of dredging on the occurrence of blooms may have been overstated. When the blooms occurred during summer during the construction of the Northern Breakwater the presence of the contaminated groundwater plumes entering the harbour was not fully recognised. DEP believes the dredging was held responsible for the blooms as it was the only obvious operation in the vicinity that could be responsible. Subsequent investigations have identified the presence of the contaminated groundwater plumes and the DEP suggests that the in-flowing groundwater quality is the primary cause of the blooms rather than the dredging. This is supported by the presence of blooms in the absence of dredging in other areas.	
Recreation – conflicts with recreational boating use	The Northern Harbour	Ensure that shipbuilding operations do not compromise boating and other existing or potential recreational activities within the Northern Harbour.	Jervoise Bay Boat Harbour is planned as a boat launching facility for trailerable craft which is used both by the general public and by members of the Cockburn Power Boat Association. The Department of Transport has advised that the proposed separation distance of 108m between the ship-lift and the recreational boat harbour breakwater is adequate provided that any ship moving to a berth on the northern side of the ship-lift has a beam of less than 18m. The Department of Transport advises that the first 30m of channel width between the recreational harbour breakwater and the proposed ship-lift is the minimum that should be nominally reserved for recreational boating activity, with the balance being retained for manoeuvring of ships using the ship-lift facility. On the occasions when ship movements are taking place (there would be 20-30 ships constructed per year), it is anticipated that the proposed Marine Safety Management Plan (Commitment 5) would detail the measures necessary to avoid conflicts between users.	Having regard for: a) advice from the Department of Transport regarding the potential impact on recreational boating activities; and b) proponent's commitment to prepare a Marine Safety Management Plan, it is the EPA's opinion that the proposal can be managed to meet the EPA's objective for this factor.
Recreation – restriction on beach access	The Northern Harbour	Ensure that recreational uses of the region, as developed by planning agencies, are not compromised.	Lots 165-168 are zoned Industrial under both the Metropolitan Region Scheme (MRS) and City of Cockburn Town Planning Scheme (TPS) and the proposed use is consistent with this zoning. The EPA considered the Industrial zoning of Lots 165 and 166 under City of Cockburn TPS Amendment 150 (gazetted 4 July 1997) and Lots 167 and 168 under Amendment 160 (gazetted 24 July 1998) and set the	Having regard for: a) the existence of an official dog beach within 6km of the site; b) the role of the planning authorities in determining regional recreational areas; and c) previous assessments of planning amendments to zone lots 165-168 for

RELEVANT FACTOR	RELEVANT AREA	EPA OBJECTIVES	EPA ASSESSMENT	EPA ADVICE
Recreation – restriction on beach access (cont'd)			level of environmental assessment as 'Not assessed'. The EPA also considered the Industrial zoning of Lots 167 and 168 in MRS Amendment (986/33) and set the level of environmental assessment at 'Not assessed'. When considering these proposals the EPA was aware that the beach had limited recreational use as a dog exercise area but did not believe the potential social impact for an Industrial zoning was so severe as to warrant 'formal assessment'	industrial purposes, it is the EPA's opinion that the proposal can be managed to meet the EPA's objective for this factor.
Management responsibility – adequacy of environmental management framework	The Northern Harbour	Ensure that a clear defined management structure is in place which delineates responsibilities for on-going management and monitoring of the environmental quality of the Northern Harbour.	The proponent will retain ultimate responsibility for the satisfactory implementation of all Ministerial Conditions and Commitments included in the Ministerial Statement for the proposal. Prior to the establishment of the shipbuilding, repair and maintenance industries, the Department of Transport will sub-lease the seabed adjacent to the Study Site to the proponent who will ensure that management commitments related to the seabed are included as conditions of the lease. In accordance with Sections 16 and 17 of the West Australian Land Authority Act 1992, LandCorp will place conditions on the seabed lease to ensure that the future shipbuilding, repair and maintenance industries comply with the management plans prepared by LandCorp. The proponent would be responsible for all environmental matters during Phase 1 of the proposal. The environmental management of Phase 2 would be addressed by the shipbuilding, repair and maintenance industries through compliance with Part V of the Environmental Protection Act (1986) and lease conditions. Schedule 1 (Category 49) of the Environmental Protection Regulations 1987 considers the future shipbuilding, repair and maintenance industries under Phase 2 of the project to be 'prescribed premises'. Consequently, these industries would be subject to the Works Approval, Licensing and/or Registration requirements of Part V of the *Environmental Protection Act (1986).* Schedule 2 of the Environmental Protection Regulations 1987 requires the future industries under Phase 2 of the project to be registered if they undertake abrasive blasting operations on the premises. The environmental control of these activities will be exercised according to the Environmental Protection (Abrasive Blasting) Regulations 1998. Prior to establishment of shipbuilding, repair and maintenance facilities (Phase 2), and the developer/s will be required to submit a development application to the City of Cockburn and WAPC.	Having regard for: a) the previous assessments by the EPA and commitments made by DCT to monitor and manage the water quality of the Northern Harbour; b) the commitments made by the proponent; c) the ability for the proponent to implement these commitments through other legal means; and d) requirements of Part V of the Environmental Protection Act (1986), it is the EPA's opinion that the proposal is capable of being managed to meet the EPA's objective for this factor.

3.2 Groundwater quality – nutrients as a source of harbour water quality impairment

Description

Groundwater investigations along the coast of Jervoise Bay have identified two major contaminated groundwater plumes discharging to the Northern Harbour. The sources of these plumes are a wastewater injection point at the Weston Bioproducts facility and the Water Corporation sludge drying beds at the Woodman Point Wastewater Treatment Plant (WWTP) (BSD, 1999a).

Although delineation of the contaminated groundwater plumes is not complete BSD (1999b) considers it likely that the Northern Harbour receives the full lateral extent of both plumes (see Figure 2). There is also additional 'background' nutrient contamination in the groundwater due to urban and horticultural development between the Jandakot mound and Jervoise Bay.

BSD (1999b) estimates that around 8,700kg of nitrogen discharges to the Northern Harbour each year as a result of contaminated groundwater inflow. The WWTP and Weston Bioproducts point sources each account for about 40% (3,500kg N/yr) of the nutrient load to the Northern Harbour with the remaining 20% (1,700kg N/yr) due to the 'background' levels from sources further to the east.

The contaminated groundwater associated with the Weston Bioproducts facility is relatively narrow and discharges into the southern section of the Northern Harbour (see Figure 2). The concentration of nitrogen in the plume reflects direct injection of waste water into the aquifer with concentrations ranging between 21 and 252mg/L (NH_4 –N) (BSD, 1999b). The DEP is working through licensing conditions to reduce this input as soon as possible.

The WWTP contaminated groundwater plume caused by leachate from sludge drying beds discharges into the northern part of the Northern Harbour across a relatively broad front. The broader and more diffuse nature of the WWTP plume is consistent with infiltration from the sludge drying beds and has nitrogen concentrations ranging between 0.5 and 26mg/L (NO_3-N) (BSD, 1999). The use of the sludge drying beds at the WWTP has recently been ceased.

The LandCorp proposal includes dredging for a ship-lift, construction of seawall and land reclamation activities (including further dredging) which may intercept the contaminated groundwater before it discharges into the harbour. This interception may result in changes to the spatial distribution of nutrients entering the harbour via groundwater that could affect the marine water quality and frequency of algal blooms in the harbour.

Assessment

The area considered for assessment of this factor is Jervoise Bay Northern Harbour and groundwater system up-gradient of the harbour.

The EPA's environmental objective for this factor is to ensure that the proposal does not result in reduction of the overall marine water quality of the Northern Harbour from either the nutrient load of groundwater, or its direction of flow.

The major sources of nutrients in the groundwater entering the Northern Harbour are associated with the groundwater plumes emanating from the Woodman Point WWTP and Weston Bioproducts facility. Dredging and land reclamation activities associated with the development of Lots 165-168 for future industrial use may slightly modify the flow path of groundwater in some areas however these activities are not likely to result in a change to the total load or concentration of nutrients in the groundwater.

Phase 1 of the LandCorp proposal constitutes construction activities associated with dredging and land reclamation activities. These activities include earth works, construction of a seawall and deposition of fill behind the seawall to reclaim part of the seabed. None of these activities will impact groundwater quality entering the harbour.

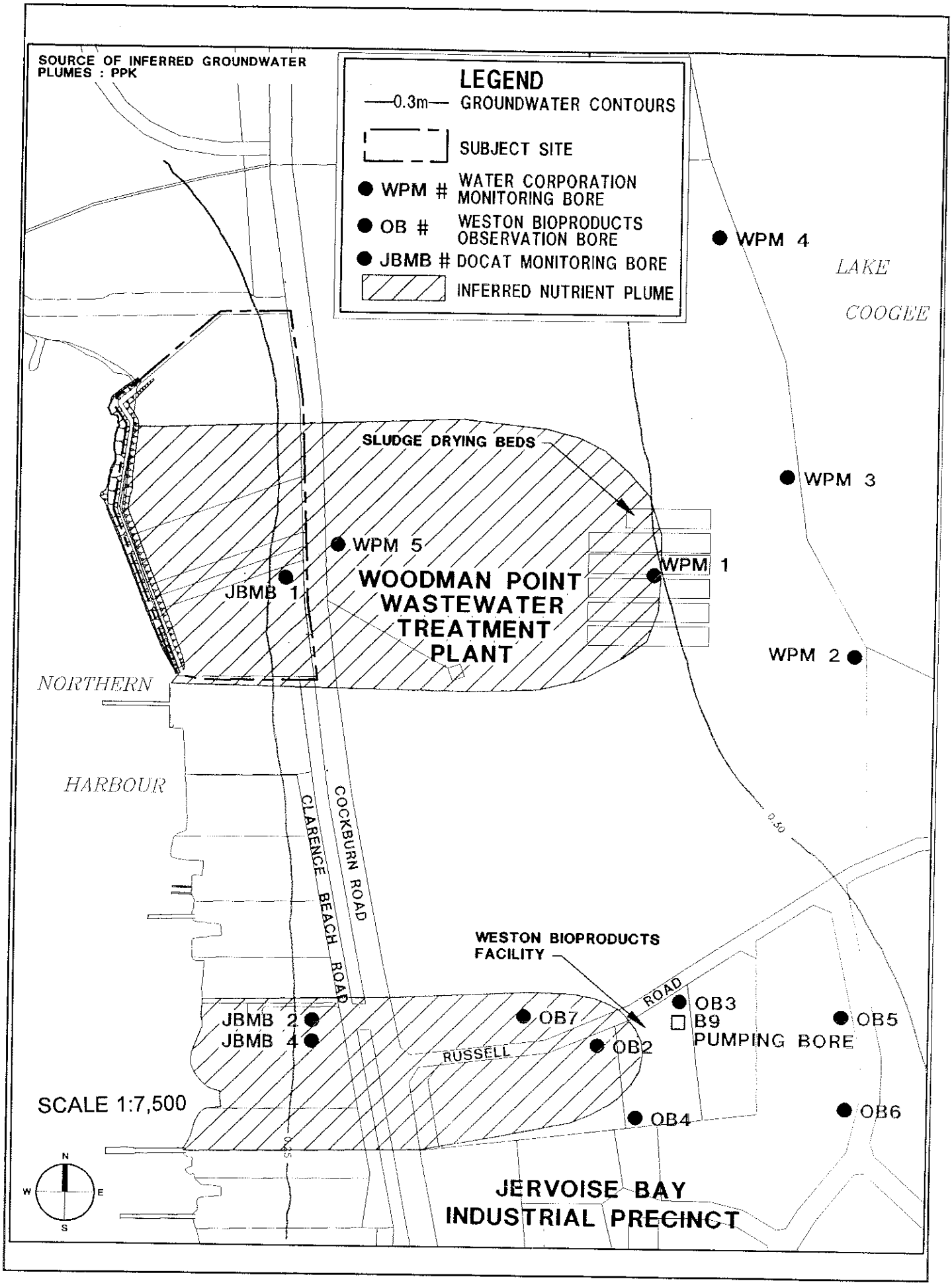

Figure 2. Estimated location and extent of contaminated groundwater plumes adjacent to Northern Harbour (BSD, 1999b).

While the specific location and extent of the plumes has not been extensively mapped it is likely that the majority of the plumes discharge to the Northern Harbour. The Phase 1 activities of the proposal may modify the groundwater flow paths slightly however the DEP has advised that the total load of nutrients entering the Northern Harbour is the most significant factor governing marine water quality. Small changes to the location of the groundwater inflow to the harbour are not likely to result in detectable changes in the overall marine water quality of the Northern Harbour.

Phase 2 of the proposal constitutes the construction of hardstand areas, sheds, jetties, ship-lift, and the installation of heavy equipment associated with the construction, repair and maintenance of steel and aluminium-hulled vessels. These activities are consistent with the permissible uses under City of Cockburn TPS and the MRS and in themselves are not expected to significantly effect existing or future groundwater quality.

Future development of industrial facilities on the newly created lots would be considered prescribed premises under Schedule 1 of the Environmental Protection Regulations (1987). As a result the environmental aspects if these activities would be subject to Part V of the *Environmental Protection Act (1986)* via works approvals, licences, registration and regulations as appropriate.

Summary

Having particular regard to:

a) the presence of contaminated groundwater plumes from the Woodman Point wastewater treatment plant and Weston Bioproducts facility;

b) construction activities which will not influence the groundwater quality;

c) DEP's advice that any changes to the specific location of the groundwater plume entry to the Northern Harbour is not likely to affect the marine water quality in the harbour; and

d) future industrial development requiring Works Approvals, Licensing or Registration under Part V of the *Environmental Protection Act (1986)*, such that environmental aspects of the development can be given attention through the Part V process,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

However, the EPA considers it extremely important that the contaminated groundwater currently flowing into the harbour is recovered and treated/disposed of, in a manner that does not cause on-going problems for the Northern Harbour. The EPA has provided further advice on this matter in Section 3.6 relating to management responsibility for the harbour.

3.3 Marine water quality – effects of dredging, seawall and changes in bathymetry and flushing characteristics

Description

The water quality of the Northern Harbour has deteriorated following the construction of the northern breakwater in November 1997 with summer chlorophyll a levels often exceeding 10mg/L compared to less than 2mg/L for the majority of Cockburn Sound (Hale *et al*, 1998). The higher level of productivity within the harbour is primarily due to the high loading of bioavailable nitrogen (as ammonium, nitrate and nitrite) entering the harbour via the groundwater (see Section 3.2). Recent investigations indicate that the large nitrogen load has resulted in such a high nitrogen-rich environment that the growth of phytoplankton is currently limited by the availability of phosphorus (DAL, 1999), rather than nitrogen which is the case for the rest of Cockburn Sound and most marine waters. It is expected that a two to five fold decrease in nitrogen loading is likely to be required before productivity within the harbour is again limited by nitrogen availability (DAL, 1999).

Stratification of the water column in the Northern Harbour due to poor mixing resulting in the bottom waters becoming anoxic, is also a possibility. Anoxic conditions at the bottom of the harbour may lead to the release of ammonium from the sediments to the water column (Thornstenson and Mackenzie, 1974). Ammonium is a bioavailable form of nitrogen which would become available for primary production when it moves into the light (photic zone) closer to the surface. If the water adjacent to the sediments is not anoxic the ammonium is oxidised to nitrite and nitrate which are released in a gaseous form. Nitrite and nitrate are bioavailable and bubble to the surface to be released to the atmosphere.

Algal blooms in early summer are most likely to consist of diatom species and be non-toxic, while blooms in mid to late summer are more likely to consist of dinoflagellate species with a greater risk that the bloom is of a toxic species. Consequently the months of January to March may be considered 'high-risk' months with an increased probability of dinoflagellate blooms however it should be noted that there have not been any blooms of toxic algae strains in the Northern Harbour since 1997. No data on algal species in the harbour is available prior to 1997.

Construction of the seawall and dredging associated with the proposal may alter the bathymetry and flushing mechanisms of the Northern Harbour leading to a decline in marine water quality. The excavation of a 14m deep hole for the ship-lift will almost certainly lead to increased stratification and anoxic conditions resulting in additional release of nutrients to the marine water column.

Assessment

The area considered for assessment of this factor is the Northern Harbour.

The EPA's environmental objective for this factor is to maintain or improve marine water quality consistent with Environmental Quality Objectives (EQO's) and Environmental Quality Criteria (EQC's) defined in the Southern Metropolitan Coastal Waters Study (DEP, 1996) within the Northern Harbour.

Possible impacts on marine water quality within the Northern Harbour as a result of Phase 1 of the proposal include:

- suspension of nutrients, sediments and silica trapped in bottom sediments into the marine water column (during dredging operations);
- changes to the flushing characteristics of the harbour due to changes to the bathymetry and shoreline; and
- stratification and release of nutrients from the bottom of the hole dredged for the ship-lift.

Phase 2 of the proposal could affect water quality through disturbance of sediments because of ship movements or discharge of contaminants to the marine environment from future shipbuilding and maintenance industries established on the lots.

Phase 1

Disturbance of bottom sediments

Dredging and ship movements within the Northern Harbour could result in the disturbance of bottom sediments leading to increased turbidity and the suspension of materials trapped in bottom sediment to the marine water column. Materials trapped in the bottom sediments may include nutrients (particularly nitrogen), silica and algal spores.

LandCorp proposes to manage dredging operations associated with the construction of the ship-lift, seawall and land reclamation works according to a Dredging and Dredge Spoil Management Plan (DDSMP) (Commitment 1.1). The DDSMP would address a range of issues including:

- dredging method;
- assessment of potential impacts;
- contamination assessment;
- disposal of sediments and slurry;
- monitoring plans and water quality criteria;
- management measures; and
- contingency measures.

DEP has advised that, considering dredging operations are relatively common and well understood, the proposed management plan can be developed to adequately manage turbidity and disturbance of sediments associated with the dredging operation at the dredge.

The DEP has advised that the DDSMP will need to establish water quality criteria and a monitoring and management program which can demonstrate that dredging will not affect the water quality in the harbour to any extent that could be directly attributable to causing an algal bloom. This would involve water quality monitoring immediately outside the silt curtain surrounding the dredged areas, and at an appropriate control point selected to measure background water quality in the Harbour. Contingency measures would include cessation of dredging if water quality criteria are exceeded.

The summer period has an increased risk of algal blooms due to the longer day length and warmer temperatures. Although previous investigations (HGM, 1998) have suggested that the summer dredging in December 1997 may have contributed to the first major algal bloom in the Harbour, the DEP considers that this association may be a coincidence. When the bloom occurred over summer during the construction of the Northern Breakwater, the presence of contaminated nutrient-rich groundwater plumes and the effect of enclosing these plumes by the breakwater was not recognised. The DEP believes that the dredging and associated suspension of silica and algal spores was held responsible for the diatom bloom as it was the only obvious related operation in the vicinity at the time.

Subsequent investigations have quantified the presence of highly contaminated groundwater plumes, and the DEP suggests that the in-flowing nutrient-rich groundwater associated with reduced flushing of the harbour is the primary cause of the blooms, rather than dredging activities. This is supported by the almost annual occurrence of blooms over summer in the absence of dredging. Therefore, subject to an acceptable DDSMP, the EPA considers that dredging can be undertaken in summer without unacceptable increases in the likelihood of an algal bloom. Even without dredging, an algal bloom is likely to occur in summer until groundwater remediation is undertaken.

LandCorp has given a commitment (Commitment 2.1) to ensure that direct discharge of dredge slurry water into the Northern Harbour and adverse effects on marine water quality does not occur by disposing of the dredge spoil directly behind the seawall for use as fill material. LandCorp will ensure that a clause is included in the dredging contract that dredging will occur at such a rate that there will be no overflow of dredge slurry over the seawall, allowing the water component to percolate back to the harbour through the seawall or via groundwater.

Sediment sampling undertaken by LandCorp during the preparation of the CER confirm that the levels of contaminants in the sediment to be dredged during Phase One of the proposed project are below the Environmental Quality Criteria for Industrial Buffer Zones (BSD, 1999a). The proponent has included further sampling of sediment within the area to be dredged as part of the Dredge and Dredge Spoil Management Plan (Commitment 1.1) to ensure contaminants contained in the sediment disposed of behind the seawall meet the draft Guidelines for Investigation Levels for Soil and Water (NEPM, 1999) for industrial landuse.

Harbour Flushing

Consideration of the potential changes to the flushing of the Northern Harbour as a result of the LandCorp proposal indicate a minor but negative change to the flushing characteristics of the harbour are likely to occur.

At present, the time to exchange the total estimated volume of water within the Northern Harbour is 18.5 days. After development, the total estimated flushing time is predicted to increase to 19.3 days, which is about a 5% change (BSD, 1999b).

Ship-lift

Issues associated with a ship-lift are only relevant if deep dredging of a -14m AHD hole for the ship-lift is required. LandCorp has provided a commitment that dredging of the ship-lift hole would only be undertaken when there is a commercial arrangement in place for the construction of a ship-lift. Unless such an arrangement is in place the hole will not be constructed (Commitment 3.2).

Should the proposal for a ship-lift proceed, an appropriate hole would be dredged into the seabed. This hole would be approximately 50m x 80m (4,000m^2) in area and 6m deeper than the rest of the harbour with no direct connection to the marine waters outside the harbour. The hole is likely to act as a sink accumulating sediment and other debris from the harbour that cannot easily flush to open water. Over time, stratification of the water column would occur in the ship-lift hole which is likely to lead to anoxic conditions near the bottom. Anoxic conditions adjacent to sediments containing nutrients (particularly nitrogen) is likely to lead to the release of nitrogen in a bioavailable form (ammonia) rather than a non-bioavailable form (nitrite-nitrate). The quantity of bioavailable nitrogen released from the hole dredged for the ship-lift has been estimated to be approximately 220kg/a (BSD, 1999a; DAL, 1999).

To manage the potential release of bioavailable nitrogen to the marine water column from the ship-lift LandCorp has committed to preparing a 'Ship-lift Monitoring and Management Plan (SMMP)' (Commitment 3.1). The SMMP would include:

- an assessment of possible impacts;
- monitoring plans and water quality criteria;
- management measures; and
- a description of how management measures might be applied to, and be implemented by, a ship lift operator.

Management measures in the SMMP would include regularly removing sediment and debris build-up from the ship-lift hole (source reduction) and undertaking measures to manage anoxia of the bottom waters (BSD, 1999b).

Anoxia and the need to re-oxygenate the bottom waters would be assessed based on a monitoring program and criteria defined in the SMMP to the satisfaction of the DEP. If the monitoring program shows water quality in the ship-lift meets agreed criteria it would not be necessary to implement re-oxygenation measures. The need to implement the re-oxygenation measures is likely to be greatly reduced, if not removed altogether, if the groundwater remediation activities proposed by the Department of Commerce and Trade are successfully implemented. This aspect is further addressed in Section 3.6 on management responsibility for the harbour.

LandCorp has committed to ensuring the design of the ship-lift includes consideration of the potential need to implement the re-oxygenation measures (Commitment 3.3) to allow rapid response if monitoring shows water quality exceeds agreed criteria in the SMMP. The re-oxygenation of the bottom water in the ship-lift hole would be achieved by extracting, re-oxygenating and then re-injecting water to the bottom of the ship-lift (BSD, 1999b).

Phase 2

Bottom sediments already experience some disturbance due to the existing level of boat movements within the harbour and it is not anticipated that the additional ship movements due to future ship building and maintenance operations would have a significant effect.

Currently craft up to 100m in length regularly turn in the harbour. The proponent believes shipping movements will be relatively low, since the industries will construct at most 20 to 30 vessels a year (BSD, 1999a). It could take in the order of 30 weeks to build one of the larger vessels, during which period that vessel would be stationary on site. There would then typically follow a four to six week period of commissioning and sea trials with daily shipping movements. The DEP considers that reduced flushing due to the construction of Northern Harbour breakwater in 1997 and the nitrogen-rich groundwater plumes are the most significant factors affecting water quality. In this environment any localised turbidity due to infrequent ship movements is considered unlikely to pose a significant threat to the marine water quality within the Northern Harbour.

Potential contamination of the marine water by the shipbuilding activities would also be managed under Part V of the *Environmental Protection Act (1986)*. Schedule 1 (Category 49) of the *Environmental Protection Regulations 1987* considers the future shipbuilding, repair and maintenance industries under Phase 2 of the project to be 'prescribed premises'. Consequently, these industries would be subject to the Works Approval, Licensing and/or Registration requirements of Part V of the *Environmental Protection Act (1986)*.

Schedule 2 of the *Environmental Protection Regulations 1987* requires the future industries under Phase 2 of the project to be registered if they undertake abrasive blasting operations on the premises. The environmental control of these activities will be exercised according to the *Environmental Protection (Abrasive Blasting) Regulations 1998*.

Summary

Having particular regard to the:

(a) the commitments to monitor and manage dredging operations to prevent a decline in marine water quality;

(b) the minor increase in flushing time of the harbour;

(c) the commitment to monitor and manage nutrient issues associated with the ship-lift; and

(d) the proposed Department of Commerce and Trade groundwater remediation program for the northern harbour,

it is the EPA's opinion that the proposal will not unduly compromise the EPA's environmental objective for this factor, however it is essential to reduce the nutrients in groundwater entering the Northern Harbour.

3.4 Recreation – conflicts with recreational boating use

Description

The Northern Harbour is currently subject to nautical traffic from both the public and industry. The public traffic comprises small craft launched from the powerboat marina located in the north-west of the harbour, whereas the industrial traffic comprises much larger aluminium and steel-hulled craft (up to 100 metres in length) which have been constructed or repaired and serviced by the industries located within the harbour (BSD, 1999a).

There appears to be a potential traffic and navigational safety problem within the Northern Harbour where, at times, powerboat operators feel threatened by the close passage of the large ferries and other craft. In addition the powerboat marina is regularly subject to congestion

during summer afternoons when the sea-breeze has set in and large numbers of powerboats attempt to use a small number of marina boat ramps (BSD, 1999a).

The implementation of the proposal would result in additional movements of large vessels within the Northern Harbour. During these times there would be a reduction in the width of the channel solely available for public use entering or exiting the public marina.

The proponent has advised that the industry can be assumed to construct in the order of 20-30 vessels per year. It would take up to 30 weeks on site to build a larger vessel, followed by 3-4 weeks of commissioning and approximately nine days of sea trials. These would comprise three days of "active trials" which could involve up to 3 trips (6 movements) per day and six days of normal sea trials which would likely involve 1 trip (2 movements per day). The commissioning of each vessel could therefore typically involve up to 15 trips (30 movements) over a three week period

Over the year, maximum movements of 3 trips (6 movements) per day could occur for 90 days, with a further 180 days with 1 trip per day. However, and given that two sites will be constructing vessels, two vessels may be commissioned and trialed at one time, resulting in up to 6 "active" trips (12 movements) per day which could occur for 45 days of the year, with 90 days when 2 trips (4 movements) per day would occur. The proponent has advised that it is more likely that with one of the vessels on active trial on any one day, the combined movements of both vessels would be 4 trips (8 movements) per day occurring on up to 90 days of the year. 90 trips would occur over the remaining 270 days of the year, with expected vessel movements of either none or 1 trip per day.

Assessment

The area considered for assessment of this factor is the Northern Harbour.

The EPA's environmental objective for this factor is to ensure that shipbuilding operations do not compromise boating and other existing or potential recreational activities within the Northern Harbour.

Implementation of the LandCorp proposal would result in a seawall and reclaimed land within about 110m of the existing Cockburn Power Boat Marina. Once the lots have been on-sold and developed for ship building and maintenance operations, there will be periodic movements of large vessels to and from the facilities with possible short term restrictions on recreational boating activities from time to time.

The Department of Transport has advised that the proposed separation distance of 108m between the ship-lift and the recreational boat harbour breakwater (Figure 3) is adequate provided that any ship moving to a berth on the northern side of the ship-lift has a beam of less than 18m. LandCorp has advised that it will ensure the development of the ship-lift and associated infrastructure complies with this advice within the proposed Marine Safety Management Plan (MSMP) (Commitment 6.1). It is also likely that ship movements relating to industries will be more frequent during the week, while recreation boating movements tend to be more frequent on the weekend.

Further advice from the Department of Transport indicates a 30m wide channel between the recreational harbour breakwater and the proposed ship-lift is the minimum that should be normally reserved for recreational boating activity. This channel should be closest to the recreational harbour breakwater with the balance of the distance to the ship-lift retained for manoeuvring of ships using the ship-lift facility. On the occasions when ship movements are taking place (there would only be 20-30 ships constructed per year at the most), the proposed MSMP (Commitment 6.1) would detail the measures necessary to avoid conflicts between users including:

- the interaction of recreational and commercial boat movements;
- minimum clearance requirements;
- management measures;

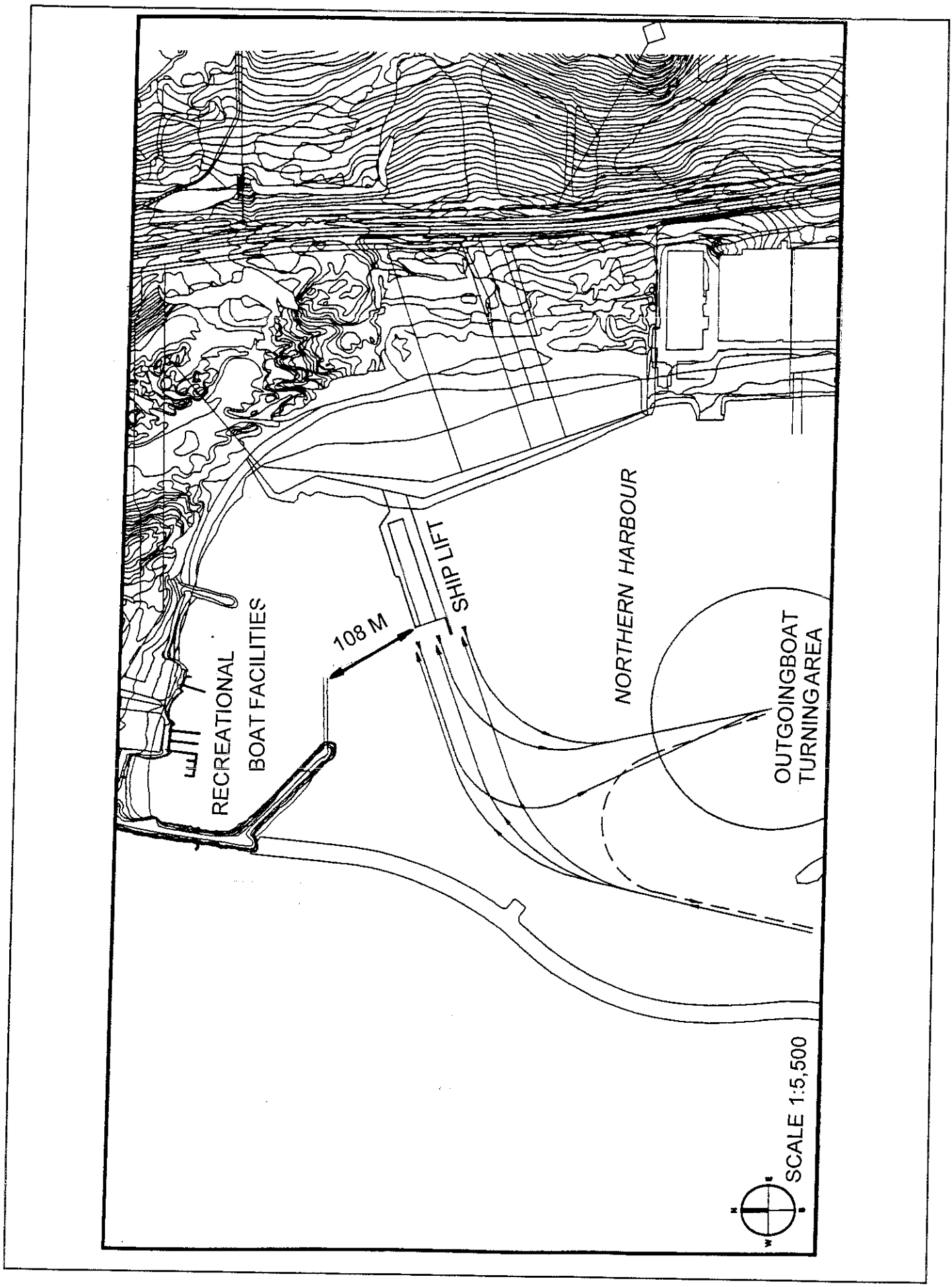

Figure 3. Proposed separation distance between the ship-lift and the recreational boat harbour breakwater.

- cooperative education programs and materials;
- emergency procedures/response strategies; and
- future management.

The EPA considers that the Marine Safety Management Plan has a major role in informing and consulting with recreational boat owners to ensure they are aware of issues and requirements associated the use of the Northern Harbour as a recreational and commercial boating facility.

Summary

Having particular regard to the:

(a) advice from the Department of Transport regarding the potential impact on recreational boating activities; and

(b) proponent's commitment to prepare a Marine Safety Management Plan (MSMP),

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

3.5 Recreation – restriction on beach access

Description

Public access to the beach at the proposed development site is currently achieved via the car park facilities located in the Woodman Point Reserve. The beach is signposted and used by members of the public for a range of activities including exercising dogs, swimming and fishing.

While the City of Cockburn does not regard the beach as an official dog beach, it appears unofficial sanction was given for the use of the beach south of the Woodman Point public boat ramps, to the northern end of the shipbuilding yards, as a dog beach. This probably occurred sometime following the return of the land to the State government, by the Commonwealth government, in the early 1980's (BSD, 1999a). An official dog beach is located 5 to 6 kilometres north of this site.

Implementation of the proposal would result in a section of the beach being taken up within the land reclamation component. Public access to both the section of beach taken up and future industrial development would be prohibited.

Assessment

The area considered for assessment of this factor is the foreshore in the general vicinity of the Northern Harbour.

The EPA's environmental objective for this factor is to ensure that recreational uses of the region, as developed by planning agencies, are not compromised.

Lots 165-168 have an 'Industrial' zoning under both the MRS and City of Cockburn TPS. The Industrial zoning of Lots 165 and 166 under City of Cockburn TPS Amendment 150 (gazetted 4 July 1997) and Lots 167 and 168 under Amendment 160 (gazetted 24 July 1998) have been previously considered by the EPA. Strategic planning of recreational zones is considered to be a matter for local authorities and the Western Australian Planning Commission, and after examination of the environmental issues associated with these amendments the EPA set the level of environmental assessment at 'Not assessed'.

The EPA has also considered the Industrial zoning of Lots 167 and 168 in MRS Amendment (986/33). Again, the EPA set the level of environmental assessment at 'Not assessed'.

When determining the level of assessment for the amendments to planning schemes discussed above, the EPA was aware that the beach had limited recreational use and is used as a dog exercise area. On consideration of the potential environmental impacts and the role of the planning authorities the EPA did not believe the potential social impact for an Industrial Zoning was so severe as to warrant 'formal assessment'.

The proposed use of lots 165-168 for ship building and maintenance activities is consistent with the Industrial zoning under the City of Cockburn and Metropolitan Region planning schemes.

Summary

Having particular regard to the:

(a) existence of an official dog beach within 6km of the site;

(b) role of the planning authorities in determining regional recreational areas; and

(c) previous assessments of planning amendments to zone lots 165-168 for industrial purposes,

it is the EPA's opinion that the proposal meets the EPA's environmental objective for this factor.

3.6 Management responsibility – adequacy of environmental management framework

Description

A number of state government departments and local government have management responsibilities which bear on the Northern Harbour. These include:

- Department of Commerce and Trade (DCT);
- Department of Transport (DOT);
- LandCorp;
- City of Cockburn;
- Fremantle Port Authority (FPA);
- Department of Environmental Protection (DEP);
- Waters and Rivers Commission (WRC);
- Health Department;
- Department of Land Administration (DOLA); and
- Department of Conservation and Land Management (CALM).

DCT has a major role in the management of the Northern Harbour due to legally binding conditions and commitments made during the EPA assessment of the Northern Harbour Extension. These include commitments to '...identify a proposed course of action in the event that water quality in the harbour becomes unacceptable...' and to '...coordinate the implementation of the contingency plan...' (EPA Bulletin 836, 1996; Ministerial Statement 443 of 24 April 1997). These commitments result in DCT having a role in water quality management within Northern Harbour. Other development proposals that may have an effect on water quality would need to be developed in consultation with DCT to ensure consistency.

Overall management responsibility for the Northern Harbour is currently being considered by the various government departments. The proposals under consideration would result in a three tiered approach to management consisting of a:

- Cockburn Sound management body;
- Jervoise Bay Northern Harbour Contingency Management Committee; and

- Northern Harbour Land, Water and Facilities Management Body.

A *Cockburn Sound management body* would be an overarching body formed to address environmental planning and management matters related to the Sound.

The *Jervoise Bay Northern Harbour Contingency Management Committee* is in the process of being established as a result of the commitments made by the DCT during the assessment of the construction of the Northern Breakwater (EPA Bulletin 836, 1996). Membership of the committee would comprise LandCorp, DCT, Department of Transport, Fremantle Port Authority and the Cockburn Powerboat Association.

The DCT's Stage 1 Contingency Plan was completed prior to commencement of construction of the Northern Breakwater. DCT's Stage 2 Contingency Plan is currently being finalised, and describes the management structure, tasks and responsibilities associated with the Northern Harbour. The Stage 2 Contingency Plan will also include proposed strategies to manage discharges from the emergency sewage outfall, spills of contaminants, stormwater inflows and algal blooms.

The *Northern Harbour Land, Water and Facilities Management Body* would be the third tier of management for the Harbour. The make-up of this body has yet to be established which will be assisted by a LandCorp study to advise government on the most appropriate agency or body to manage the Northern Harbour.

Assessment

The area considered for assessment of this factor is the Northern Harbour.

The EPA's environmental objective for this factor is to ensure that a clear defined management structure is in place which delineates responsibilities for on-going management and monitoring of the environmental quality of the Northern Harbour.

Overall Harbour Management

The EPA assessment of the Southern Harbour (EPA, 1998b) and subsequent Ministerial Conditions and proponent commitments require the DCT to prepare and implement a Groundwater Recovery Plan to remediate the contaminated groundwater plumes associated with the Woodman Point Wastewater Treatment Plant Sludge Drying Beds and the Weston Bioproducts facility. The DEP has advised that the nutrient contribution to the Northern Harbour due to these plumes is the most significant factor affecting the water quality of the Northern Harbour. The DEP has further suggested that the Groundwater Recovery Plan should be an integral part of the DCT Contingency Plan (Stage 2) for the Northern Harbour. The Contingency Plan (Stage 2) must be prepared by the DCT as a result of commitments provided during the assessment of the Northern Breakwater (EPA, 1996) within which DCT accepted certain responsibilities for the water quality of the Northern Harbour. The Stage 1 and Stage 2 Contingency Plans will provide the umbrella control for water quality management in the Harbour.

LandCorp has developed management strategies which address potential water quality issues associated with dredging operations (Commitments 1.1 & 1.2) and construction of the ship-lift (Commitments 3.1-3.4). The DEP will require that the management plans developed and implemented by LandCorp are consistent with the DCT Contingency Plans for the Northern Harbour.

Proposal Management

While some aspects of the various commitments made by the proponent may require implementation through contractors and future industry (through contract conditions and lease agreements), LandCorp, as the proponent, retains ultimate responsibility for the commitments and conditions under the *Environmental Protection Act (1986)*. Commitments relating to Phase 1 of the proposal are clearly LandCorp's responsibility, however as the proposal moves into Phase 2, there is opportunity for some confusion to arise regarding responsibility for

environmental management. In order to implement the dredging and land reclamation components of the proposal the Department of Transport has agreed to sub-lease the seabed adjacent to the development site to LandCorp who will ensure that the environmental management commitments related to the seabed are included as conditions of the lease. In accordance with Sections 16 and 17 of the *West Australian Land Authority Act (1992)*, LandCorp will place conditions on the seabed lease to ensure that the future shipbuilding, repair and maintenance industries comply with the management plans prepared by LandCorp.

It should be clearly understood that although LandCorp has made a number of commitments that relate to Phase 2 of the proposal that may, at least in part, be implemented through third parties through various legal means, ultimate responsibility for these commitments remains with LandCorp. This responsibility can only be transferred to other parties in accordance with the *Environmental Protection Act (1986).*

Other aspects of environmental management would be addressed by the shipbuilding, repair and maintenance industries through compliance with Part V of the *Environmental Protection Act (1986).* Schedule 1 (Category 49) of the *Environmental Protection Regulations 1987* considers the future shipbuilding, repair and maintenance industries under Phase 2 of the project to be 'prescribed premises'. Consequently, these industries would be subject to the Works Approval, Licensing and/or Registration requirements of Part V of the *Environmental Protection Act (1986).*

Schedule 2 of the *Environmental Protection Regulations 1987* requires the future industries under Phase 2 of the project to be registered if they undertake abrasive blasting operations on the premises. The environmental control of these activities will be exercised according to the *Environmental Protection (Abrasive Blasting) Regulations 1998.*

The City of Cockburn and Western Australian Planning Commission would also require a development application to be submitted prior to establishment for each of the shipbuilding, repair and maintenance facilities that subsequently intend to locate at the site (Phase 2). When considering the development applications the planning authorities would take this EPA assessment into account and may choose to seek advice from any of a number of state government agencies (including the DEP) prior to approval.

Summary

Having particular regard to:

(a) the previous assessments by the EPA and commitments made by DCT to monitor and manage the water quality of the Northern Harbour;

(b) the commitments made by the proponent;

(c) the ability for the proponent to implement these commitments through other legal means; and

(d) requirements of Part V of the Environmental Protection Act (1986),

it is the EPA's opinion that the proposal is capable of being managed to meet the EPA's environmental objective for this factor.

4. Conditions and Commitments

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

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

assessment of the proposal and, following discussion with the proponent, the EPA may seek additional commitments.

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

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

4.1 Proponent's commitments

The proponent's commitments as set in the CER and subsequently modified, as shown in Schedule 2 and included in Appendix 3, should be made enforceable. These include the following management plans:

- Dredging and Dredge Spoil Management Plan (DDSMP) to address issues associated with dredging operations and disposal of dredge slurry;
- Ship-lift Monitoring and Management Plan (SMMP) to address potential changes in water quality at the proposed ship-lift; and
- Marine Safety Management Plan (MSMP) to inform and consult with recreational boat owners to ensure they are aware of issues and requirements associated the use of the Northern Harbour as a recreational and commercial boating facility.

4.2 Recommended conditions

Having considered the proponent's commitments and the information provided in this report, the EPA has developed a set of conditions which the EPA recommends be imposed if the proposal by LandCorp to dredge, reclaim land and create up to three level lots at Lots 165-168, Henderson Road Cockburn (Phase 1) for use by shipbuilding industry within the Northern Harbour of Jervoise Bay (Phase 2) is approved for implementation.

These conditions are presented in Appendix 3. Matters addressed in the conditions include the following:

(a) that the proponent be required to fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 3.

It should be noted that other regulatory mechanisms relevant to the proposal are:

- Part V of the Environmental Protection Act (1986); and the
- City of Cockburn Town Planning Scheme No.2.

5. Other Advice

5.1 Water Corporation Treated Wastewater Emergency Outfall

The EPA notes the presence of the Water Corporation treated wastewater emergency outfall within the proposal area. As a result of discussions between the proponent and the Water Corporation, the emergency outfall will be modified by lowering the land section and terminating the outlet at the proposed seawall.

The Water Corporation has advised that it can meet the requirements of Ministerial Conditions (Statement Number 52, 21 December 1988) and DEP Licence Conditions (Licence No. 4201). The EPA considers however, that the discussion provided during the assessment of the Northern Harbour Breakwater (EPA Bulletin 836, 1996) regarding the management of the outfall is still applicable.

6. Conclusions

The EPA has considered the proposal by LandCorp to dredge, reclaim land and create up to three level lots at Lots 165-168, Henderson Road Cockburn (Phase 1) for use by shipbuilding industry within the Northern Harbour of Jervoise Bay (Phase 2).

The EPA notes that:

- the proposal is consistent with the City of Cockburn Town Planning Scheme No.2 and Metropolitan Region Scheme;
- the marine water quality in the Northern Harbour is degraded due to high nutrient levels and poor flushing, and experiences algal blooms from time to time;
- the major source of nutrients entering the Northern Harbour is associated with the nutrient-rich groundwater plumes emanating from the Woodman Point WWTP and Weston Bioproducts facility;
- dredging and land reclamation activities associated with the development of Lots 165-168 for future industrial use may slightly modify the flow path of groundwater in some areas however these activities are not likely to result in a change to the total load or concentration of nutrients in the groundwater;
- although some short-term localised effects may be apparent from time to time, the implementation of Phase 1 of the proposal is not likely to lead to a decline in the overall water quality of the Northern Harbour;
- implementation of Phase 2 of the proposal can be adequately managed under Part V of the Environmental Protection Act (1986) and City of Cockburn Town Planning Scheme No.2; and
- a management commitment has been made to undertake an information and consultation program to ensure recreational boat owners in the Northern Harbour are aware of issues and requirements associated the use of the Northern Harbour as a recreational and commercial boating facility.

The EPA has concluded that the proposal is capable of being managed in an environmentally acceptable manner such that it is most unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 3 and summarised in Section 4, including the proponent's commitments.

7. Recommendations

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.

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

1. That the Minister notes that the project being assessed is to dredge, reclaim land and create up to three level lots at Lots 165-168, Henderson Road Cockburn (Phase 1) for use by shipbuilding industry within the Northern Harbour of Jervoise Bay (Phase 2), which may include a ship-lift facility;
2. That the Minister considers the report on the relevant environmental factors as set out in Section 3;
3. That the Minister notes that the EPA has concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 3 and summarised in Section 4, including the proponent's commitments;
4. That the Minister imposes the conditions and procedures recommended in Appendix 3 of this report.
5. That the Minister note the Other Advice provided in Section 5 of this report in relation to the location of the Water Corporation treated wastewater emergency outfall within the Northern Harbour.

Appendix 1

List of submitters

Organisations:

Aboriginal Affairs Department
CALM
City of Cockburn
Cockburn Power Boats Assn (Inc)
Com-Net
Conservation Council of WA
DEP - Kwinana Branch
Department of Transport
Health Department of Western Australia
Heritage Council of Western Australia
Ministry for Planning
Spearwood District Residents Association (Inc)
Water and Rivers Commission
Water Corporation
Wattleup Citizens' Association

Individual:

Mr Brian Fleay
Ms Mary Jenkins
Ms Val Williams

Appendix 2

References

ANZECC Australian Water Quality Guidelines (1992)

BSD (1999a), Consultative *Environmental Review - Development of Lots 165 - 168 Cockburn Rd, Henderson, Seawall Construction, Land Reclamation and Dredging Adjacent to Lots 165 and 167, Including Lots 166 and 168 and Management of Shipbuilding, Repair and Maintenance Facilities at Cockburn Sound, Cockburn Rd, Henderson*, prepared for the Western Australian Land Authority trading as LandCorp, May 1999.

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Appendix 3

Recommended Environmental Conditions and Proponent's Consolidated Commitments

Recommended Environmental Conditions

Statement No. XX

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

DEVELOPMENT OF LOTS FOR THE ESTABLISHMENT OF SHIP BUILDING AND MAINTENANCE FACILITIES WITHIN THE NORTHERN HARBOUR, JERVOISE BAY.

Proposal: Seawall Construction, Land Reclamation and Dredging adjacent to Lots 165 & 167, including Lots 166 & 168, and Management of Shipbuilding, Repair and Maintenance activities at Cockburn Sound, Cockburn Road, Henderson.

Proponent: LandCorp

Proponent Address: 8 Davidson Terrace
JOONDALUP WA 6027

Assessment Number: 1265

Report of the Environmental Protection Authority: Bulletin 947

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

1 Implementation

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

1-2 Where the proponent seeks to change any aspect of the proposal as documented in Schedule 1 of this statement in any way that the Minister for the Environment determines, on advice of the Environmental Protection Authority, is substantial, the proponent shall refer the matter to the Environmental Protection Authority.

1-3 Where the proponent seeks to change any aspect of the proposal as documented in Schedule 1 of this statement in any way that the Minister for the Environment determines, on advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

2 Proponent Commitments

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

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

3 Proponent

3-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the Environmental Protection Act 1986 is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person in respect of the proposal.

3-2 Any request for the exercise of that power of the Minister referred to in condition 3-1 shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the proposal in accordance with the conditions and procedures set out in the statement.

3-3 The proponent shall notify the Department of Environmental Protection of any change of proponent contact name and address within 30 days of such change.

4 Commencement

4-1 The proponent shall provide evidence to the Minister for the Environment within five years of the date of this statement that the proposal has been substantially commenced.

4-2 Where the proposal has not been substantially commenced within five years of the date of this statement, the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment will determine any question as to whether the proposal has been substantially commenced.

4-3 The proponent shall make application to the Minister for the Environment for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this statement at least six months prior to the expiration of the five year period referred to in Conditions 4-1 and 4-2.

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

5 Compliance Auditing

5-1 The proponent shall submit periodic Performance and Compliance Reports, in accordance with an audit program prepared in consultation between the proponent and the Department of Environmental Protection.

5-2 Unless otherwise specified, the Chief Executive Officer of the Department of Environmental Protection is responsible for assessing compliance with the conditions, procedures and commitments contained in this statement and for issuing formal clearances.

5-3 Where compliance with any condition, procedure or commitment is in dispute, the matter will be determined by the Minister for the Environment.

Schedule 1 - Summary of key proposal characteristics

Element	Description
Phase 1 - Construction of Lots	
Seawall	Approximately 500 metres in length. Width of wall at top- approximately 4.5 metres. Width of wall at base- approximately 20 metres. Limestone construction of seawall: core: 78,500 tonnes; armour rock: 11,000 tonnes; filter rock: 8,000 tonnes.
Dredging	Approximately 2.6 ha; Generally from -4m to -9m CD final depth. Ship-lift surface area approximately 50m x 80m, down to -14m CD. Approximately 80,000 m3 of spoil.
Reclamation	Approximately 2.9 hectares
Area available for development	Lot 165 6.62 ha Lot 167 2.73 ha Reclamation 2.90 ha Top of seawall 0.22 ha TOTAL 12.47ha
Phase 2 - Establishment and Operation of Shipbuilding, Repair and Maintenance Facilities by Industry	
Future development by industry	Construction of hardstand areas, sheds, jetties and a ship-lift, and the installation of heavy equipment. Construction, repair and maintenance of steel and aluminium-hulled vessels.

Schedule 2 - Proponent's Commitments

Topic	Objective/s		Commitment	Timing	Satisfaction	Advice
Marine Water Quality - Dredging	To ensure that dredging activities have no significant impact on the overall water quality in Northern Harbour.	1.1	The proponent will prepare a Dredging and Dredge Spoil Management Plan (DDSMP). The Plan shall address: • dredging method; • assessment of potential impacts; • contamination assessment; • disposal of sediments and slurry; • monitoring plans and water quality criteria; • management measures; and • contingency measures.	Prior to the commencement of Phase One construction.	DEP	City of Cockburn
		1.2	The proponent will implement the DDSMP.	During Phase One construction.	DEP (PCR)	Nil
Marine Water Quality - Dredging	To ensure there will be no direct discharge of dredge slurry water into Northern Harbour.	2.1	All dredge slurry water will be infiltrated behind the sea wall and/or filtered. There will be no overflow of dredged slurry water into Northern Harbour. (Note: This commitment will be implemented via a clause/s in the contract for dredging)	During Phase One construction.	DEP (PCR)	Nil
Marine Water Quality	To ensure that there is no significant impact on the overall water quality in Northern Harbour.	3.1	The proponent will prepare a Shiplift Monitoring and Management Plan (SMMP). The Plan shall address: • assessment of possible impacts; • monitoring plans and water quality criteria; • management measures; and • describe how management measures might be applied to, and be implemented by a shiplift operator.	Prior to dredging the shiplift basin.	DEP	Nil
		3.2	The proponent will not dredge the shiplift basin unless there is a commercial arrangement in place to construct the shiplift itself.	Prior to dredging the shiplift basin.	DEP	Nil
		3.3	The proponent will implement the SMMP.	Once the ship lift basin has been dredged.	DEP (PCR)	Nil
		3.4	The proponent will ensure relevant management measures are designed and commissioned into the shiplift.	During design and construction of the shiplift.	DEP (PCR)	Nil
Noise	Protect the health and amenity of nearby residents.	4.1	The proponent will ensure all Phase One construction activities, comply with the Environmental Protection (Noise) Regulations 1997. (Note: Noise from construction of Phase Two and operation future industries will be controlled through Works Approval, Licensing or Registration and the Environmental Protection (Noise) Regulations 1997.)	During construction of Phase One.	DEP (PCR)	Nil
Dust Management	Protect the surrounding land users such that dust and particulate emissions will not adversely impact upon their health and amenity.	5.1	The proponent will prepare a Dust Management Plan (DMP). The Plan shall address: • assessment of potential impacts; • relevant criteria and standards; • monitoring; and • management measures.	Prior to commencement of Phase One construction.	DEP	City of Cockburn
		5.2	The proponent will implement the DMP.	During Phase One construction.	DEP (PCR)	City of Cockburn
Marine Safety	Ensure that industries (Phase Two) accommodate legitimate recreational boating activities within Northern Harbour.	6.1	The proponent will prepare a Marine Safety Management Plan (MSMP). The Plan shall address: • interaction of recreational and commercial boating movements; • minimum clearance requirements; • management measures; • cooperative education programs and materials; • emergency procedures/response strategies; and • future management.	Prior to the operation of any new industries (Phase Two).	DEP	Dept. of Transport City of Cockburn
		6.2	The proponent will implement the MSMP.	During the operation of industries (Phase Two).	DEP (PCR)	Nil

Flora and Fauna - Woodman Point Regional Park	Ensure the proposal and operation of the future industries have no adverse off-site impacts on the Regional Park.	7.1	The proponent will design and construct an appropriate interface/buffer on Lot 165B and will include: • signage; • landscaping; and • fencing.	During the design and construction of Phase Two.	DEP (PCR)	CALM
		7.2	All stormwater from the development site will be treated (if required) and contained (infiltrated) within the proposal area (outside the Woodman Point Regional Park) unless an alternative stormwater disposal arrangement is agreed with CALM.	During Phase Two operations	DEP (PCR)	CALM
Ship Wrecks	Ensure that shipwreck sites are protected to the satisfaction of the Maritime Museum of Western Australia.	8.1	The proponent will comply with the recommendations of the 1997 WA Maritime Museum study (Garratt and Souter, 1997) in undertaking the reclamation works and seawall construction.	During Phase One construction.	DEP (PCR)	Nil

PCR - Performance and Compliance Reporting

Appendix 4

Summary of Submissions and Proponent's Response to Submissions

Response to Submissions

Development of Lots 165 - 168 Cockburn Rd, Henderson

Seawall Construction, Land Reclamation and Dredging Adjacent to Lots 165 and 167, Including Lots 166 and 168 and Management of Shipbuilding, Repair and Maintenance Facilities at Cockburn Sound, Cockburn Rd, Henderson

Prepared for
Western Australian Land Authority
trading as
LandCorp

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BSD Centre, 2 Bagot Road
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PREAMBLE

LandCorp proposes to develop Lots 165 to 168 Cockburn Road, in Henderson, which are zoned 'Industrial' under the Metropolitan Region Scheme and 'Industrial General (Restricted Use - Shipbuilding and the Manufacture, Fabrication and Assembly of Components for Use by the Offshore Petroleum Industry)' under the City of Cockburn Town Planning Scheme- No. 2.

The project will involve the construction of a 500m long seawall, approximately 2.6ha of dredging within the Northern Harbour (involving approximately 80,000m^3 of sediment) and the reclamation of approximately 2.9ha of land. The development will facilitate the establishment of shipbuilding, repair and maintenance industries capable of building and servicing aluminium and steel hulled vessels. The project will complete the northern end of the Western Australian Shipbuilding Precinct and, therefore, comply with the development intent of the Northern Harbour as set out in the Jervoise Bay Infrastructure Masterplan.

Figure 1 presents the proposed development site and surrounding features. Figure 2 presents the general layout of the proposed development, and a cross section through the centreline of the shiplift platform.

A Consultative Environmental Review (CER) was prepared for the project, in order to meet the requirements of the Environmental Protection Authority under the Environmental Protection Act 1986. The CER was available for public comments for four weeks, commencing 24 May 1999 and closing 21 June 1999. This document responds to questions and issues arising from submissions received during this period from the public and decision-making authorities. Each summary point is indicated in italics and the Proponent's response follows in 'normal' text.

The Proponent has made 14 environmental commitments in support of the proposal, summarised in the following table.

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1. SUMMARY

Twelve summary questions have been posed by the DEP as a means of encapsulating the key issues raised in the submission period. The twelve questions have been consolidated into five logical groups, and each group is best answered with a single comprehensive and coherent response. The first group relates to the likely influence of the project on harbour flushing and consequent impacts on marine water quality. The second group of questions raise potential impacts on the volume and distribution of nutrient rich groundwater and resultant impacts on water quality. The third group of questions focus on direct impacts on marine water quality, both within the Northern Harbour and in Cockburn Sound. The fourth group of questions relate to the management of the water quality aspects of the project, and the final question relates to navigational safety.

1.1 Harbour Flushing

The following questions raise the concern that the development may further impair hydrodynamic exchange between the Northern Harbour and Cockburn Sound:

(1) *Apart from the intrusion of nitrogen rich groundwater entering the marine environs, poor flushing is the single biggest factor contributing to water quality problems in Northern Harbour. Will the construction of the sea wall, land reclamation and dredging of the harbour bottom affect flushing within the harbour?*

(2) *How might any altered flushing and changes in bathymetry impact water quality, stratification and physiochemistry (spatially and seasonally), and will this lead to a decline in water quality (algae blooms)?*

LandCorp engaged specialist coastal and marine engineers M P Rogers & Associates Pty Ltd to advise on the impact of the proposed development on the flushing and water exchange of the Jervoise Bay Northern Harbour. The following is extracted directly from their report (M P Rogers & Associates, 1999a).

The proposed dredging will increase the volume of water inside the Northern Harbour (in the order of 80,000 m^3 of sediment is expected to be dredged). However, the proposed reclamation (which will be a combination of this dredged material and fill from other sources) will act to offset this volume increase. In fact, after construction, both the surface area and the volume of water in the Northern Harbour will decrease. Initial estimates of the surface area and volume of water within the harbour before and after development are shown below in Table 1.

Table 1 - Northern Harbour Dimensions - Before and After Development

Item	Before	After	% Difference
Surface Area at MSL (m^2)	762,000	729,000	-4%
Volume at MSL (m^3)	6,338,000	6,333,000	-0.1%
Average Depth (m)	8.3	8.7	+5%

Table 1 shows that the expected change in the surface area after the proposed development is estimated to be around 4% and that the change in the volume of water after the proposed development is expected to be less than 1%. The average depth in the harbour is estimated to increase by around 5%.

1.1.1Water Exchange and Flushing Mechanisms

The key physical processes that dominate the flushing and water exchange of the Jervoise Bay Northern Harbour and the adjacent source waters are:

- tidal fluctuations (from both astronomical and meteorological);
- wind induced currents; and
- density currents.

1.1.1.1 Tidal Fluctuations

The tidal exchange of a tidal water body can be estimated using the tidal prism ratio (TPR) (US EPA, 1995). The tidal prism ratio (TPR) is defined as the ratio of the volume of tidal flow entering the waterway from low to high tide to the total volume of water in the waterways. This gives a relative measure of the potential for tidal flushing. The tidal exchange process will be enhanced by variations in water levels due to atmospheric pressure effects and winds. However, the effectiveness of tidal exchange is largely dependent on the water column being well mixed.

The astronomical tides at Fremantle are usually diurnal (one cycle per day) with the typical spring and neap ranges being 0.5 and 0.2 metres respectively. Based on these tide ranges and the values in Table 1 the TPR was estimated before and after development. These results are shown in Table 2 below.

Table 2 - Tidal Prism Ratio

Parameter	Pre-Development	Post Developed
Surface Area	762,000 m^2	729,000 m^2
Total Water Volume	6,338,000 m^3	6,333,000 m^3
TPR Spring Tides (0.5 m range)	6%	5.8%
TPR Neap Tides (0.2 m range)*	2.4%	2.3%

*NOTE: It should be noted that the TPR is calculated for one tidal cycle. Therefore, during neap tides, the daily tidal exchange will be twice the value shown in the above table. This is because analysis of tide data at Fremantle shows that during neap tidal cycles the tide becomes semi-diurnal.

1.1.1.2 Wind Induced Currents

Winds blowing over closed-end waterways are known to create water motions that are important for water mixing and exchange. McKeehan (1975) specifically studied the effects of wind on water motion in man-made waterways. This study shows that wind blowing over a closed-end waterway causes:

- a slope on the water surface, raising the level at the down-wind end of the waterway; and
- surface water movement in the down-wind direction, and an opposite motion in the bottom layer.

The expression for the water velocity as a function of depth and surface velocity is given as:

$$U(z) = U_s\left[1 - 4\left(\frac{z}{h}\right) + 3\left(\frac{z}{h}\right)^2\right] \qquad \text{[Equation 1]}$$

where $U(z)$ = water velocity at depth z,
U_s = water velocity at the surface,
z = distance below the surface, and
h = the total depth of water.

The water flow at the surface is usually taken to be in the range of 2 to 5% of the wind speed, refer to Wu (1973), Bishop (1979), and McKeehan (1975). The above suggests that the water speed decreases rapidly with depth and reaches zero at about one-third of the total depth. Underneath this level, there is a reverse flow to ensure conservation of mass. However, laboratory experiments and observations in the field suggests that the reverse flow occurs at a height of about one sixth of the total depth. Also, the most effective water exchange under wind action will occur when the wind direction is aligned with the harbour entrance.

The harbour entrance and the wind regime are not altered by the development. Equation 1 and the fact that the total harbour volume would barely change, means that the impact of the proposed development on wind induced exchange in the Northern Harbour, as a whole, is expected to be negligible. The configuration of the harbour entrance, the volume of water in the harbour, and the wind patterns are the controlling factors for wind driven exchange. As the proposed development does not alter these factors, the wind driven exchange will not be affected by the development.

1.1.1.3 Density Currents and Groundwater Inflow

Groundwater, which is less dense than sea water when flowing into an adjacent body of water can create current flows. This could be due to both the momentum input from the groundwater discharge as well as the density difference created by the influx of less dense groundwater.

When a horizontal gradient in density exists, the difference in gravitational potential energy causes the less dense fluid to flow over the top of the denser fluid. In general, the two fluids will have the same frontal velocities but be moving in opposite directions.

Measurements in the Hillarys Boat Harbour by Schwartz & Imberger (1988) showed that density currents due to freshwater inflow substantially increased the rate of flushing in the harbour. It was concluded that, with the existence of density currents, the flushing time of the harbour was half that of the flushing time under tidal action only.

Turner (1973) describes a method of estimating the frontal velocity, u_f, resulting from a longitudinal density difference.

$$u_f = 0.5\left(\frac{g}{\rho_0}\Delta\rho h\right)^{\frac{1}{2}} \qquad \text{[Equation 2]}$$

where u_f = frontal velocity,
g = acceleration due to gravity,
ρ_0 = reference density,
$\Delta\rho$ = longitudinal density difference, and
h = the total depth of water.

Given the current knowledge of the effect of the proposed development on groundwater of the area (refer to Section 1.2) it has been assumed that the amount and the location of groundwater inflow into the development are the same before and after development. Consequently, the longitudinal density difference is likely to remain the same before and after development. Table 1 shows that there will be a minor increase in the average depth of the harbour after development. Therefore, based on Equation 2 and the insignificant change in the total harbour volume, the impact of the proposed development on density driven exchange in the Northern Harbour as a whole is expected to be negligible.

1.1.2 Resultant Water Quality of the Northern Harbour

Table 3 below summarises the results of the estimated changes to each of the flushing and water exchange mechanisms examined in the previous Section 1.1.1.

Table 3 - Estimated Change to the Major Flushing Mechanisms

Exchange Mechanism	Impact of Development on Exchange Mechanism
Tidal Currents	Little impact (in the order of 5% change)
Wind Induced Currents	Little to no impact (less than 5% change)
Density Currents	Little to no impact (less than 5% change)

From the results of the analysis, the proposed development is likely to have little impact on the dominant flushing mechanisms of the Jervoise Bay Northern Harbour (refer to Table 3 above).

Although the development is unlikely to affect the flushing of the harbour as a whole, the proposed dredging and reclamation is likely to create localised changes to the current regime.

The proposed dredging to RL -14 metres CD for the shiplift may create localised persistent stratification and hence the possibility of anoxic conditions in the deeper basin. The autumn months tend to be calmer than the summer months and it is during this period that stratification of the shiplift basin is most likely to result in low oxygen levels (DAL, 1999). With the exception of the shiplift basin, the development is generally geometrically smooth and there are no pockets or shelves in the bathymetry which would result in localised 'dead zones'. Management of water quality within the shiplift basin is discussed below in Section 1.4.

1.2 Groundwater Considerations

The second issue raised concerns the flow of nutrient contaminated groundwater into the harbour and the likely effects on the overall nutrient loading as posed by the following questions:

(3) *Will the proposal affect the volume and distribution of nitrogen rich groundwater entering Northern Harbour?*

(4) *How would the predicted impacts of the proposal change if the government funded Groundwater Remediation Plan is not implemented?*

To address these questions is useful to first review the hydrogeological setting of the Harbour and the work done to date on establishing the groundwater nutrient loading to the harbour as a means of providing the context for the assessment of likely impacts.

1.2.1 Hydrogeological Setting

Jervoise Bay is located on Cockburn Sound, approximately 10km south of Fremantle. The two dominant geological formations in this area are the Safety Bay Sand and the Tamala Limestone. They form the Superficial Formations and extend down to approximately -25m AHD. The Safety Bay Sand extends down to approximately -10m AHD and is geologically younger than the Tamala Limestone, lying above and on the coastal side of the outcropping limestone. Woodman Point to the north of the Northern Harbour is comprised of Safety Bay Sand which thins to a narrow strip along the current shore line of the North Harbour and is not present south of Russell Road. The coastal margin of the Safety Bay Sand is also known as the Becher Sand due to its marine rather than aeolian origins (Davidson, 1995) however for the purposes of this summary it will be referred to as the Safety Bay Sand.

The Safety Bay Sand and the Tamala Limestone are often separated by a thin (0.5 to 1m) silty or clayey shell bed (Appleyard, 1994). The presence of this bed at the development site has not been confirmed. The implications of the presence or absence of this bed are discussed in Sections 1.2.3.

The Tamala limestone extends beyond Cockburn Sound and outcrops on Garden Island. The Safety Bay Sand is also present on Garden Island although the sand forming the floor of Cockburn Sound is known as the Parmelia Bank Unit and probably represents reworking of the Safety Bay Sand and Tamala Limestone with younger marine carbonate sediments. A geological profile through the Northern Harbour area is provided in Figure 3.

Groundwater contained within the Superficial Formations flows from the Jandakot Mound, located 20km to the east, and discharges into the near shore marine environment. Groundwater flow through the Tamala limestone is highly variable ranging from about 200 to 2000m/year (Davidson, 1995). Near the coast, fresh groundwater overlies saline marine water that has intruded into the lower section of the aquifer by virtue of its greater density.

As groundwater approaches the harbour it is forced over the more dense saline marine water, following the path of 'least resistance' and discharges into the shallow, near shore zone. The volume and distribution of ground water flow is influenced by the hydraulic conductivity of the aquifer through which it is flowing, the presence of

preferred pathways (karst formations or holes in the limestone) and fluctuations in sea level and groundwater elevation. The difference between groundwater elevation and sea level is particularly important due to the low hydraulic head and high transmissivity of the Tamala Limestone aquifer. Passmore (1970) and Spencer (1993) found that the rate of groundwater discharge is inversely related to the sea level at the time.

Based on the general stratigraphy of the area most groundwater discharge will occur in the near shore zone. Investigations carried out by Thomas & Evans (1995) found that groundwater from the Tamala Limestone and the Safety Bay Sand discharged up to 40m from shore in the vicinity of the Alcoa Refinery. They also reported that groundwater discharge had been encountered 540 to 600 metres from shore although it was uncertain whether the source of this discharge was artesian (below the Osborne Formation) or from the Tamala Limestone. Davidson (1995) mentions anecdotal reports of off-shore groundwater discharge from springs connected to solution channels in the Tamala Limestone. Appleyard (1994) suggests that discharge from the Safety Bay Sand takes place at or near the shore line while discharge from the Tamala Limestone may take place several hundred metres offshore when it is overlain by the clayey confining bed. Where the limestone is not confined, groundwater discharge commonly takes place from springs and seeps at the base of limestone cliffs.

1.2.2 Sources of Nutrients in Groundwater Flowing to the Northern Harbour

Groundwater investigations along the coast of Jervoise Bay identified two major point sources of nitrogen inland from the Northern Harbour as waste water injection at the Weston Bioproducts facility and the Water Corporation sludge drying beds (PPK, 1998a and 1998b). Although delineation of the plumes is not complete, it is likely that the Northern Harbour receives the full lateral extent of both nutrient plumes (PPK, 1999). The inferred extent of the plumes is illustrated in Figure 4. Additional "background" nutrient loading is contributed by urban and horticultural development between the Jandakot Mound and Jervoise Bay.

Estimates of nutrient discharges into the Northern Harbour were made by PPK (1998a and 1998b). The first report (PPK, 1998a) did not include discharges from the Weston Bioproducts' plume and was estimated to be 5,600 kg/year. The second report (PPK, 1998b) included results for an observation bore that intersected the Weston Bioproducts' plume and the total flux of nitrogen discharging into the Northern Harbour was re-estimated to be approximately 8,700 kg/year.
It should be noted that there is considerable range in the nutrient flux estimates due to the variable transmissivities reported for the Tamala Limestone. It was concluded that the Woodman Point Wastewater Treatment Plant and the Weston Bioproducts Plant together account for approximately 80% of the nutrient flux entering the harbour. The

remaining 20% is derived from sources further east. Concentrations of nitrogen in the Weston Bioproducts plume range from 21 to 252mg/l (NH_3 -N) and in the Water Corporation plume from 0.5 to 26mg/l (NO_3 -N). The plume from the Weston Bioproducts site is relatively narrow and concentrated reflecting the direct injection of waste water into the aquifer. The plume emanating from the sludge drying beds is broader and more diffuse reflecting the infiltration of leachate from the surface.

1.2.3 Potential Impacts of the Proposal on Groundwater

The construction of the proposed sea wall and associated dredging and filling operations has the potential to locally modify existing groundwater flow conditions. Figure 3 is a geological cross section across the Northern harbour, along the axis of the proposed ship lift basin. The cross section shows the relationship between the proposed works and the existing geological formations.

Construction of and backfilling behind the seawall will force groundwater that is discharging from the Safety Bay Sand along the current beach front to discharge through the seawall. As the sediments being dredged from in front of the seawall are of similar composition to the sediments behind the seawall (Geological Survey, WA, 1985), the hydraulic properties of the spoil will be similar to the sediments they will rest upon. As such, no significant diversion of groundwater flow is anticipated.

The dredging of the shiplift basin will potentially extend into the upper section of the Tamala Limestone (Figure 3). The potential for modification to groundwater flow will depend largely on the presence of the clayey shelly layer at the base of the Safety Bay Sand. If the clayey layer is present, fresh groundwater at the top of the Tamala Limestone may be intersected. In this case, flows of groundwater into the shiplift basin will be controlled by the hydraulic head differential between the aquifer and sea level. If the clayey shelly layer is not present, the dual-saline wedge illustrated in Figure 3 will not have developed and no fresh water will be intersected by the shiplift basin.

In direct response to questions 3 and 4, it is considered that the proposal will not result in an increased nitrogen loading to the harbour from the groundwater on the basis of the information currently available. This prediction is not reliant on the implementation of the Groundwater Remediation Plan proposed by DCT.

1.3 Water Quality Considerations

The third group of questions focuses on direct impacts on marine water quality, both within the Northern Harbour and in Cockburn Sound, as follows:

(5) Will the proposal cause an increase in the amount of bio-available nitrogen in Northern Harbour?

(6) Will an increase in nitrogen load within the harbour or parts of the harbour contribute to a decline in water quality (algal blooms)?

(7) How might this impact water quality outside the harbour, in Jervoise Bay and in Cockburn Sound?

(8) *How might the suspension of nutrients, sediments and silica (either during dredging or because of ship movements) interact and interrelate to affect water quality?*

To address these questions it is necessary to summarise the known water and sediment quality history of the harbour. The water and sediment quality of the Northern Harbour has been subject to recent scrutiny following the construction of the extension to the Northern Breakwater (HGM, 1998; HGM, 1999; DAL, 1999). The following summary has been taken from these reports.

1.3.1 Temperature and Chlorophyll *a*

The temperature of the harbour water is an important factor in determining the potential for blooms to occur. Productivity (measured as chlorophyll *a* concentration) generally increases with temperature if nutrients remain available. The winter influence of the Leeuwin Current and outflows from the Swan and Peel-Harvey estuaries tends to result in a more complex response in Perth coastal waters, with higher productivity recorded over winter months in some instances (DEP, 1996). However, the data from HGM (1998), HGM (1999) and Hale et al. (1998) suggest that blooms in the Northern Harbour are generally coincident with higher temperatures as shown in Figure 5, where the recorded temperature in the harbour ranges between 16 and 26 °C.

Figure 5: Productivity Versus Temperature in the Northern Harbour

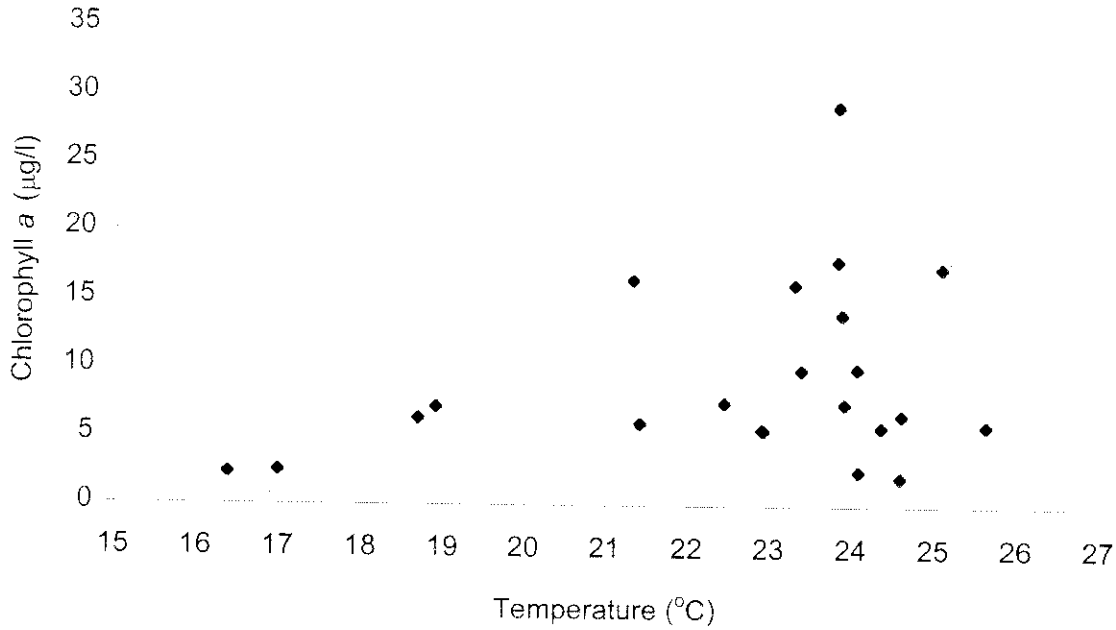
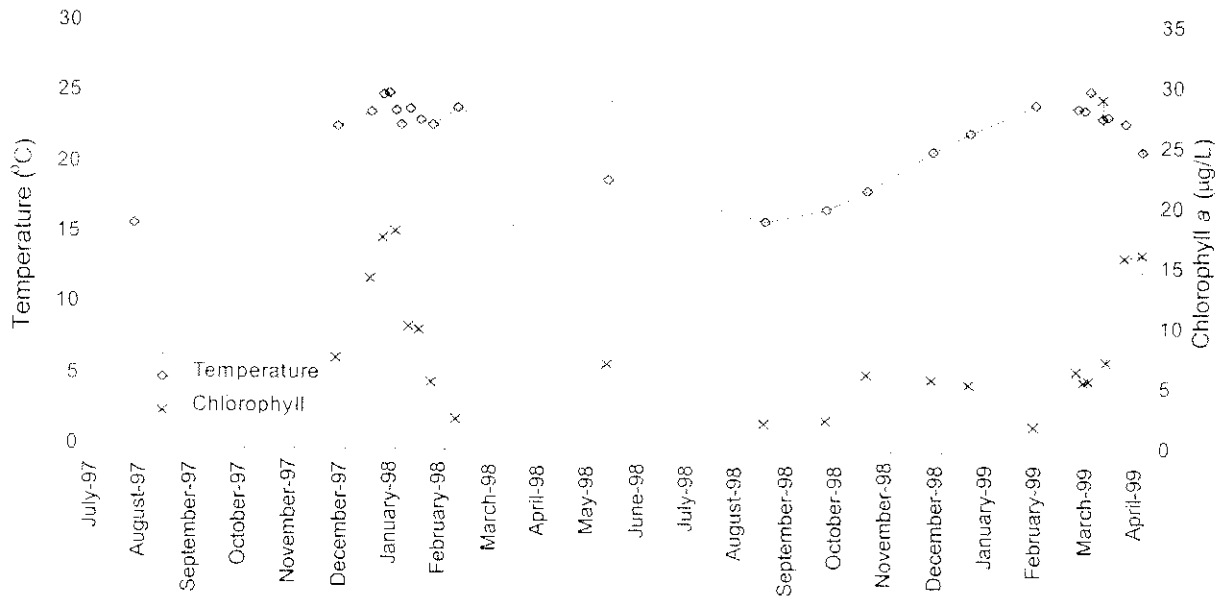


Figure 6 shows the mean temperature and the chlorophyll *a* concentrations recorded in the harbour over the period August 1997 to April 1999. It can be seen that the peak of the blooms over summer 1997/98 started in mid-December and finished by mid-February while the 1998/99 peak occurred in early March. On the basis of this limited data it is concluded that blooms are most likely to occur between early December and end of March.

Figure 6: Northern Harbour Temperature and Productivity Over Time



1.3.2 Nutrients

The harbour is highly productive relative to Cockburn Sound, with summer chlorophyll levels in the harbour frequently higher than 10 mg/l and in excess of 30 mg/l in one instance while levels in the Sound are generally less than 2 mg/l (mean = 1.6 mg/l) and occasionally exceeding 5 mg/l in some locations (Hale et al, 1998). This productivity is primarily a result of the high loading of bioavailable nitrogen (as ammonium, nitrate and nitrite) which enters the harbour via the groundwater. The large nitrogen load has resulted in the growth of phytoplankton in the harbour being limited by the availability of phosphorus (DAL, 1999) rather than the availability of nitrogen which is the case in Cockburn Sound and most marine waters. It is estimated that a 2 to 5 fold decrease in nitrogen loading will be required before productivity is again limited by nitrogen availability (DAL, 1999). The enclosed nature of the harbour means that bioavailable nitrogen concentrations remain high within the harbour and relatively low immediately outside the harbour. Implementation of the DCT proposal to actively reduce the groundwater nutrient loading to the harbour should significantly reduce the productivity of the harbour and the subsequent export of nitrogen into the Sound from the harbour.

1.3.3 Phytoplankton Species

It is useful to examine the succession of phytoplankton species in the harbour as current evidence suggests that the spring/early December period will be dominated by diatom and picoplankton species then, following the collapse of these blooms, the larger motile dinoflagellate species may dominate in mid to late summer. Diatom species may also reappear from time to time (HGM, 1998;1999). This same succession is seen in many other waters including the Swan River system (Water and Rivers Commission, 1998). There are many recorded instances of blooms of toxic phytoplankton species in Western Australian waters and, in general, if a bloom contains toxins which are potentially harmful then the chances are that it will be a bloom of a dinoflagellate species (Hosja and Deeley, 1994). On the basis of current information and observation of phytoplanton ecology in other Western Australian systems, a bloom in the harbour in early summer is most likely to consist of diatom species and be non-toxic while blooms occurring in mid to late summer are more likely to consist of dinoflagellate species with a greater risk that the bloom is of a toxic species. As such, the months of January to March may be thought of as the 'high-risk' months with respect to increased probability of dinoflagellate blooms. Since 1997 no blooms of toxic species have occurred in the Northern Harbour. There are no data on species in the harbour prior to this time.

1.3.4 Dissolved Oxygen

The dissolved oxygen (DO) status of the harbour has important ramifications for the survival of sessile fauna, the rate of nutrient release from the sediments and hence the entire ecology of the harbour. During the winter months when productivity is low and

the system is well mixed, the DO levels in the harbour are close to saturated values throughout the water column (HGM, 1999). The DO levels will fluctuate on a diurnal basis with highest levels in the afternoon following the production of oxygen via photosynthetic activity through the day. The levels will be lowest in the early morning before sunrise after the effects of respiration. This cycle is common for waters supporting plant life and, as the productivity of the waters increase, the amplitude of the cycle becomes more pronounced.

Another factor affecting DO is more pertinent to the harbour. After organic matter (eg. dead phytoplankton) settles to the bottom, the bacterial decomposition of the material creates a demand for oxygen at the sediment-water interface. Following the decay of a large bloom this sediment oxygen demand may be large enough to result in a prolonged period of hypoxia (low DO) or anoxia (no DO) near the sediment. This effect is juxtaposed with the diurnal oxygen cycle and, as such, anoxia is most likely to occur in the early hours of the morning. Since the demand is at the bottom of the water column, regular vertical mixing of the water column will reduce the risk of anoxia. If the water column is not mixed due to strong stratification or prolonged calm conditions, the anoxia may be prolonged for a number of days or weeks.

Under hypoxic (low oxygen) conditions the release of ammonium and phosphate from the sediments is also promoted, potentially further increasing the productivity of the overlying water column.

Measurements of DO levels in the harbour near the sediments over the past two summers taken between 7 am and 3 pm have revealed two instances of anoxia within 0.5 m of the bottom. These both occurred at HGM monitoring Site 3, immediately south of the public boat ramp on 16/1/98 and 28/1/98 (HGM, 1998). Otherwise there has not been a recorded instance of anoxia lasting into the day (HGM, 1999), even following the collapse of several significant algal blooms. However, the shiplift basin will be prone to poor vertical mixing and it is likely that anoxia could occur in the water trapped in the basin (DAL, 1999). Left unmanaged this will not significantly affect the overall harbour water quality due to the small size of the shiplift relative to the harbour. If localised impacts occur which are unacceptable, the water quality in the shiplift basin can be managed using the remediation techniques described later in this response (Refer to Section 1.4.2).

1.3.5 Sediment Organic Content

The higher productivity of the harbour has resulted in a higher percentage of organic content in the sediments compared to Cockburn Sound. This has translated into

sediment nitrogen levels in the harbour being approximately three times higher than levels immediately outside the harbour in Jervoise Bay (HGM, 1998).

The project will have three impacts on the total sediment organic content of the harbour and hence the sediment nutrient load to the harbour. Firstly, the shiplift basin will tend to accumulate organic material at a faster rate than the surrounding seabed due to its depth. Secondly, by dredging the region in front of the reclaimed areas there will be removal of organic material from 2.6 ha of the harbour. Thirdly, by reclaiming 2.9 ha of the harbour there will be a removal of organic material over at least 50% of this area. The result is that for an increase in organic accumulation in the shiplift over an area of ca. 5000 m^2, there would be a removal via dredging and reclamation of ca. 40,000 m^2 of organic material from the harbour. This will effectively remove the store of sediment nutrients in the north-east corner of the harbour. Once the site is developed, a large portion of the reclaimed material will be capped with either pavement or roofed areas and therefore the potential for surface stormwater to percolate through the sediments and leach out the nutrients will be minimised.

The present level of organic accumulation of organic material has occurred over a time scale of years/decades and as such the re-accumulation of organic material back to present levels will occur over a similar time scale.

On this basis it is concluded that the project will not add to the overall sediment nutrient load to the harbour. In direct response to Questions 5 and 6, the Proponent does not believe the project will result in increased concentrations of bio-available nitrogen in the Northern Harbour nor will the project contribute to a further decline in the water quality of the harbour as a whole. However, recognising the justifiable concern on this issue, the Proponent has committed to monitoring the water quality in and adjacent to the shiplift basin. If there are signs that the basin is causing localised nutrient release, then the reactive management strategy outlined in Section 1.4 for the basin will be implemented. In response to Question 7, if the project is designed and managed so it does not result in reduced water quality in the Northern Harbour then the project will not result in reduced water quality in Cockburn Sound.

1.3.6 Turbidity and Sediment Resuspension During Dredging

The process of dredging and reclamation has the potential to cause sediments to be resuspended at the dredge cutter head and the point where water from the disposal site drains back into the harbour. These impacts will be mitigated by the use of 300 mm silt curtains around the dredge area (EGIS, pers. comm). The Proponent has committed to prepare and implement a Dredging and Dredge Spoil Management Plan (DDSMP) to ensure that dredging activities have no significant impact on the water quality of the

Northern Harbour (Commitments 1.1 and 1.2). As there are no benthic habitats of significance in the region, a localised increase in turbidity will not cause any impacts. Resuspension of sediments may result in short term increases in silica, nitrogen and phosphorus availability (Sondergaard et. al, 1992) and may also resuspend dormant phytoplankton cysts into the water column.

The project will not introduce new cysts to the harbour and therefore at most will result in more than the usual number of cysts being exposed to the water column. The disturbance of the sediment in the harbour is a common occurrence (via ship movement, small craft movement, wave action etc) and as such the disturbance of the bottom by dredging should not result in the exposure of cysts which have not previously been exposed to the water column of the harbour.

As the harbour appears to be strongly phosphorous limited (HGM, 1999) an increase in phosphorous availability may result in increased localised production for the period of dredging. Silica is a particularly important nutrient for diatom growth and any diatom bloom may be further promoted by the release of additional silica and phosphorus. The Dredging and Dredge Spoil Management Plan will include monitoring of phytoplankton species and abundance on a twice weekly basis throughout the dredge program. The results of this monitoring will be incorporated into the Northern Harbour monitoring reports.

Past monitoring of the harbour shows that blooms have occurred frequently over summer even in the absence of dredging (HGM, 1998; 1999). However, it is important to know quickly if any bloom of a toxic species occurs and this is the reason for implementing the phytoplankton monitoring programme. If a bloom of a toxic species occurs, the Proponent will follow the procedures outlined in the Northern Harbour Management Plan which include notification of the DEP Health Department, Water and Rivers Commission, City of Cockburn and the Public.

1.4 Management Issues

The following questions are assumed to focus on water quality management issues particularly related to the Proponent's proposal to implement sediment removal and oxygen injection techniques in the shiplift basin in the event that the project does not meet the EPA objective to maintain or improve water quality in the harbour.

(9) Does the Proponent believe that the management measures proposed in the CER are adequate?

(10) Have the management measures proposed for the ship lift been successfully and sustainably implemented in a comparable marine harbour?

(11) Can the proposal be modified or management measures amended to ensure a decline in water quality does not occur?

1.4.1 Overall Management Strategy

The Department of Commerce and Trade (DCT) has responsibility for water quality management in the Northern Harbour, through Ministerial Conditions placed on the approvals for the Northern Breakwater (EPA Bulletin 836, December 1996). LandCorp has finalised a consulting brief for a contract to identify management issues, assess the legal framework available and determine the most effective structure of formal management body for the Northern Harbour. The responsibility for water quality management will remain with DCT until a new agency is nominated as the Northern Harbour Management Agency or Organisation.

A Dredging and Dredge Soil Management Plan (DDSMP) is being prepared by LandCorp to comply with Management Commitment 1.1 of the CER. It is intended that the DDSMP will comply with the DCT's Northern Harbour Management Plan (NHMP), which is also referred to as the Stage II Contingency Plan. The NHMP is currently in draft form, having been submitted to the Department of Environmental Protection for comment in December 1998. The NHMP will provide the umbrella control for harbour management, and LandCorp's DDSMP will be consistent with the overall strategies and criteria nominated in these plans.

Water quality monitoring in the overall harbour will continue to be the responsibility of a single agency, either DCT or in due course the new Harbour Management Agency or Organisation. Water quality monitoring of the shiplift basin will occur at more frequent intervals than the general harbour monitoring, and more appropriately rests with the future shiplift operator through lease conditions with LandCorp. The Proponent has committed to prepare and implement a Shiplift Monitoring and Management Plan (SMMP) to ensure that the proposal will have no significant impact on the overall water quality of the Northern Harbour (Commitment 3.1 and 3.3).

LandCorp is developing management strategies to control the potential impacts on water quality associated with dredging operations through the DDSMP and the operation of the ship-lift facility through the SMMP which will be dovetailed into the existing Jervoise Bay Northern Harbour Management Plan (DCT, 1998). These management strategies reflect the Proponent's Management Commitments and the EPA objectives for the proposal. The proposed remediation of contaminated groundwater by the DCT would greatly compliment the Proponent Management Commitments, but the predicted impacts of the proposal will not change if the DCT Groundwater Recovery Plan is not implemented.

The Jervoise Bay Northern Harbour Monitoring Programme (DCT, 1999) is in place until at least 2002 with the prospect of continuation at the request of the DEP. The programme requires, as its base level, quarterly monitoring of water quality at three sites in the harbour and three sites immediately outside the harbour with annual monitoring of sediment contamination at the six sites. In addition, there is a requirement for reactive monitoring in the event of reports of poor water quality within the harbour. As a result of summer algal blooms, there has been additional monitoring conducted in the harbour over the summers of 1997/98 and 1998/99 (HGM, 1998; 1999).

The SMMP will detail management strategies that could be implemented by the future shiplift operator (through incorporation into the terms of the lease) to ameliorate potential adverse impacts on water quality associated with stratification within the shiplift basin. The Proponent will ensure that the relevant management measures are designed and commissioned into the shiplift (Management Commitment 3.4).

While the seawall and dry land may eventually be sold to future shipbuilding, repair and maintenance industries, the remaining seabed lease will remain vested in the Department of Transport pending the introduction of the new harbour management agency or organisation. It should be noted that a deep shiplift basin will not be dredged unless there is a firm contract in place to construct a shiplifting facility (Management Commitment 3.2). The time delay between dredging the deep basin and constructing the shiplift will be minimal. Any conditions placed on LandCorp related to the shiplift will be transferred to the dredging contractor. On the day of practical completion, these conditions will role over onto the operator of the shiplift.

The proposed management strategy for the operational phase has been developed on the basis of the following key points (refer to Section 1.3 and to DAL, 1999):

- the construction of this proposal is highly unlikely to increase nutrient loading to the harbour from current levels;
- there is an existing water quality monitoring programme for the Northern Harbour;
- the bottom waters of the shiplift basin are more likely to become anoxic than other waters in the harbour; and
- the primary impact of this will be to promote the release of nutrients from any organic material which has settled in the basin.

The Proponent considers it unlikely that the shiplift facility will result in a reduction of the present water quality of the harbour, however, recognising the justifiable concern regarding this issue, it is proposed to monitor the water quality and build up of organic material in and adjacent to the shiplift basin and determine the requirements for

implementation of reactive management strategies on this basis. The location of the proposed monitoring sites are shown on Figure 7. Further details of the shiplift monitoring programme will be provided in the SMMP.

DAL (1999) suggested that there are two proven techniques for managing nutrient release from the basin if monitoring shows that nutrient release is occurring. The first technique involves the removal of settled organic material from the bottom of the shiplift basin using a small suction dredge while the second option is to pump out the deeper waters of the basin and oxygenate them before reinjecting the waters back into the deeper basin. These techniques have been successfully used elsewhere in Western Australia and the world. The sediment removal strategy works on the principle that if the organic material is not allowed to build up then there is a limited amount of nutrients available for release. This has been implemented in ports, harbours and marinas throughout Europe and the United States (eg. refer to Ellicot International home page for examples). The oxygen injection technique has been utilised recently in Western Australia and successful large scale trials in the Vass and Canning Rivers have resulted in Water and Rivers Commission adopting this strategy as a tool to manage water quality in small sections of river which are affected by nutrient release from deeper, stratified pockets of water (Water and Rivers Commission, 1998). The principle appears to be ideal for application to the shiplift. These two techniques and other options will be examined to determine the best one for the shiplift facility.

In response to Questions 9 and 10, the Proponent believes that the proposed management measures are adequate. The reactive strategies proposed are feasible, consistent with best practice and have been proven as effective in managing water quality problems due to organic build-up and anoxia. With respect to Question 11, therefore, the Proponent does not believe that further modifications to the proposal or management measures are necessary.

1.5 Navigational Safety Issues

(12) Based on known, expected and future ship movements, is the ship lift located appropriately, such that the potential risk of accidents (between commercial and recreational boats) is low enough to be considered acceptable? (Reference should be made to appropriate expert opinion, government policy or position).

The Department of Transport is the State Maritime Authority with specific responsibilities for all aspects of recreational boating, including safety. LandCorp has outlined in writing to the Department of Transport the operational land use reasons why the shiplift is located in its current position as outlined in Figure 4.5 of the CER. A formal response from the Department of Transport has been provided to the Department

of Environmental Protection under separate cover (Department of Transport, 1999) which has confirmed that the proposed separation distance of 108m between the shiplift and the recreational boat harbour breakwater is adequate provided that any ship moving to a berth on the northern side of the shiplift has a beam of less than 18m. LandCorp will prepare and implement a marine safety management plan for the berthing and departure of ships from the shiplift, which complies with Transport's requirements, in accordance with LandCorp's Management Commitments 6.1 and 6.2.

The Jervoise Bay Boat Harbour operates as a boat launching facility for trailerable craft. It is used both by the general public and by members of the Cockburn Power Boat Association. The Department of Transport has advised that generally, craft of this type are highly manoeuvrable and could cope with a 30m wide entrance channel equivalent to that provided for similar craft at the Ocean Reef Boat Harbour. On those relatively rare occasions when ship movements are taking place, it is anticipated that the proposed Marine Safety Management Plan would determine the steps needed to prevent any problems (Refer to Management Commitment 6.1).

Based upon the Department of Transport's (Maritime Division) Draft Marine Safety Plan Guidelines (1998), it is anticipated that the Northern Harbour Marine Safety Management Plan could address a range of safety issues which may include the following:

- ***Navigation Aids***

The safety plan will document maintenance procedures for navigation aids, including regular inspection, maintenance and replacement schedules, and notification regarding compromised aids.

- ***Channels and Berths***

The safety plan will document procedures and practice for maintaining the depths of shipping channels and alongside berths, including regular verification of designated depths, a maintenance schedule, internal and external reporting of depths less than designated levels and restoration of depths to designated levels within agreed time frames.

- ***Dangerous Goods***

The safety plan will document procedures and practices for training personnel in the transport and handling of dangerous goods.

- ***Emergency Response***

The safety plan will document procedures and practice for training personnel and in emergency response (in accordance with AS 4360), reporting of incidents, maintenance and reporting of emergency equipment, and maintenance of an emergency plan based upon risk assessment principles.

- ***Communications***

The safety plan will document the procedures and practice to ensure effective communication, alerting of appropriate personnel and organisations in the event of an emergency, and maintenance of traffic and communications records for audits by the Department of Transport.

- ***Harbour Masters***

The safety plan will document procedures for regular performance reviews of the harbour master and authorised personnel, medical fitness, arrangements for periods of absence, interaction with the Department of Transport, and maintenance of performance records.

Some of the above issues may overlap with, and would be addressed by, the Northern Harbour Management Plan. The primary focus of the Marine Safety Management Plan would be to ensure the safe professional sharing of the waters of Jervoise Bay between recreational and commercial vessels.

2. SUBMISSION ISSUES

2.1 Broader Issues Raised During the Submission Period

The following issues have been raised. Some are beyond the control of the Proponent, do not directly relate to the assessment of this proposal under Part IV of the Environmental Protection (EP) Act and/or cover some broader issues related to Jervoise Bay and Cockburn Sound which are currently being considered and addressed by Government and other Proponents through other processes.

In considering how this proposal may meet it's objectives and under what conditions, the EPA will need to assess how this development interrelates with these other issues, previous EPA advice and recommendations. Accordingly, the Proponent is requested to respond to the following issues:

(1) The results of the CSIRO survey for the Southern Metropolitan Coastal Waters Study (SMCWS), on community wishes for the Perth coastline, and in particular, Cockburn Sound, are pending. Until this data is assessed, no more developments should permitted.

A: Lots 165-168 have been zoned 'Industrial' under the Metropolitan Region Scheme (MRS) and 'Industrial General (Restricted Use - Shipbuilding and the Manufacture, Fabrication and Assembly of Components for Use by the Offshore Petroleum Industry)' under the City of Cockburn Town Planning Scheme No. 2. The EPA has considered the environmental implications of the MRS and TPS amendments that lead to this area being zoned for 'Industrial' purposes. If the EPA had been of the view that it is imperative to wait for the release and acceptance of the SMCWS before further development is permitted to occur in this area it would not have considered the rezonings to be environmentally acceptable. More specifically the EPA strategic advice did not specifically preclude future development in this area until the SMCWS report is released. It is important to recognise that the proposed project is a relatively small development, particularly in comparison with the Southern Harbour development, and is a direct expansion of commercial activities already being undertaken within the existing shipbuilding precinct. The proposed project will complete the northern end of the Western Australian Shipbuilding Precinct and thus comply with the development intent for the Northern Harbour set out in the 1997 Jervoise Bay Infrastructure Masterplan.

LandCorp is aware that the results of the CSIRO survey for the Southern Metropolitan Coastal Waters Study (SMCWS), regarding community wishes for Perth coastline, are pending. This ongoing community process will lead to the establishment of final Environmental Quality Objectives (EQOs) and Environmental Quality Criteria (EQCs) to facilitate the protection of significant marine environments, such as Cockburn Sound.

The potential environmental impacts of this project can be managed according to the Proponent management commitments provided in the preamble to this document. The management commitments for Marine Water Quality will ensure that the Proponent meets the EPA objectives for the environment and, thus, maintains or improves the water quality of the Northern Harbour.

(2) *The expansion of shipbuilding activities at this site should not occur without first evaluating the long-term eutrophication problems of the Northern Harbour. Construction of the Northern Breakwater has clearly had a deleterious impact on water quality and it is strongly suggested that this part of the coast is not suited to a closed harbour with poor flushing.*

A: The recent extension of the Northern Harbour breakwater did not alter the groundwater nutrient load to the harbour, however, it served to increase the retention time of the harbour (HGM, 1998). This had the effect of increasing the mean nutrient concentrations in the harbour (HGM, 1998). The causes of water quality problems in the Northern Harbour have been well documented (HGM, 1998 and HGM, 1999) and are summarised in Section 1.0 of this response. This has resulted in significant commitments being made by the Department of Commerce and Trade (DCT) to implement a groundwater management plan for the region. The current proposal has been developed so that it is in agreement with the over-arching draft Jervoise Bay Northern Harbour Management Plan (or Jervoise Bay Northern Harbour Stage Two Contingency Plan (draft), DCT 1999).

The question also alludes to the suitability of the location for the existing Jervoise Bay Northern Harbour. This issue is beyond the scope of this response.

(3) *The public has been waiting for the establishment of a Cockburn Sound Management Authority that has the power and expertise to safeguard the Sound. Until such a body is established there should be no further development in Cockburn Sound.*

A: The Department of Commerce and Trade has responsibility for water quality management in the Northern Harbour, through Ministerial Conditions placed on the approvals for the Northern Breakwater. LandCorp has finalised a consulting brief for a contract to identify management issues, assess the legal framework available and determine the most effective structure of formal management body for the Northern Harbour. The responsibility for water quality management will remain with DCT until a new agency is nominated as the Northern Harbour Management Agency or Organisation.

A Dredging and Dredge Spoil Management Plan (DDSMP) is being prepared by LandCorp to comply with Management Commitment 1.1 and will be made available for public inspection. The Northern Harbour Management Plan under preparation by DCT will provide the umbrella control for harbour management, and LandCorp's DDSMP will be consistent with the overall strategies and criteria nominated in this plan.

(4) What is being done to address the long-standing problems of water quality in Cockburn Sound? What specific action has been taken to improve the water quality of the Northern Harbour prior to further construction beginning on Lots 165-168 and who is responsible for these actions to be carried out?

A: The majority of water quality problems in Cockburn Sound were caused by an excess of nutrients discharged to these waters.

Over the last decade, an enormous effort has been expended in reducing the loads by industry, government and various local government bodies (Kwinana Industries Council, 1999; Hale et al, 1998). Routine monitoring has shown that the clarity of Cockburn Sound waters has slightly improved over the last few years (Hale et al, 1998) and consequently the effects of earlier management action are now being measured.

The results of the most recent water quality monitoring program in Cockburn Sound (summer 1999) indicated that the recent trend of improved, stabilised conditions has continued (Hale, pers. comm.). The concentrations of nutrients and chlorophyll *a* are substantially lower and less variable than they were two decades ago. The results of an investigation of periphyton growth on artificial seagrass, indicated that the water quality within Cockburn Sound can and does provide a healthy environment for seagrass growth.

Monitoring has regularly shown that the north-east corner of Cockburn Sound in the Northern Harbour of Jervoise Bay shows the highest levels of primary production which are attributed to groundwater containing high nutrient concentrations. However, the increased concentrations of nutrients and phytoplankton within the Northern Harbour of Jervoise Bay does not appear to be having a significant impact on the water quality in the rest of Cockburn Sound. (HGM, 1999).

The groundwater management plans developed by DCT with assistance from the Water Corporation will provide a rapid and measurable reduction of these nutrient loads. Furthermore, a number of other groundwater remediation programmes are being undertaken along the eastern shore of Cockburn Sound. The management structure and responsibilities is further discussed in section 1.4.

(5) *The impact of development in the region cannot be adequately assessed on a case by case basis. The Minister for the Environment is strongly urged to undertake a strategic assessment of the Cockburn Sound region to establish an environmentally and socially acceptable approach to development that considers cumulative as well as site specific effects on the environment.*

A: A strategic assessment of the Cockburn Sound region has already been undertaken. As a result of two MRS amendments, the EPA provided advice to government on the development of the Cockburn Sound region under Section 16 of *the Environmental Protection Act 1986*. This report includes strategic advice pertaining to the marine environment of Cockburn Sound, and considered both cumulative and site specific impacts on the environment. The EPA's advice is detailed in Bulletin 907 (EPA, 1998). The project is contained entirely within the Jervoise Bay Northern Harbour and, as such, does not have any contributory impact on the circulation and residence time of Cockburn Sound. The Proponent also believes that the project can be effectively managed so that there will be no adverse impacts on the water quality of Cockburn Sound. Therefore, in respect to the EPA's consideration of cumulative impacts within the Sound, this project does not contribute to a cumulative degradation of Cockburn Sound.

The Consultative Environmental Review (CER) for LandCorp's proposed development is currently being evaluated according to the environmental impact assessment (EIA) process, under Part IV of the *Environmental Protection Act 1986*. In accordance with this EIA process, the Environmental Protection Authority (EPA) will consider the potential cumulative and site specific environmental impacts of the project.

Through this process, the proposed development is also being assessed in a broader framework which will consider environmental implications within the whole Northern Harbour.

The establishment of a formal management body for the Northern Harbour, as well as an overarching management body for the whole of Cockburn Sound (Cockburn Sound Management Body), will also ensure a coordinated approach to management that addresses environmental and social issues and controls the development and other usage of the Sound. For further details refer to the response to question *2.2(8)* below.

(6) If the beach is so reclaimed, how will the dog beach be preserved? The beach 5km to the north is also available for use by horses and other animals. The two activities are not always compatible. The entire length of the dog beach needs to be retained.

A: The City of Cockburn has advised that the beach south of the Woodman Point public boat ramps, to the northern end of the shipbuilding yards, is not and never has been an official dog beach, and this has been confirmed by the Ministry for Planning.

There is an official dog beach located 5 to 6 km north of the site. The control of this northern dog beach is the responsibility of the Local Authority under the Local Government Act 1996 and LandCorp will refer the above issue, regarding the incompatibility of use of this beach for both dogs and horses, to the relevant authorities.

2.2 General Comments in Submissions

(1) Department of Transport (Maritime Section) has limited its advice to Commitments 1, 2 and 6.

A: Noted.

(2) The Water Corporation has requested that the term 'emergency sewage' outfall should read 'treated wastewater emergency outlet' in all sections of the CER.

A: Noted.

(3) Discussions regarding the alteration of the treated wastewater emergency outlet are not finalised. Consequently the Water Corporation comments on the CER are on the basis that the outlet remains in its current location.

A: A range of options for relocating the outlet have been discussed with the Water Corporation, and the preferred option is to lower the land section of the Jervoise Bay outlet and terminate it at the proposed seawall (WaterCorp, 1999). Refer also to response to question 2.3 (1).

(4) Until Stage 2 of the Northern Harbour Management Contingency Plan is finalised the Water Corporation is unable to comment on the possible impacts on the treated wastewater emergency outlet.

A: A range of options for relocating the outlet have been discussed with the Water Corporation, and the preferred option is to lower the land section of the Jervoise Bay outlet and terminate it at the proposed seawall (WaterCorp, 1999).

(5) It is incorrect to say the treated wastewater emergency outlet is unlikely to be used. This facility may be occasionally or infrequently used in the future.

A: Noted.

(6) The City of Cockburn strongly supports the removal of the treated wastewater emergency outlet from the Northern Harbour as part of the development proposal.

A: Noted.

(7) The haste for the project has not been adequately explained or justified.

A: There is an urgent demand for the development of Lots 165-168 to facilitate the establishment of shipbuilding repair and maintenance industries, and potential purchasers require this land as soon as possible to enable them to meet market demands for the construction and servicing of larger vessels. There is no obvious alternative location for these industries at the present time, and the State and Federal governments have already invested millions of dollars in the necessary infrastructure in Henderson. Inability to meet the immediate demand for more land for shipbuilding, repair and maintenance industries is likely to see the potential purchasers of this land establishing their industries elsewhere in Australia, resulting in a considerable loss of revenue and employment for the State. The development will meet all the requirements of the EP Act and should the proposal be approved it will be implemented in accordance with best environmental practice.

(8) The CER does not consider the overall cumulative impacts from the various components of their proposal. The whole picture and combined impacts are ignored as each problem is dealt with individually and a specific management strategy is suggested.

A: The CER does consider the cumulative impacts from the various components of the proposed development, particularly with respect to noise and marine water and sediment quality issues. In Section 4.6.3 of the CER, the noise impacts associated with the proposal are evaluated in conjunction with noise levels from existing industries and traffic along Cockburn Road. In Section 4.3 of the CER, water and sediment quality issues, such as release of nutrients, release of contaminants, interception of contaminated groundwater, stratification and turbidity, are considered as site specific issues but are also interrelated throughout that section of the CER. The potential site specific and cumulative impacts on the marine environment have been further discussed in Section 1.0 and the response to question 2.2 (8).

LandCorp is committed to ensuring the effective management of the harbour and has released a consulting brief for a contract to identify management issues, assess the legal framework available and determine the most effective structure of a formal management body for the Northern Harbour. The development and establishment of an appropriate management framework for the Northern Harbour will include clear responsibilities for the management of water quality and other issues.

(9) It is difficult to comment on the CER as it contains no specific details of how the environmental factors will be managed. The Proponent makes a lot of commitments to abide by government policies and guidelines but fails to say how this will be achieved. The Proponent appears confident that they have the answers to all the problems that could arise but in essence is asking for approval on the basis of commitments without outlining how these commitments will be met. The same Proponents have failed to successfully manage the environmental impacts for the previous stages of the Northern Harbour and consequently no approval should be given for this proposal until full details of how water quality will be monitored and managed are provided.

A: The purpose of a CER is to provide enough evidence to demonstrate that although there are a number of environmental issues that need to be addressed, the situation is such that they can be managed through the development of detailed management plans. The CER examines the environment, potential impacts and the management measures available. Where the CER can reference similar

situations where management plans have been developed and implemented successfully, these sections can be treated more generally. If there are no tried and proven management measures for a particular situation, the CER is required to provide enough detail to give confidence that an adequate management plan can be developed.

LandCorp believes that the CER, in conjunction with this Response document, has achieved the above aims and has demonstrated that the management plans can be confidently developed at a later stage of the project.

With respect to the site specific environmental factors identified in the EPA Guidelines, LandCorp has developed management commitments which can be audited by the DEP or are related to legislative requirements. Proponent Management Commitments 1.1, 1.2, 2.1, 3.1, 3.2, 3.3 and 3.4 relate to the management of water quality within the Northern Harbour. These management commitments involve the preparation and implementation of a Dredging and Dredge Spoil Management Plan (DDSMP) and a Shiplift Management and Monitoring Plan (SMMP) to the satisfaction of the DEP.

Management Commitments 5.1 and 5.2 relate to the preparation and implementation of a dust management plan, prepared to the satisfaction of the DEP on advice from the City of Cockburn. The dust management plan will address:

- the assessment of potential impacts;
- relevant criteria and standards;
- monitoring; and
- management measures.

Management Commitments 6.1 and 6.2 involve the preparation and implementation of a Marine Safety Management Plan which will address:

- interaction of recreational and commercial boating movements;
- minimum clearance requirements;
- management measures;
- cooperative education programs and materials;
- emergency procedures/response strategies; and
- future management.

These commitments can be monitored by the Department of Transport (DOT), and enforced by LandCorp under the *Western Australian Land Authority Act 1992*.

Management Commitment 8.1 and 4.1 relate to LandCorp's compliance with the recommendations of the WA Maritime Museum study (Garratt and Souter, 1997) and the *Environmental Protection (Noise) Regulations 1997*, respectively.

Management Commitment 7.1 commits to the design and construction of an appropriate interface/buffer on the northern boundary of the development to ensure that the proposal and operation of the future industries will have no adverse off-site impacts on the Woodman Point Regional Park.

It should be noted that the Proponent for this proposal (LandCorp) is not the same Proponent that was responsible for the construction of the northern breakwater within the Northern Harbour (DCT). However, LandCorp is developing a legal framework with DCT to manage water quality in the Northern Harbour.

Further details pertaining to the monitoring and management of water quality within the Northern Harbour will be provided in the Dredging and Dredge Spoil Management Plan (DDSMP), and the Shiplift Management and Monitoring Plan (SMMP) which will be available for public inspection.

2.3 Submissions on the Selection of the Preferred Option

(1) ES-1 has not identified any proposed modifications that may be required for the treated wastewater emergency outlet. This is a major factor that requires consideration as it could double the project expenditure for the first phase of the project. It should be noted that the Water Corporation is not prepared to fund any proposed modifications to the outlet.

A: The existing location of the Water Corporation's wastewater emergency outlet pipeline on the seabed within Jervoise Bay places constraints on the future development of Lots 165A, 165B and 167. The outlet riser at its present position also represents a potential shipping hazard. At present the top of the diffuser is located at –4.5metres CD. The larger ferries being constructed in the harbour have draft requirements approaching 4m and potential users of the new lots proposed for development have indicated a requirement to cater for vessels up to 8m draft. Requirements for suitable pipe protection against damage by ship anchors are likely to result in further reductions in the available draft within the Northern Harbour.

The Water Corporation has advised that to ensure reliability of operation any emergency overflow arrangements need gravity systems that are simple to operate. The preferred option after discussions with WaterCorp is to terminate the outlet at the proposed seawall (WaterCorp, 1999).

(2) *The proposal to dredge to -6m in the harbour area will intercept the Woodman Point treated wastewater emergency outlet. Unless the Woodman Point treated wastewater emergency outlet is altered or relocated the Water Corporation would find it difficult to accept the proposal in the CER. The current proposal may prevent the Water Corporation meeting their environmental conditions for the outlet should an emergency overflow be necessary.*

A: A range of options for relocating the outlet have been discussed with the Water Corporation and the preferred option is to terminate the outlet at the proposed seawall (WaterCorp, 1999). The impacts of this change are predicted to be minor as discussed below and the proposed modifications can be reflected in the licence conditions for the outlet.

LandCorp engaged specialist coastal and marine engineers M P Rogers & Associates Pty Ltd to comment on the impact on the water quality inside the Jervoise Bay Northern Harbour by relocating the diffuser outlet to the edge of the proposed seawall after the construction of the proposed development (M P Rogers & Associates, 1999b).

To enable a comparison of the impact on the water quality of relocating the diffuser outlet the following assumptions were made:

- the same volume of treated wastewater would be discharged at the new outlet location;
- the same diffuser outlet would be used at the new location;
- the orientation of the diffuser outlet would be kept the same;
- the vertical location of the diffuser outlet at the seawall would be the same as the current position (ie at -4.5 metres CD); and
- the use of the Jervoise Bay outlet would be within the guidelines of the licensing agreement between the Water Corporation and the Department of Environmental Protection.

The discharge of treated wastewater via the Water Corporation emergency wastewater outlet into the Jervoise Bay Northern Harbour was analysed using turbulent diffusion and dispersion theory to determine the dilution of the effluent plume. It is assumed that the discharge from the Water Corporation diffuser outlet will be essentially lighter (density ~ 1,000 kg/m^3) than the ambient seawater (density ~ 1,025 kg/m^3).

The dilution of the effluent from the Water Corporation emergency wastewater outlet is determined by:

- initial vertical mixing;
- horizontal turbulent diffusion; and
- longitudinal (shear flow) dispersion.

Initial mixing of the effluent and the ambient water occurs at the discharge point due to the momentum possessed by the effluent as it exits the diffuser outlet. This initial mixing is largely controlled by the outlet design and the operational conditions. Following this initial dilution, the plume continues to rise through the water column until it forms a surface layer. This buoyant plume is then carried in the direction of the mean flow, and spreads out due to random velocity fluctuations.

For the purpose of this study, it was assumed that the discharge of treated wastewater from the current outlet position is analogous to the "centreline" discharge of effluent in an infinitely wide channel. This can be assumed because the time required for "shear flow" dispersion effects due to the presence of the shoreline to become significant (which is estimated to be in the order of about a week) is far greater than the time scale of interest ($t \leq 12$ hours). (Twelve hours is the maximum cumulative time the emergency wastewater outlet is allowed to be operated in one year under the DEP License Conditions). The discharge of treated wastewater from the new location at the seawall can be considered as a "side wall" discharge of effluent. In both cases, the flow is expected to be much wider than it is deep. Therefore, the vertical mixing can be assumed to be instantaneous relative to the horizontal mixing.

Analytical solutions for continuous "centreline" and "side wall" discharge of a buoyant effluent as developed by Fisher et. al (1979) were used in this assessment.

On a macro scale (consideration of the harbour as a whole), the relocation of the outlet to the edge of the proposed seawall will not change the total amount of

pollutant entering the harbour from this source. However, the reduction in mixing efficiency caused by relocating the outlet may increase the period of time the pollution can impact on the water quality.

The dilution of the discharged effluent is unlikely to be as effective as dilution of the effluent from the present discharge location, which may cause localised increases in pollution levels in the vicinity of the proposed development. However, it would be possible to achieve similar dilution at the new outlet location by designing an alternative diffuser outlet to provide greater initial mixing of the discharged effluent.

These localised increases will only be temporary, as the Water Corporation has stated that after 2002, any emergency overflows from the Woodman Point WWTP discharged into the Northern Harbour will be of advanced secondary effluent quality (Water Corporation, 1999).

2.4 Submissions Relating to EPA Factors

2.4.1 Biophysical

2.4.1.1 Terrestrial Flora

2.4.1.1.1 Vegetation Communities

(1) Landcorp are suggesting the creation of a buffer zone between industry and Woodman Point by utilising part of the reserve. We find this response unacceptable. One of the Lots in question was reserved as a buffer, this has been rezoned, and now they see the need to utilise a public area to develop a new buffer for the development.

A: LandCorp's original project concept included the possible contribution of funds towards the enhancement of a landscaped triangular buffer zone on the north side of Lot 165B, just south of the Water Corporation's outfall pipeline reserve. Preliminary consultation by LandCorp had indicated possible support for the concept of diverting some of the site stormwater runoff water into a small dampland located just to the north of the development site, which has formed in a depression left over from the 1970s Ocean Endeavor project. The proposed concept was to enhance the wetland functions and environmental values of this dampland, and improve the aesthetics of the former Ocean Endeavor construction site through a Landscape Management Plan incorporating boardwalks and cycle paths. The concept was linked to the possible upgrading/expansion of carparking at the public boat launching ramp.

In response to public submissions, LandCorp has modified the proposal such that the northern boundary of the seawall will be entirely contained within LandCorp held property (Lot 165B). Site drainage and stormwater runoff concepts have also been modified to be entirely contained on site.

(2) *A condition of approval for this proposal should be that the seawall and any associated facilities should be contained outside the Woodman Point Regional Park.*

A: LandCorp has re-designed the facilities to ensure that they are contained outside the Woodman Point Regional Park.

(3) *A condition of approval of the CER should be that an appropriate buffer zone is fully contained on the development site to separate Lot 165B from the Regional Park. The size and nature of the buffer zone (including appropriate landscaping) should be prepared to the requirements of the DEP, on the advice of CALM.*

A: LandCorp has modified its proposal to include a landscaped parking area on the northern boundary of the site, contained entirely within the development.

It is proposed to provide an access route to Lot 165B on the northern boundary of the lot which will include landscaped parking areas and will provide an effective building setback from the southern boundary of the Woodman Point Regional Park as outlined in the Proponent's Commitment 7.1.

The revised concept plan will be resolved to the satisfaction of the DEP.

2.4.1.2 Marine Biota

2.4.1.2.1 Seagrass, Benthic and Other Marine Flora and Fauna

(1) *The CER does not appear to provide details on site specific surveys of the marine environment within the development area. What evidence is there that seagrass is not present in Northern Harbour?*

A: Spot dives were undertaken in January 1999 by the Marine and Freshwater Research Laboratory (MAFRL), in the waters directly affected by the proposed development. These dives were carried out to assess the local marine biota and to verify the findings of the seagrass and benthic fauna survey, undertaken by Halpern Glick Maunsell (HGM) in 1996, in an area adjacent to the construction site for the northern breakwater. MAFRL observations confirmed the sparse distribution (scattered, individual plants) and low species diversity of seagrass,

predominantly of the genera *Halophila*, in the proposed development area. MAFRL also noted the presence of a reef and two shipwrecks containing a high abundance but low diversity of sessile filter feeders, predominantly ascidians (indicators of poor water quality) (MAFRL, pers. comm), within the waters adjacent to the Study Site. The spot dives by MAFRL confirmed the limited ecological function and low conservation value of marine biota in the Northern Harbour, as reported by HGM in 1996. The report from MAFRL has been provided to the Department of Environmental Protection under separate cover (MAFRL, 1999).

(2) *The EPA Bulletin 907 stated quite clearly that dredging of the basins and shipping channels in the shallow margins of the Sound, where seagrasses once flourished but since have been lost, would create areas where bottom light levels would be greatly diminished.*

The construction of breakwaters and reclaimed areas would permanently cover additional areas of these shallow margins. The dredging effectively removes an area of possible seagrass habitat. If seagrass can be replanted then it is essential that all possible remaining habitats be retained.

A: It is correct that deepening will reduce the amount of light reaching the seabed and therefore further reduce the chance that seagrass could one day re-grow in this part of the Northern Harbour. The region in question does not contain any seagrass meadow though it may have in the past (DEP, 1996).

As stated in the CER, the Northern Harbour has been devoid of seagrass meadows since at least 1950. Remnant seagrass patches were observed in the harbour in 1950, but these were lost sometime between 1950 and 1975 (Soros-Longworth and McKenzie, 1978). A recent seagrass survey (HGM, 1996) reported no seagrass meadows in the Northern Harbour, only scattered individual plants of less than 5% cover. The same survey observed no evidence of viable rhizome material in sediments, confirming that the seagrass community had been at its current sparse density for a significant period of time. MAFRL (1999) observations confirmed the sparse distribution (scattered, individual plants) and low species diversity of seagrass predominantly of the genera Halophila, in the proposed development area.

The proposed development will not involve any construction works outside the Northern Harbour and, as the proposal is not likely to have adverse impacts on water quality, there are not expected to be any impacts on seagrass meadows located near Garden Island and Success Bank.

(3) Page 4-10 of the CER states that the blooms 'have been of non-toxic species, and there have been no reported incidents of public health problems or fish deaths (HGM, 1998).' This is not true as within weeks of the completion of the Breakwater crabs, fish, including starfish, and barnacles were lying dead on the seabed and shoreline. Are any of the algae species responsible for blooms toxic?

A: In a report on water quality in the Northern Harbour over the summer of 1997/98, HGM (1998) concluded that there was no evidence of fish deaths following extensive enquiries. Oxygen levels were recorded in the bottom waters at the time which could have resulted in fatalities amongst sessile benthic species. The blooms at the time were not of species considered to be harmful to marine life (HGM, 1998).

During February 1999, the dinoflagelate *Gymnodinium breve* – like species occurred in high numbers (up to 43,000 cells per litre) in the Northern Harbour of Jervoise Bay and there were initially concerns that this may be a harmful strain. Subsequent toxicity tests indicated that the species present was not toxic. There have been no other incidents of potentially toxic algal blooms within this water body. Further information on phytoplankton (algal) species is presented in Summary section 1.3.3.

2.4.2Pollution Management

2.4.2.1 Groundwater Quality and Surface Water Quality

(1) A condition of approval should be that all drainage is fully treated and contained outside of the Woodman Point Regional Park.

A: The Proponent agrees with this condition. Refer also to the response to question *2.4.1.1.1 (1) and 2.3 (2).*

(2) The Water Corporation is concerned that the Proponent has only elected to address the groundwater issues and not include the treated wastewater emergency outlet strategy in the CER. The Water Corporation considers both issues are equally important in terms of this development.

A: A range of options for relocating the outlet have been discussed with the Water Corporation, and the preferred option is to terminate the outlet at the proposed seawall (WaterCorp, 1999). Refer also to the response to questions 2.3 (1) and 2.3 (2).

(3) Although the magnitude of the nitrogen load discharge by groundwater will not change, the land reclamation project may have an impact on the distribution of

groundwater discharge, which may in turn affect the intensity of algal blooms in the harbour. This may occur because the dredged material will have a generally low permeability, and this may divert groundwater flow from the treatment plant to the north and concentrate discharge in the northern part of the harbour near the Cockburn Power Boat Association where blooms commonly occur. The change in the harbour bathometry may also effect the location of the groundwater discharge into the harbour. Not enough is currently known about the distribution of groundwater discharge in the harbour to accurately predict the effect of the reclaimed land on groundwater flow in the area.

A: An overview of the groundwater issues related to this project is provided in Summary section 1.2. The construction of the proposed sea wall and associated dredging and filling operations has the potential to locally modify existing groundwater flow conditions. Figure 3 is a geological cross section across the Northern harbour, along the axis of the proposed ship lift basin. The cross section shows the relationship between the proposed works and the existing geological formations.

Construction of and backfilling behind the seawall will force groundwater that is discharging from the Safety Bay Sand along the current beach front to discharge through the seawall. As the sediments being dredged from in front of the seawall are of similar composition to the sediments behind the seawall (Geological Survey, WA, 1985), the hydraulic properties of the spoil will be similar to the sediments they will rest upon. As such, no significant diversion of groundwater flow is anticipated.

(4) *While the CER has recognised the possibility of a preferred flow path it has not addressed the possibility of intercepting a preferred flow path which could lead to an increase in the nutrient loading to the harbour. The CER does not provide sufficient detail to give confidence that this situation will not occur and does not provide detail on management strategies which could be implemented should this occur.*

A: An overview of the groundwater issues related to this project is provided in Summary section 1.2. The dredging of the shiplift basin will potentially extend into the upper section of the Tamala Limestone (Figure 3). The potential for modification to groundwater flow will depend largely on the presence of the clayey shelly layer at the base of the Safety Bay Sand. If present, fresh groundwater at the top of the Tamala Limestone may be intersected. In this case, flows of groundwater into the shiplift basin will be controlled by the hydraulic head differential between the aquifer and sea level. If the clayey shelly layer is not

present, the dual-saline wedge illustrated in Figure 3 will not have developed and no fresh water will be intersected by the shiplift basin.

(5) *The CER has not addressed the nutrients moving west in groundwater from sources to the east of Lake Coogee. Nutrients from these sources are likely to continue moving west, and possibly increase, with future development. The CER has not considered the long-term consequences for the Northern Harbour of this continued nutrient inflow nor do any studies appear to have been undertaken in this regard. The CER assumes the proposed clean-up operation will successfully manage the eutrophication problem in the harbour.*

If the proposed clean-up operation is not successful future drastic action, such as the removal of the Northern Breakwater, may be necessary. This possibility has a major bearing on the long-term viability of the proposed expansion to shipbuilding activities and should have been considered and evaluated in the CER.

A: Sources of nutrients in groundwater flowing to the Northern Harbour are presented in Summary section 1.2.2. Groundwater investigations along the coast of Jervoise Bay identified two major point sources of nitrogen inland from the Northern Harbour as waste water injection at the Weston Bioproducts facility and the Water Corporation sludge drying beds (PPK, 1998a and 1998b). Although delineation of the plumes is not complete, it is likely that the Northern Harbour receives the full lateral extent of both nutrient plumes (PPK, 1999). The inferred extent of the plumes is illustrated in Figure 4. Additional "background" nutrient loading is contributed by urban and horticultural development between the Jandakot mound and Jervoise Bay.

Estimates of nutrient discharges into the Northern Harbour were made by PPK (1998a and 1998b). Although there is considerable range in the nutrient flux estimates due to the variable transmissivities reported for the Tamala Limestone; it was concluded that the Woodman Point Plant and Weston Bioproducts together account for approximately 80% of the nutrient flux entering the harbour. The remaining 20% is derived from sources further east.

The Groundwater Recovery Plan initiated by the Department of Commerce and Trade will address all sources of nutrients entering the harbour and the remediation strategy will focus on the elimination of algal blooms, regardless of the nutrient source. There is also little evidence to suggest that this up gradient nutrient contribution will increase in the long term (PPK, pers. comm.).

(6) *The inference that wastewater discharge from the Woodman Point Treatment Plant is contributing to the degradation of water quality in Cockburn Sound and Jervoise Bay is not acceptable to the Water Corporation. The Water Corporation*

does not believe the Woodman Point Wastewater Treatment Plant has had a significant influence on the reduction in water quality in Cockburn Sound as, with the exception of minor and infrequent emergency flows, no waste waters have been discharged to Cockburn Sound since the mid 1980's. The old outlet that did discharge into Cockburn Sound was replaced in 1984 and the water quality issues in Cockburn Sound since that time would be due to other outside influences.

A: Noted.

(7) The proposal in the CER must reflect the existing Department of Environmental Protection conditions on the Water Corporation wastewater emergency outlet from Woodman Point Wastewater treatment Plant. The imposition of further restrictions on the Water Corporation's ability to operate the approved outlet and meet the DEP conditions would not be acceptable. Although the Water Corporation has indicated the use of the wastewater emergency outlet is only likely to be used infrequently it is an essential asset that must be available for emergency situations.

A: Noted.

(8) The remediation strategy being developed by the Water and Rivers Commission, Department of Commerce and Trade, Water Corporation, Department of Environmental Protection, Landcorp and Weston Bioproducts is focussed on ameliorating the impact of groundwater discharge to the Northern Harbour from the Weston Bioproducts plume. This strategy may need to be re-evaluated and modified in the future to include clean up contamination from the Water Corporation site if land reclamation effects the groundwater flow.

A: The Groundwater Recovery Plan initiated is a legally binding commitment as a result of the southern harbour proposal by the Department of Commerce and Trade. The plan will address all sources of nutrients into the harbour and the remediation strategy will focus on the elimination of algal blooms, regardless of the nutrient source. Land reclamation activities are unlikely to change the current nutrient loading contribution of the Water Corporation's sludge drying beds.

(9) The Proponent should maintain an easement along the eastern boundary of the development to allow groundwater recovery bores and other infrastructure to be installed should a remediation strategy become necessary for the groundwater moving through this area.

A: If the further work shows that the recovery bores need to be on the western side of Cockburn Road then they can be accommodated through a short term access arrangement.

(10) The proposed groundwater remediation will most likely involve pumping of polluted groundwater, removal of contaminants and injection of the water back into the limestone aquifer. It should be noted that at this location the freshwater is floating on a tongue of intruding sea water (Figure C2) and pumping will cause a sharp up-coning of the saline water that can take years to subside once pumping ceases. In such circumstances it is necessary to pump at low rates, often intermittently and from several bores over the affected area. This takes longer that is the case where such circumstances do not exist and it is expensive. This remedial action needs to be included in the CER.

A: This question relates to the Groundwater Remediation programme which is beyond the scope of this assessment. The Groundwater Recovery Plan initiated by the Department of Commerce and Trade will identify the most appropriate approach to groundwater remediation. Nevertheless, the Proponent acknowledges the points raised and will pass the information to the DCT for consideration in their remediation plan.

2.4.2.2 Marine Water and Sediment Quality

(1) The draft criteria referred to in the CER has been suggested so that an exceedence of the lower of the two criteria, the ERL, triggers a management response in the form of an investigation of elevated concentrations of contaminants, while exceedence of the ERM can require the immediate development and implementation of a remedial management plan should that be necessary. The purpose of the ERL criteria is to provide triggers for management action before the probability of unacceptable environmental impacts becomes significant. The ERLs have been developed from a database consisting of many individual sediment quality/eco-toxicity data sets and the ERL and ERM concentrations of contamination have been set such that approximately 10% and 50% respectively, of those data sets would demonstrate an unacceptable impact (mortality) on marine in-fauna. This means that maintaining the concentration of contaminants at the ERL level does not in itself guarantee that there will be no impacts and this is the basis for requiring investigations into the source and implications of the contamination at these concentrations.

A: The DEP as a part of the Perth Coastal Waters study, has developed draft environmental quality objectives (EQO) which represent the long-term goals of an environmental management program. One of these objectives (EQO 2) is for the

maintenance of ecosystem integrity. This EQO has been divided into three classes: Class I – conservation zone, Class II – multiple use zone; and Class III – industrial buffer zone. Environmental quality criteria have been developed to ensure that the EQOs are met. The draft EQCs for contaminants in water are the same for ECO 2 Classes II and III. However, the sediment quality criteria for these classes are substantially different. The Class II EQCs are based on ERL (effect low range) or an estimate of the contaminant concentration below which biological effects occurred rarely (10%). The class III EQC's are based on ERM (effects range median) or an estimate of the contaminant concentration above which adverse biological effects occurred frequently (50%). These criteria are based on eco-toxicity data developed in the USA.

(2) *In relation to the ongoing sediment monitoring programme, the Proponent makes a case for sampling to be scaled down to take place on a triennial basis as opposed to annually. This argument seems to rest on the Proponents assertion that "all sediments contaminant concentrations were well below the DEP (1996a) draft EQCs for Industrial Buffer Zones..... and have not changed dramatically over three sediment monitoring surveys." The Proponent has simply applied the EQCs for an EQO 2 Class III zone by comparing the survey data against the higher of the two criteria which are presented in the SMCWS. The results of the monitoring show one site exceeds the ERL (effects range low) for copper and two sites exceed the ERM (effects range medium) for TBT. This claim also contradicts the statement in Section 4.3.1.2 Release of Sediments "The Site.....(Site 1, Figure 4.4) had an average concentration of 325 nano-grams of TBT per gram of sediment....which is seven times the draft EQC for industrial Buffer Zones. These statements need to be amended in any future relevant documentation.*

A: With respect to the first part of this submission, LandCorp must clarify the misunderstanding that they are making a case "*for sampling to be scaled down to take place on a triennial basis as opposed to annually*". In the CER (*Section 4.3.1.2 page 4-13*), the Proponent is merely restating a recommendation by HGM (1999) that ongoing sediment monitoring for contaminants be reduced, on the basis that concentrations have not changed dramatically over three annual sediment monitoring surveys. Ongoing sediment monitoring is the responsibility of DCT, as part of the conditions of approval for the Northern Breakwater.

The CER shows sediment contaminant concentrations for the existing HGM sampling sites (HGM, 1998) compared with levels measured within the actual area to be dredged for the development (MAFRL, 1999- **Appendix D** of CER). As stated within this submission, the results of the HGM monitoring show one site exceeds the ERL (effects range low) for copper and two sites exceed the ERM

(effects range medium) for TBT. However, it must be clarified that these HGM sampling sites are not within the proposed area to be dredged (refer to **Figure 4.4** of the CER). The recent sampling by the Marine and Freshwater Research Laboratory (ARLA, 1999- **Appendix D** of CER) shows levels of contaminants within sediments in the area to be dredged are well below the ERM (EQC Class III) criteria and, with the exception of TBT, all contaminants are below the ERL (EQC Class II) criteria. For further details of these sampling results refer to the response to submission *2.4.2.2(4)* below.

The final point in this submission relates to an average measurement of 0.325 mg TBT kg^{-1} of sediment at HGM Sampling Site 1 (HGM, 1998), which is seven times the draft EQC for Industrial Buffer Zones. As detailed in the CER, this sampling site is in the southern corner of the Northern Harbour, adjacent to existing shipbuilding, repair and maintenance industries. The proposed development site is in the north of the harbour and, as shown by recent sampling, exhibits low levels of sediment TBT contamination. The amended *Environmental Protection Regulations 1987* (Part 7- Anti-fouling paint), the *Environmental Protection (Abrasive Blasting) Regulations* 1998 and licence conditions under Part V of the *Environmental Protection Act 1986* will significantly reduce potential TBT pollution adjacent to the proposed development.

(3) In light of this the sediment monitoring should be conducted annually for at least three years after which it should be reviewed. Annual sediment monitoring has been conducted for the last two years as part of a five year commitment made by the Department of Commerce and Trade (DCT) in relation to the Jervoise Bay Northern Harbour Management Plan. The monitoring programme required of LandCorp in this instance must be linked to that being conducted by DCT. This programme will also sample sediments annually for the next three years and linking and rationalising the two monitoring programmes, will effect efficiencies for both Proponents, develop adequate information for assessment of potential and existing environmental threats and impacts and contribute to coordinated (between the existing Proponents) environmental management of the whole of the Jervoise Bay Northern Harbour.

A: The Department of Commerce and Trade has responsibility for water quality management in the Northern Harbour, through Ministerial Conditions placed on the approvals for the Northern Breakwater. The Northern Harbour Management Plan under preparation by DCT will provide the umbrella control for harbour management, and LandCorp's monitoring programme will be consistent with the overall strategies and criteria nominated in this plan. Refer also to Summary Section 1.4.

(4) In using the EQC for industrial Buffer Zones the CER has ignored that fact that people swim and fish in Northern Harbour and boat launching involves frequently entering the marine environment. More strict criteria should be adopted.

A: The Northern Harbour of Jervoise Bay is used for two main activities: the ship building industry; and public recreation in the form of boating, fishing and swimming. However, these two activities generally do not geographically overlap. The public recreational facilities are limited mostly to the northern end of the harbour in the vicinity of the boat ramp and the breakwaters.

The following Table 4 presents the results of sediment analysis in the vicinity of the development area and the public boat ramps.

Table 4: Concentrations (mg kg^{-1}) of contaminants in sediments compared with draft environmental quality criteria. All values are expressed as dry weight.

Parameter	EQO 2 Class II (ERL)	EQO 2 Class III (ERM)	Proposal Site		Boat Ramp
Arsenic	8.2	70	2	1	8
Cadmium	1.2	9.6	0.1	<0.1	0.1
Chromium	81	370	8	7	17
Copper	34	270	2	3	0.3
Nickel	20.9	51.6	1	1	18
Lead	46.7	218	<0.1	2	13
Zinc	150	410	4	7	47
Mercury	0.15	0.71	<0.02	<0.02	0.07
PAH's*	4.02	44.8	bdl**	bdl	bdl
TBT*	0.01	0.05	0.022	0.018	0.05

* expressed as entire compound (rather than elemental metal).

** below detection limit.

The sediment contaminant levels in the development area and in the vicinity of the boat ramp are both within the Class II criteria; with the exception of TBT concentrations. These were outside the Class II criteria, but within the Class III limits. It is expected that the increase in shipbuilding activities will result in increases to the concentrations of metals within the area of the seawall. Management and monitoring plans will be put into place to ensure that the Class III criteria are met.

It should be noted that these criteria are still in draft form. The new ANZECC Australian and New Zealand Guidelines for Fresh and Marine Water Quality have been released for public comment, and the EPA may adopt these guidelines in line with the National Water Quality Management Strategy. The ANZECC Sediment Guidelines are very similar to the Draft DEP criteria.

(5) *It appears that the recommendations and comments from the EPA in Bulletin 907 have been ignored by this development. Bulletin 907 quite clearly states that:*

- *the cumulative effect of a number of large scale developments along the eastern margin is likely to be a reduction in the rate of exchange of water between the inner eastern margin and the remainder of the sound; and*
- *the spatial extent of changes will not be restricted to the areas enclosed by breakwaters but will also affect the inner harbour marine areas and may possibly affect the broader Cockburn Sound.*

A: The proposal is not a large scale harbour development, nor will it extend into Cockburn Sound. The proposal may affect the water quality in the immediate vicinity of the basin, however, there will be no impact on the Sound. Cockburn Sound was fundamentally impacted by the large nutrient (specifically nitrogen) loads discharged to the Sound over the past three decades. This project will not result in increased nitrogen loadings to Cockburn Sound.

This proposal is consistent with the amendments to rezone the land to Industrial under the City of Cockburn Town Planning Scheme (Amendments 150 and 160) and under the Metropolitan Region Scheme (Amendment 986/33). These amendments have already been assessed by the EPA under Section 48A of the Environmental Protection Act 1986.

(6) *To what extent will the increased depth affect flushing, and thereby water quality, in the Northern Harbour? The CER states that the Northern Harbour is mixed by tidal action, wind, waves and baroclinic motion. Observations of water mixing during the algal blooms clearly indicated poor mixing at the mouth of the harbour. Opposing winds moved the plume in a visible demarcation - out on the easterlies and in again with the sea breeze. The prevailing winds from the south west contain the water body.*

A: The physical processes which are likely to dominate the flushing and water exchange of the Jervoise Bay Northern Harbour are tidal fluctuations, wind induced currents, and density generated currents. Using appropriate empirical techniques, the effect on these flushing mechanisms were examined before and

after the construction of the proposed development by MP Rogers and Associates (1999a). The results show that there will be little to no change in the flushing of the harbour under these various water exchange mechanisms after development. Further details of this assessment are provided in Summary section 1.1.

As the question states, the blooms observed in the Northern Harbour in summer 1997/1998 tended to be concentrated on the surface and follow the wind driven surface currents. With the morning easterly breezes the surface visible bloom will be blown away from the shore with part of the bloom entering the Sound. Algal cells on the surface will be blown back in the opposite direction with the afternoon sea-breeze. The construction of the current proposal will not change these processes.

(7) *The Proponent claims that the groundwater pathway may change marginally but that there will be no change in the volume or form of the contaminated groundwater. The impact of the location of groundwater intrusion on the harbour flushing is not addressed. The additional limestone material may cause other undetermined changes to the plumes and flushing in the harbour. These possible effects should be evaluated before approvals for the project are considered.*

A: The project may have an impact on the distribution of groundwater discharge. The nutrient plume emanating from the sludge drying beds is already being captured within the northern harbour and the proposed dredging and filling activities are unlikely to change this. The composition of the dredging spoil will be very similar in composition to the existing aquifer matrix and will actually be representative of the lower section of the Safety Bay Sand and the Tamala Limestone. The plume from the sludge drying beds is quite diffuse and of low average concentration due to the source of the nutrients being on the surface and the resulting attenuation and mixing through the soil column and the saturated profile of the aquifer. Where groundwater is discharging directly into the nearshore marine environment behind the proposed seawall, from fissures in the underlying Tamala Limestone, seawall construction and back filling is likely to result in a diffuse discharge.

Changing the bathometry of the harbour through dredging may also have an impact on the distribution of groundwater discharge. This will largely depend on whether dredging intersects only Safety Bay Sand, or extends into the top of the Tamala Limestone. In either scenario, groundwater discharge after the dredging operation will be occurring into deeper water near the seawall. Refer also to Summary section 1.2.

(8) *It is proposed to create a 14m hole of 4000m² for a ship-lift. As indicated in the CER this may cause or trigger a number of water problems. A number of management measures are proposed. The Proponent has already discounted 1 and 3 because they could release nutrients from the sediment into the water column. 2 and 4 have the potential to cause turbidity in the water and release silica, there by triggering algal blooms. No assessment has been made of the impact these activities would have on fauna, the affect of the organic matter released from the bottom, and recreational activities.*

A: The strategy for management of the shiplift basin has been detailed in Section 1.0. The Proponent has committed to preparing and implementing a Shiplift Monitoring and Management Plan (SMMP) (Management Commitments 3.1 and 3.3). The SMMP involves monitoring the water quality (including algal species) in and adjacent to the basin and also the rate of build-up of organic material in the newly dredged basin. The monitoring plan includes a detailed review of remediation options including potential environmental impacts.

(9) *The management measures indicated do not show how the water quality problems will not arise from the ship-lift.*

A: The management strategies have been put forward because the Proponent acknowledges that the construction of the ship-lift basin may reduce the water quality in the basin area if left unmanaged. The proposed strategy for management of water quality in the basin has been detailed in the response given in Section 1.4.

(10) *The water in the area of the CPBA marina and public facilities showed the greatest degree of deoxygenation during the algal blooms. Flows from the ship-lift will impact most heavily on this area.*

A: The area in front of the CPBA currently suffers from some of the poorest water quality in the Northern Harbour and this has been shown in recent monitoring reports (HGM, 1998; 1999). The poor water quality throughout the harbour is a result of the high nutrient loads to the harbour from the groundwater (HGM, 1998). This is worsened in front of the CPBA by the increased retention time of these waters which are sheltered behind a smaller breakwater which extends off the main northern breakwater. The shiplift facility will not result in any measurable change to the quality of the waters in front of CPBA and the Proponent has committed to monitor the effect of the shiplift on water quality and to remedy the situation if a problem is found to arise (refer Section 1.4) and Management Commitments 3.1, 3.2, 3.3, and 3.4. Furthermore, the reduction of

groundwater nutrient load to the harbour is currently the aim of a major undertaking to be funded by Department of Commerce and Trade in the near future. The positive impacts of substantially reducing the groundwater nutrient load are anticipated to be seen in improved water quality in front of the CBPA and throughout the harbour.

(11) The management proposals for the ship-lift area are complex and appear largely unproven in situations such as the Northern Harbour.

A: In essence, the management proposed involves monitoring the situation and then if the basin is found to be adding to existing water quality problems in the harbour through sediment nutrient release then the preferred remediation option will be implemented. All remediation strategies which have been identified have been successfully implemented in situations similar to that likely to occur in the basin (refer Section 1.4).

(12) The turning of large craft in the region of the ship-lift will cause turbidity. What effect will this have on the water quality in the harbour?

A: As stated in the CER Section 4.6.1.1, shipping movements will be relatively low, since the industries will construct at most 20 to 30 vessels a year. It could take in the order of 30 weeks to build one of the larger vessels, during which period the vessel would be stationary on site. There would then typically follow a four to six week period of commissioning and sea trials with more frequent shipping movements.

Presently craft up to 100 m length regularly turn in the harbour. The action of the propellers may generate short term increases in turbidity and may result in short pulses of increased nutrient concentrations. This will not alter the water quality of the harbour over the longer term (on a time scale greater than days to weeks).

2.4.2.2.1 Dredging

(1) It is quite likely that dredging adjacent to lots 165 and 167 will release contaminated sediments and could even increase the flow of contaminated groundwater into the Northern Harbour. No evidence is provided to refute this concern and no plan of action is provided to deal with it.

A: Sampling by Halpern Glick Maunsell (HGM, 1998 and HGM, 1999) and MAFRL in May 1999 (refer to CER Appendix D), showed that contaminant levels in sediments in the area to be dredged were well below the draft EQCs defined in the

Southern Metropolitan Coastal Waters Study (DEP, 1996). The extremely low levels of contaminants in the sediment, as well as containment measures to limit the dispersion of suspended sediment (detailed in the DDSMP), will ensure that dredging operations do not detrimentally impact on water quality within the Northern Harbour.

It is unlikely that dredging would increase the flow of contaminated groundwater into the harbour although a redistribution of flow is possible. Refer to Section 1.2.

(2) *The CER does not fully address the issue of contingency plans with regards to the effects of dredging and construction work. These plans should be formulated and available for scrutiny before the project is given any endorsement.*

A: Contingency plans with regards to dredging and construction work will be presented in the Dredging and Dredge Spoil Management Plan. This plan will be available for public inspection.

(3) *The CER does not mention the possible return of the dredged slurry back into the harbour. From the CER this appears to be a likely scenario. If dredged material were to return to the harbour what would be the effect and how would it be managed?*

A: The Proponent has made a commitment that all dredge slurry water will be infiltrated behind the seawall and/or filtered such that there will be no direct discharge of dredge slurry water into the Northern Harbour. (Management Commitment 2.1) This commitment will be implemented via a clause(s) in the contract for dredging.

The available volume in the reclamation area exceeds the dredging volume by approximately 90,000 m^3 (ie more than double dredge volume.) Dredge water will return to the harbour by filtration through the seawall and by groundwater flow. Retention time is therefore maximised and the filtering effect of the seawall (including the filter cloth incorporated in the seawall) will ensure that turbidity usually associated with return water is minimised (and almost nonexistent). A water balance has been undertaken by Egis Consulting (1999) which confirms that spilling of dredge return water will not be necessary, since the potential outflow through the seawall (10,000m^3/day) will exceed the maximum inflow rate (8,000m^3/day). As a contingency measure, one or more dredge water recovery wells, consisting of a soak well type well liner with filter cloth covering the inlet holes, can be located within the ponded area, where clean water can be collected and pumped back into the harbour in the unlikely event that flow paths are blocked by fines.

(4) While the Consultant readily agrees that dredging activities have the potential for impacts on water quality, no details of containment measures are specified. It is clear that it will be difficult to manage the construction of the seawall, dredging and reclamation in a manner, which will protect against short-term water quality impacts within the harbour. Rather than discuss the issue in detail up front the approach taken in the CER is to prepare a Dredging and Dredge Spoil Management Plan once approval is obtained. This approach is of concern as it does not allow proper public scrutiny of the proposed criteria or methods to manage water quality. In the absence of this detail it is difficult to have confidence in the assertion that this aspect of the proposal will not lead to a loss of water quality.

A: Containment of dredge spoil will be effected by the seawall which will be constructed in advance of dredging activities. In addition, a silt curtain will be deployed around the dredge, if necessary, to minimise impacts on water quality. These issues will be addressed in the Dredging and Dredge Spoil Management Plan which will be available for public inspection (Management Commitment 1.1 and 1.2).

2.4.2.2.2 Dredging-turbidity

(1) The Proponent has failed to address the possible impact on water quality of suspended silt, sediments and silica in the water column around the dredge.

A: These issues are be addressed in the Dredging and Dredge Spoil Management Plan. As mentioned above a silt curtain will be deployed around the dredge if necessary and the return of dredge water by filtration through the seawall will minimise the presence of fine suspended sediments (Management Commitment 1.1, 1.2 and 2.1).

(2) Fine silt, silica and sediments could be suspended in the water column. The CER management measures do not adequately address this problem.

A: Refer to response to question *2.4.2.2.2 (1) Dredging Turbidity.*

(3) No Dredge Spoil Plan is shown in the CER. Approval should not be granted conditionally. The plan should be part of the CER.

A: The Dredge Spoil Management Plan will be available for public inspection (Management Commitment 1.1).

2.4.2.2.3 Discharge from Shipbuilding, Servicing and Maintenance Operations.

(1) On the basis of information in the Southern Metropolitan Coastal Waters Study, the future ship building operations associated with the development are likely to lead to a reduction in water quality and contamination of sediments within the harbour. Extremely rigorous management practices will need to be maintained for shipbuilding activities and stormwater control to minimise these impacts. While the CER outlines the broad practices and procedures that could be implemented it does not incorporate any commitments by the Proponent in terms of monitoring changes in water quality following the commencement of operations, nor does it address the management impacts which may arise.

A: The CER details the potential environmental impacts and management strategies pertaining to the civil construction works (Phase One) of the proposed development, for which LandCorp is the Proponent. Phase One of the project comprises dredging, seawall construction, earthworks, land reclamation and installation of services.

LandCorp is not the Proponent for Phase Two of the proposed development and, thus, does not have any direct responsibility with respect to the construction and operation of the future shipbuilding, repair and maintenance industries with the exception of management and monitoring of the shiplift basin and facility through seabed lease conditions. However, in the CER, LandCorp discusses potential environmental impacts associated with future shipbuilding, repair and maintenance industries, and outlines management strategies and regulatory processes available to control the impacts of these industries. The exact details of the future industries to be established on Lots 165-168 are not yet confirmed, consequently, the CER provides generic licence conditions that have been applied to similar industries in Western Australia. As discussed in *2.4.4.1.1(9)* below, the Department of Environmental Protection (DEP) is confident that the potential environmental impacts of future industries will be effectively dealt with under Part V (Works Approval and Licensing) of the *Environmental Protection Act 1986*, following the submission of detailed designs to the DEP.

Consequently, LandCorp does not believe that " *the future shipbuilding operations associated with the development are likely to lead to a reduction in water quality and contamination of sediments within the harbour*". As discussed in the CER (pages 4-21 to 4-22), improvements in industry practice, works approval and licence conditions, the amended *Environmental Protection Regulations 1987* (Part 7- Anti-fouling Paint) and the *Environmental Protection (Abrasive Blasting)*

Regulations 1998 will significantly reduce the potential for future industries to contaminate the waters and sediment of the Northern Harbour.

As discussed in *2.4.4.1.1(1)*, LandCorp has released a consulting brief for a contract to identify management issues, assess the legal framework available and determine the most effective structure of a formal management body for the Northern Harbour. Refer to Section 1.4 for further details.

2.4.2.3 Contamination

2.4.2.3.1 Dredge Spoil

(1) It is recommended that a sampling program be established to confirm the suitability of the sediment as reclamation infill. If levels of contaminants remain within the background levels of the ANZECC/NHMRC (1992) Guidelines for the Assessment and Management of Contaminated Sites there would be negligible risk to public health.

A: As discussed in the CER, a sediment sampling programme was undertaken by the Marine and Freshwater Research Laboratory (MAFRL) in May 1999, in accordance with the ANZECC Interim Ocean Disposal Guidelines (ANZECC, 1998). The MAFRL sampling data verified historic sediment sampling data from Halpern Glick Maunsell (HGM, 1998 and HGM, 1999) and confirmed that the level of contaminants within the area to be dredged are well below the soil acceptance criteria for industrial land use and, consequently, the dredge spoil is suitable for use as fill in the proposed reclamation works. In fact, for all contaminants measured, concentrations were so low that the dredge spoil would be acceptable for use in residential areas (ANZECC B soil acceptance criteria). The bulk of contaminants is also generally within the top 2 to 5 cm of sediment and, therefore, when mixed with the full volume of dredge spoil (approximately 80,000 m3) contaminant levels will be negligible.

(2) It is not expected that TBT levels in the sediment spoil would constitute a public health problem given the degree of mixing that will occur during reclamation and the proposed land use of the area. However, TBT levels should be included in any monitoring program that is implemented.

A: The following table shows the organotin concentrations that were measured, in the area to be dredged, during the MAFRL sediment sampling programme of May 1999. These results were not available at the time of CER publication.

Parameter (mgTBT kg^{-1})	Site 1D	Site 2C	Draft EQC	Dutch C* (Industrial Land Use)
Tributyltin (TBT) as Tin	0.022	0.018	0.05	-
Dibutyltin (DBT)	0.0008	0.0022	-	-
Monobutyltin (MBT)	0.006	0.0126	-	-
TOTAL Organotin	**0.0288**	**0.0328**	-	300

* Dutch C level- Interpreted as upper level for industrial use in Australia

The total concentrations of organotin (TBT, DBT and MBT) in the area to be dredged were well below the Draft EQC (Class II) for sediment (DEP, 1996a) and the soil acceptance criteria for industrial land use. In fact the average measured sediment organotin concentration was 2 times lower than the draft EQC for sediment contamination defined in the Southern Metropolitan Coastal Waters Study (DEP, 1996). Therefore, the TBT levels in the dredge spoil would not constitute an environmental or public health risk with respect to water quality or the proposed land use of the area.

2.4.2.4 Air

2.4.2.4.1 Particulates/Dust

(1) The City of Cockburn is likely to be involved in the management of any dust problems associated with the site and it is considered imperative that the City be listed as a referral agency for the Dust Management Plan.

A: A dust management plan will be prepared and submitted to the Cockburn City Council (Commitment 5.1 and 5.2). This plan will address:

- assessment of potential impacts;
- relevant criteria and standards;
- monitoring; and
- management measures.

2.4.3Social Surroundings

2.4.3.1 Recreation

2.4.3.1.1 Beach Access. Access to Woodman Point

(1) The 'potential use of the southern breakwater for Northern Harbour activities' may conflict with the promised use of all the breakwaters by amateur fishermen and the public in general. The island breakwater precludes this activity for the western breakwater.

A: This comment relates to the Southern Harbour development which is outside the scope of this assessment. The current study relates to the Northern Harbour.

(2) The proposal does not address the impact of the development on the existing use of the beach. It is anticipated that there will be substantial community outcry if the existing beach area is developed and the proposal does not provide any contribution to community facilities or other measures, which could compensate for impacts on current recreational uses.

A: It is fully recognised that any decline in water quality generated through the construction and operation of the proposal is likely to negatively impact the amenity of nearby public areas. It is for this reason that the Proponent has committed to managing the construction and operation project to a high standard. Refer to Proponent Commitments to manage Marine Water Quality, Noise, Dust and the boundary to the Woodman Point Regional Park.

2.4.3.1.2 Boating

(1) Existing boat facilities in the region cannot cater for present recreational demand and yet the proposal has made no provision for the future growth of recreational craft in the region. The Northern Harbour should continue to be a shared facility, with more area set aside for recreational boating requirements.

A: Planning for recreational boat facilities falls under the jurisdiction of the City of Cockburn, the Ministry for Planning and the Department of Conservation and Land Management, as managers of the Woodman Point Reserve. However, LandCorp is working with these agencies to ensure that the harbour continues to operate as a shared facility.

(2) The most deoxygenated water during the recent algae blooms was in the region occupied by recreational craft. The possible impacts on water quality will most directly impact on the amenity of the public areas.

A: This submission is very similar to 2.4.2.2 (10) and the reader is referred to this response and also to Section 1.3 for relevant information. The submission is correct in stating that the lowest dissolved oxygen levels have been recorded in front of the public boat ramp. However, the Proponent is confident that the proposal will comply with the EPA objective to maintain or improve water quality within the Northern Harbour.

(3) The CER admits that there will be difficulties created by the proposal for present small boat users. It fails to identify any adequate way to address the problems that will be created. There will be a strong demand to expand the recreational boat use in this area over time however this project precludes the expansion of present launching facilities for future use. The logical plan of development would be to use the site planned for commercial fishing to allow for future public launching facilities and retain the 'buffer' site for what it was intended - as a buffer between industry and other boat users.

A: The Proponent is committed to prepare and implement a Marine Safety Management Plan that is focussed on the professional sharing of the marine harbour facilities of Jervoise Bay (Commitment 6.1 and 6.2). Planning for recreational boat facilities falls under the jurisdiction of the City of Cockburn, the Ministry for Planning and the Department of Conservation and Land Management, as managers of the Woodman Point Reserve.

2.4.3.2 Heritage

2.4.3.2.1 Aboriginal Culture and Heritage

(1) *The Proponent has satisfied all obligations under the auspices of the Aboriginal Heritage Act 1972.*

A: As noted above, the Proponent has satisfied all obligations to date under the auspices of the *Aboriginal Heritage Act 1972*.

2.4.3.2.2 Heritage

(1) The proposal does not affect any places that are currently on the Register of Heritage Places. However, it would be appropriate to check if there are any places listed on the relevant Local Government's Municipal Inventory of Heritage Places.

A: There are no heritage sites listed for the development area on the City of Cockburn's Heritage Register.

2.4.3.2.3 Maritime Shipwrecks

(1) The Federal Attorney's latest ruling regarding the shipwrecks in Jervoise bay is that, for the purposes of the Commonwealth Historic Shipwrecks Act 1926, the waters of Cockburn Sound come under Commonwealth jurisdiction.

A: While the *Alacrity* and *Abemama* are located in waters under Commonwealth jurisdiction, they are less than 75 years old and therefore are not protected under the Commonwealth *Historic Shipwrecks Act 1926*. Exceptional wrecks less than 75 years old can be protected under the Act, however the Maritime Museum has decided to not make a special case for these wrecks due to the impact of poor water quality on recreational diving conditions, and the industrial usage of the harbour, which would see damage to the wrecks if they were not buried (refer to letter from Director of Maritime Museum, August 1999). Nonetheless the Proponent has made a commitment that the wrecks will be managed according to WA Museum advice (Commitment 8.1).

(2) The proposal will see the shipwrecks Alacrity and Abemama completely enclosed within the reclamation area. This is an inadequate response to the WA Museum's expressed concern about the damage to the fabric of the wrecks.

The measures suggested do not comply with the two requirements of the Museum as:

- *the structure is permanent; and*
- *the fabric will be damaged through the weight of material.*

It is ridiculous to suggest that by carefully selecting tons of material to cover the wreck it is going to avoid destruction to wooden hulled Abemama.

A: LandCorp has consulted extensively with the Maritime Museum of WA regarding the preservation of the two shipwrecks, the Alacrity and Abemama. LandCorp commissioned the Museum's Department of Maritime Archaeology to undertake a detailed survey of the two wrecks to determine their structural condition, stability, location and depth (Garratt and Souter, 1997). The Museum concluded that the two wrecks were in a state of accelerated degradation since their inundation in the 1970s, and recommended that the wrecks be buried as part of the development process to ensure their preservation (Garratt and Souter, 1997).

The WA Maritime Museum report recommended that *"infilling the wrecks and forming a land-backed wharf is the preferred course of action"* for burial providing that the process did not cause damage to the fabric of the wrecks and that nothing of a permanent nature is built over the site" (Garratt and Souter, 1997). The Museum is confident that burial of the wrecks will ensure their preservation (M. McCarthy, WA Maritime Museum, pers. comm.). The recommendation by the Maritime Museum for 'nothing permanent' to be constructed over the wrecks relates to the damage which could be caused by foundations and piles being laid over and/or through the wrecks. As the proposed development will not require any foundations or piles to be constructed over the wreck sites, the proposed development is not in conflict with the Museum's recommendations (refer to letter from Director of Maritime Museum, August 1999) (Refer to Commitment 8.1).

2.4.3.3 Noise

(1) *The CER provides information that suggests noise from construction activities would not cause adverse impacts to the closest noise sensitive premises. However, it does not indicate that noise levels above those stipulated under the Environmental Protection Act could be associated with the operational phase of the project, particularly at the Woodman Point Caravan Park. A review of the noise assessment also highlights a number of points that have not been addressed including tonality, impulsiveness, frequency modulation and the assessment of noise sources outside the confines of buildings that may result in higher than expected noise levels at the Caravan Park.*

A: Preliminary modelling of potential noise impacts from typical shipbuilding, maintenance and repair operations has shown that cumulative noise received at the Woodman Point Caravan Park would comply with regulatory requirements during the day and evening periods, but could exceed the assigned LA10 noise level by 5 dB(A) during the night period (CER page 4-40). The CER concluded that noise control strategies would need to be incorporated into the detailed design of future industries on the site and stated that individual industries would need to document and implement detailed noise management strategies, in consultation with the DEP, as part of the Works Approval and Licensing process.

The assigned noise levels were determined by Herring Storer Accoustics Limited, according to the methodology specified by the *Environmental Protection (Noise) Regulations 1997*. According to the Regulations, the assigned noise levels are conditional on the absence of annoying characteristics such as tonality, modulation or impulsiveness. If such characteristics exist, then any measured level is adjusted upwards from 5 to 10 dB(A) as defined in the Regulations.

Hand held measurements and site observations indicated that existing industries do not contain these characteristics. Even if future industries do require the use of equipment with these characteristics, at the time of detailed design, this equipment will be selected or redesigned to eliminate the characteristics. Based on modelling results presented in Table 4.4 of the CER, the industries would still comply with daytime regulations even if penalties were to be applied. The CER in Section 7.2.2 Appendix D has already stated that external work practices during evening and night periods would be constrained to ensure compliance with regulations.

At this subdivisional stage, noise data for site specific plant layouts and equipment for future new shipbuilding, repair and maintenance industries is not yet available, and therefore the preliminary modelling done for the CER was based on noise data obtained from measurements around the existing shipbuilding precinct further to the south. There is considerable scope for new industries using 'best practice' to control their noise emissions and there is a range of simple and practical noise management strategies available to enable new shipbuilding, repair and maintenance industries to comply with the Regulations and meet the EPA objectives for noise.

(2) *The Proponent does not intend to limit activities during the construction phase to between the hours of 0700 and 1900 on weekdays and not at all on Sundays and Public Holidays. Further commitments are required to address noise issues to prevent off site noise impacts.*

A: It may not be possible to restrict working hours to 0700 – 1900 on weekdays with no weekend work or public holidays. Any such restriction could severely jeopardise the ability to have works completed by the commencement of summer which is seen by all as a high priority for environmental reasons. Notwithstanding the above, construction noise will be managed in accordance with the *Environmental Protection (Noise) Regulations 1997* and, as stated in the CER section 4.6.3.1, should construction works need to be undertaken outside of the hours of 7am to 7pm, or on a Sunday or Public Holiday, the Proponent will:

- advise all nearby residents and occupants of the works at least 24 hours before they commence;
- demonstrate to the DEP that is was reasonably necessary for the works to be undertaken "out of hours"; and
- submit to the CEO of the DEP a noise management plan at least seven days before the works commence, detailing the need for the works, anticipated

noisy activities and the predicted noise levels, control measures and monitoring for noise and vibration, and complaint response. Construction out of hours will not commence until the CEO approves the noise management plan.

As stated in Management Commitment 4.1, the Proponent will ensure that all Phase One construction activities comply with the *Environmental Protection (Noise) Regulations (1997).*

2.4.3.4 Public Health and Safety

(1) The Proponent should consider locating the ship-lift further to the south to maximise the separation between the ship-lift and the entrance to the recreational boat launching facility. There is no land planning shown to demonstrate why the ship-lift needs to be located midway along the lot.

A: The Department of Transport is the state Maritime Authority with specific responsibilities for all aspects or recreational boating, including safety. LandCorp has outlined in writing to the Department of Transport the operational land use reasons why the shiplift is located in its current position as outlined in Figure 4.5 of the CER. A formal response from the Department of Transport has been provided to the Department of Environmental Protection under separate cover (Department of Transport, 1999) who have confirmed that the proposed separation distance of 108m between the shiplift and the recreational boat harbour breakwater is adequate provided that any ship moving to a berth on the northern side of the shiplift has a beam of less than 18m. LandCorp will prepare and implement a marine safety management plan to include the berthing and departure of ships from the shiplift, which complies with Transport's requirements, in accordance with LandCorp's Management Commitment 6.1 and 6.2.

(2) A 110m separation between the ship-lift and marina jetty is not sufficient for boating safety. Vessels leaving the public and CPBA ramps have to keep to starboard to avoid collision with vessels returning to the marina. These departing boats also need to keep to the port of the enormous boulders that are dangerously near the surface at the end of the marina. Given that the sea conditions change suddenly and many small craft will be returning to shore with those sudden changes a large number of boats could be within the area at the same time. Often drivers not only have the changing winds and waves to contend with but the ever present dangers of rocks on the groynes and the difficulty of manoeuvring around Cockburn's Sea Rescue vessel towing a stricken vessel back to safety.

A: The Department of Transport, which is the state Maritime Authority with specific responsibilities for all aspects or recreational boating, including safety, has confirmed that the proposed separation distance of 108m between the shiplift and the recreational boat harbour breakwater is adequate. See response to Question 2.4.3.4 (1), Summary Section 1.5 and Management Commitments 6.1 and 6.2.

(3) There is very little room to manoeuvre vessels larger than 100 meters and the proposed management strategies of training operators are inadequate. Mistakes will occur and this poses a danger to the boating public in this area.

A: LandCorp will prepare and implement a marine safety management plan for the berthing and departure of ships from the shiplift, which complies with the Department of Transport's (Maritime Division) Draft Marine Safety Plan Guidelines (1998), in accordance with LandCorp's Management Commitment 6.1 and 6.2. Refer to Summary Section 1.5 for a description of the contents of the Marine Safety Management Plan.

(4) The Cockburn Power Boat Association (CPBA) has been highly critical of the Northern Harbour breakwater construction and configuration. The Breakwater extension has created safety problems for small craft and contributed to water quality deterioration, despite the Proponent's assertions to the contrary. The only strategy the Proponent has identified to address safety issues in the marina is education of boat users. As there is no legislation that controls the handling of pleasure craft this is an inadequate response to a problem that will be created by the implementation of the proposal.

A: LandCorp has stated that they will participate in the development and implementation of an education programme, in conjunction with the Department of Transport, to increase safety awareness and navigational skills of pilots of recreational boats, ferries and other larger craft.

The above will be done as part of the marine safety management plan in accordance with the Department of Transport's (Maritime Division) Draft Marine Safety Plan Guidelines (1998). (Refer to LandCorp's Management Commitment 6.1 and 6.2. Refer also to Summary Section 1.5 for a description of the contents of the Marine Safety Management Plan).

(5) The proposed changes to the roads identified in the CER will have an adverse affect on the quality of life, safety and accessibility of recreation users of the whole Sound region.

A: This submission refers to the planned realignment of Cockburn Road, as part of the Southern Harbour Development. As a result of this realignment, the section of

Cockburn Road adjacent to Lots 165-168 will no longer serve as a link between Fremantle and Kwinana, and will be downgraded to an industrial service road. The "*changes to the roads identified in the CER*" are not part of LandCorp's proposed development and merely reflect changes foreshadowed by MRWA or other Proponents whose proposals have been approved by the EPA.

(6) *Even though ongoing microbial monitoring may not provide results exceeding the 'Australian Guidelines for the Recreational use of Water (NHMRC, 1990) it would be prudent to exclude the public from swimming in the Northern Harbour during the seawall construction, land reclamation and dredging phase of the project.*

A: The proposed project will comply with the EPA objective to maintain or improve water quality within the Northern Harbour. This will be achieved through Proponent management commitments contained within the CER, and through the implementation of a Dredging and Dredge Spoil Management Plan (DDSMP) prepared to the satisfaction of the Department of Environmental Protection. Consequently, there should be no need to exclude the public from swimming in the Northern Harbour during the dredging, seawall construction and land reclamation phase of the project. Nevertheless, the dredging works will be done in accordance with the DDSMP under the Northern Harbour Management Plan, which details contingency plans for alerting decision-making authorities and the public in the event of a public health issue arising.

2.4.4 Other

2.4.4.1 Management

2.4.4.1.1 Management Responsibility

(1) *It is essential that LandCorp be held responsible for ongoing and upcoming problems. A continuation of the 'walk-in, walk-out' approach that has resulted in the present problems in the Sound is not acceptable.*

A: LandCorp is aware of the importance in establishing a formal management body to ensure the effective management of the Northern Harbour. LandCorp has finalised a consulting brief for a contract to identify management issues, assess the legal framework available and determine the most effective structure of formal management body for the Northern Harbour. (Refer to Section 1.4 for a discussion of the Management approach).

(2) *While it may be possible to attach adequate conditions to seabed leases and other arrangements with future operators it would be preferable that responsibility for the management of key water and operational impacts rest with a suitably resources government agency or body. The current lack of a management*

framework or clear responsibilities for the management of water quality and other issues within the harbour heightens concerns in this regard. The resolution of this issue is seen as imperative should the proposal proceed.

A: LandCorp is committed to ensuring the effective management of the harbour and has finalised a consulting brief for a contract to identify management issues, assess the legal framework available and determine the most effective structure of formal management body for the Northern Harbour. The development and establishment of an appropriate management framework for the Northern Harbour will include clear responsibilities for the management of water quality and other issues. Refer to Summary section 1.4 for further discussion of management issues.

(3) There would be more confidence if the CER were to read "In accordance with Part V (Works Approval and Licensing) of the Environmental Protection Act (1986), the following generic licence conditions shall (instead of could) be applied...". What assurances can the Proponent give that the suggested conditions will be applied to the Works Approvals and Licenses when they are issued?

A: As discussed in the response to submission *2.4.2.2.3 (1)*, the generic licence conditions provided in the CER were developed in consultation with officers of the Department of Environmental Protection and are based on environmental conditions that have been applied during the licensing of similar industries in Western Australia. The specific works approval and licence conditions that will be applied to future shipbuilding, repair and maintenance industries will be determined by the Department of Environmental Protection (DEP). As stated in submission *2.4.4.1.1(9)*, the DEP is confident that the potential environmental impacts of future industries will be effectively dealt with under Part V (Works Approval and Licensing) of the *Environmental Protection Act 1986*, following the submission of detailed designs.

(4) Concerns are also held in relation to the arrangements for long term responsibility for management of the stratification with the ship-lift facility. The long term viability and success of the proposed approach is questionable and it is considered more appropriate that if the proposal proceeds the management of the water quality aspects be the responsibility of a suitably resourced government agency.

A: As detailed in response *2.4.2.2.3 (1)*, LandCorp has finalised a consulting brief for a contract to identify management issues, assess the legal framework available and determine the most effective structure of formal management body for the Northern Harbour. This will ensure that long term water and sediment

quality monitoring within the harbour remains the responsibility of a suitably resourced government agency.

In order to fulfill their obligations for Management Commitment 3.3 and 3.4, LandCorp will place conditions on the seabed lease to ensure that the future ship-lift operator implements the SMMP. Should the monitoring programme show that the accumulation of organic material in the shiplift be degrading the water quality of the Northern Harbour, then the shiplift operator will implement the preferred reactive strategy, removing the organic material in a controlled manner. Refer also to Summary section 1.4.

(5) When construction proceeds will an independent body manage daily construction related impacts?

A: Egis Consulting Australia will be appointed as the Contract Superintendent by LandCorp and as such will have the necessary powers to monitor construction impacts and take any action necessary to ensure that the contractor conforms with the environmental conditions and Proponent commitments as defined in the DDSMP.

(6) If the EPA Water Quality Objectives are not met who will have the authority to halt construction?

A: Refer to response to question *2.4.4.1.1 (5) Management Responsibility.*

(7) The Proponent has made a welcome set of commitments but it is not clear that these commitments can be kept in the longer term unless a formal management body is established for the Northern Harbour and the body agrees to accept these commitments for Stage 2 and beyond.

A: As discussed in the response to question (1) above, LandCorp is well aware of the importance in establishing a formal management body for the Northern Harbour and is committed to ensuring the effective management of the harbour. Consequently, LandCorp has released a consulting brief for a contract to identify management issues, assess the legal framework available and determine the most effective structure of formal management body for the Northern Harbour. In the meantime, the DCT is responsible for the management of water quality in the Northern Harbour (refer section 1.4).

(8) It is mentioned that the planned activities be the subject of a Seabed Lease. The project requires reclamation of 2.9 hectares of seabed, dredging of 2.6 hectares,

and 0.22 hectares of seawall. It is inappropriate that this area is leased to industry. Proper process requires that the area should be subject to a MRS Amendment to rezone the ocean bed.

A: Construction of a seawall for shipbuilding, repair and maintenance industries is not inconsistent with the waterways reservation under the Metropolitan Region Scheme.

There are discrepancies at present between the existing foreshore watermark and the coastal boundaries of the Northern Harbour, as defined by the following agencies:

- Department of Land Adminstration boundaries;
- Metropolitan Region Scheme boundaries; and
- local town planning scheme boundaries.

These discrepancies reflect the changing coastline due to natural processes and harbour development. For example, the Metropolitan Region Scheme reflects 1991 aerial photographic data, whereas the City of Cockburn Town Planning Scheme reflects 1993 aerial photographic data. Other than those areas where a hard edge exists, such as along seawalls or breakwaters, it can be expected that coastlines will continue to vary over time.

The Ministry for Planning has advised that the next scheduled consolidation of the MRS will be in 2000/2001, at which time the hard edges of the seawall can be surveyed and tied into the MRS.

(9) Any Works Approvals, registrations and/or licences for industries that occupy the newly developed area need not be dealt with at this stage.

A: Noted.

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LIST OF FIGURES

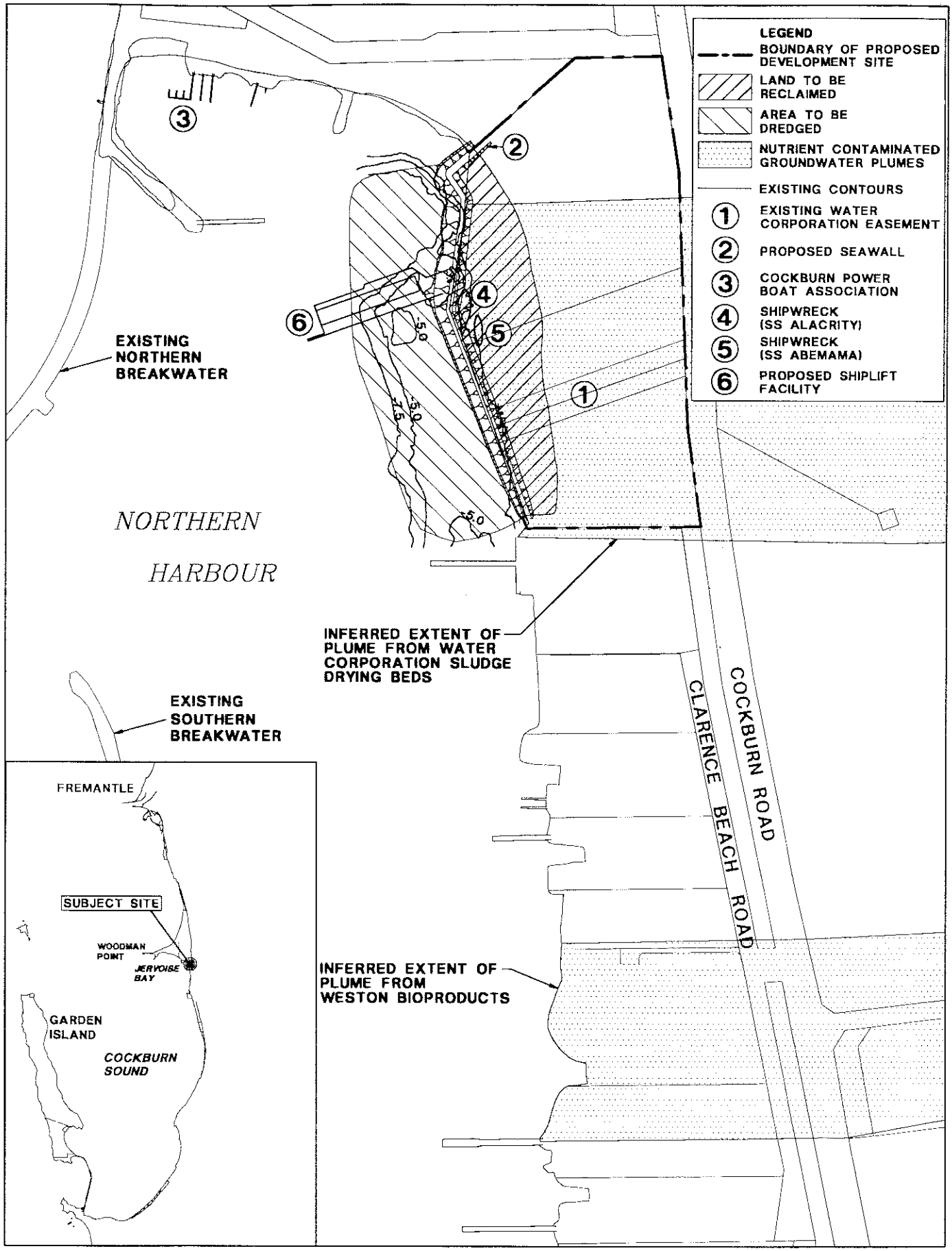

FIGURE 1

DEVELOPMENT OF LOTS 165 TO 168 COCKBURN RD, HENDERSON
CONSULTATIVE ENVIRONMENTAL REVIEW

CLIENT: LANDCORP

PROPOSED DEVELOPMENT SITE AND SURROUNDING FEATURES

BSD CONSULTANTS

Date 23.08.99 Scale 1:8,000
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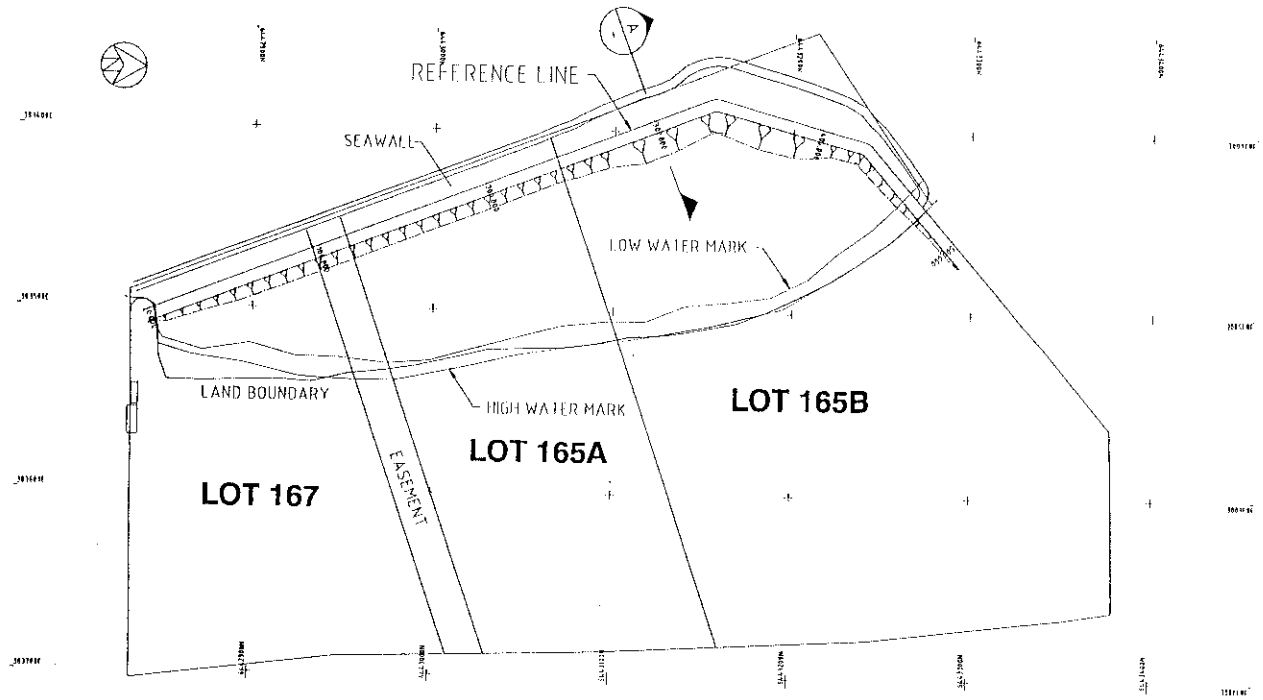
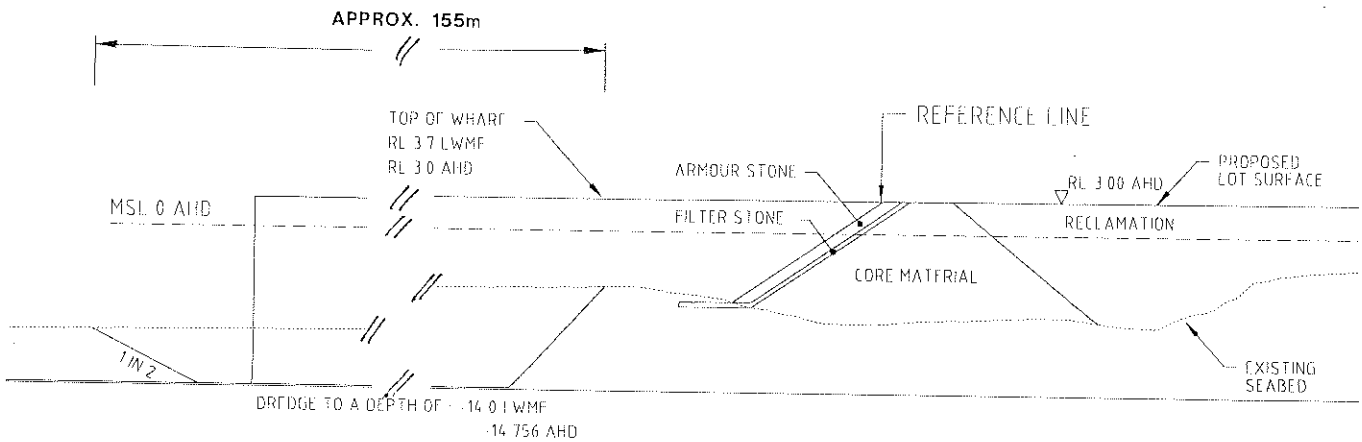
Drawn DGP Approved
Local Authority CITY OF COCKBURN Sheet 1 of 1
Project Number V98027 Drawing Number V65-SK23 Revision



GENERAL LAYOUT
AND CROSS SECTION LOCATION



CROSS SECTION THROUGH
SHIP LIFT BASIN

SOURCE : EGIS CONSULTANTS

FIGURE 2

DEVELOPMENT OF LOTS 165 TO 168
COCKBURN RD, HENDERSON
CONSULTATIVE ENVIRONMENTAL REVIEW
CLIENT : LANDCORP

GENERAL LAYOUT OF PROPOSED DEVELOPMENT AND CROSS SECTION THROUGH CENTRELINE OF SHIPLIFT PLATFORM

BSD CONSULTANTS

Date 01.09.99	Scale	N.T.S.	
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Drawn SLM	Approved	JCH 1/9/99	
Local Authority	Sheet		
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Project Number	Drawing Number	Revision	
V98027	V65-SK24	A	

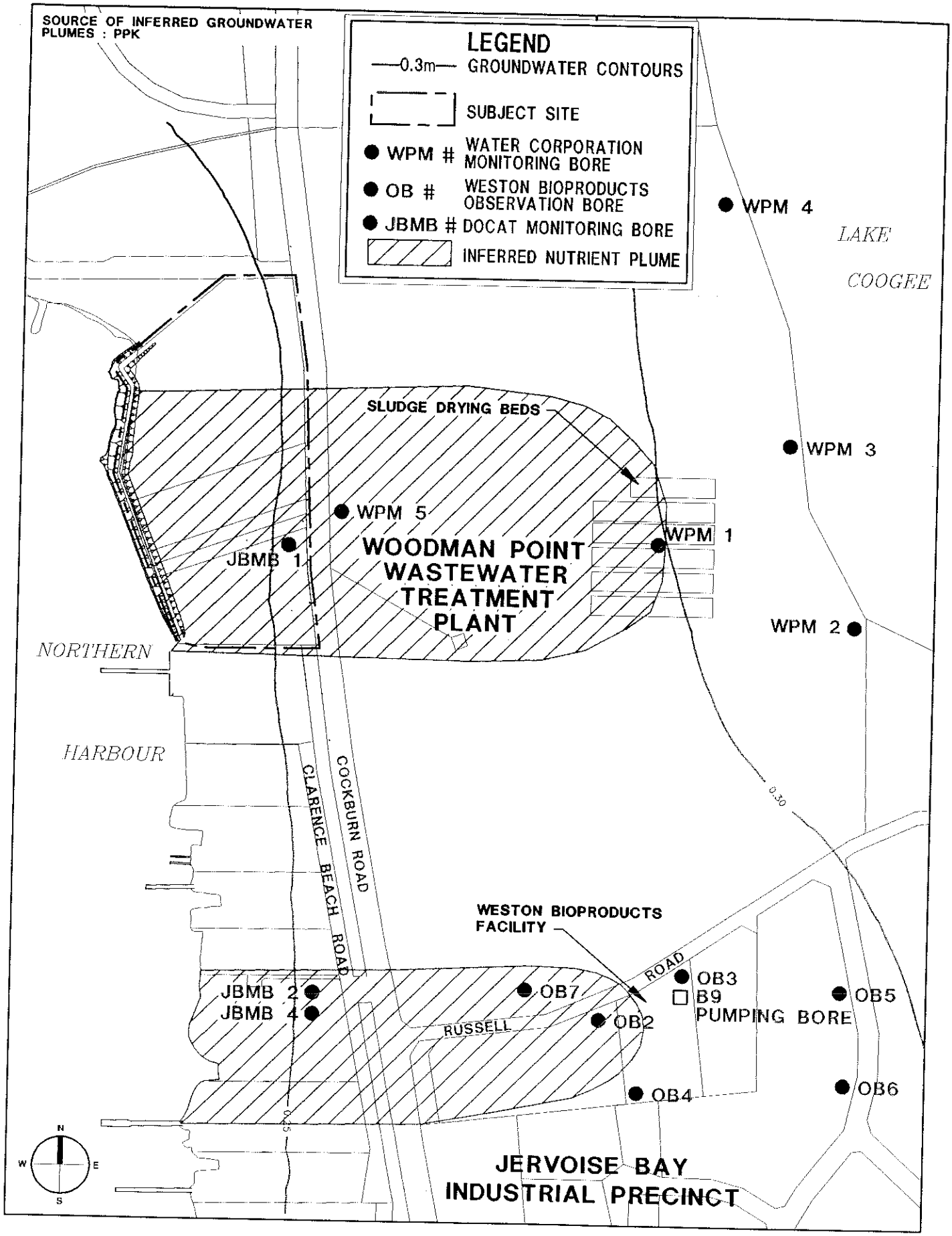

FIGURE 4

DEVELOPMENT OF LOTS 165 TO 168 COCKBURN RD, HENDERSON
CONSULTATIVE ENVIRONMENTAL REVIEW

CLIENT: LANDCORP

GROUNDWATER CONTOURS, MONITORING BORES AND INFERRED BOUNDARIES OF NUTRIENT RICH GROUNDWATER

BSD CONSULTANTS

Date 04.08.99 | Scale 1:7,500
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Project Number V98027 | Drawing Number V65-SK20 | Revision

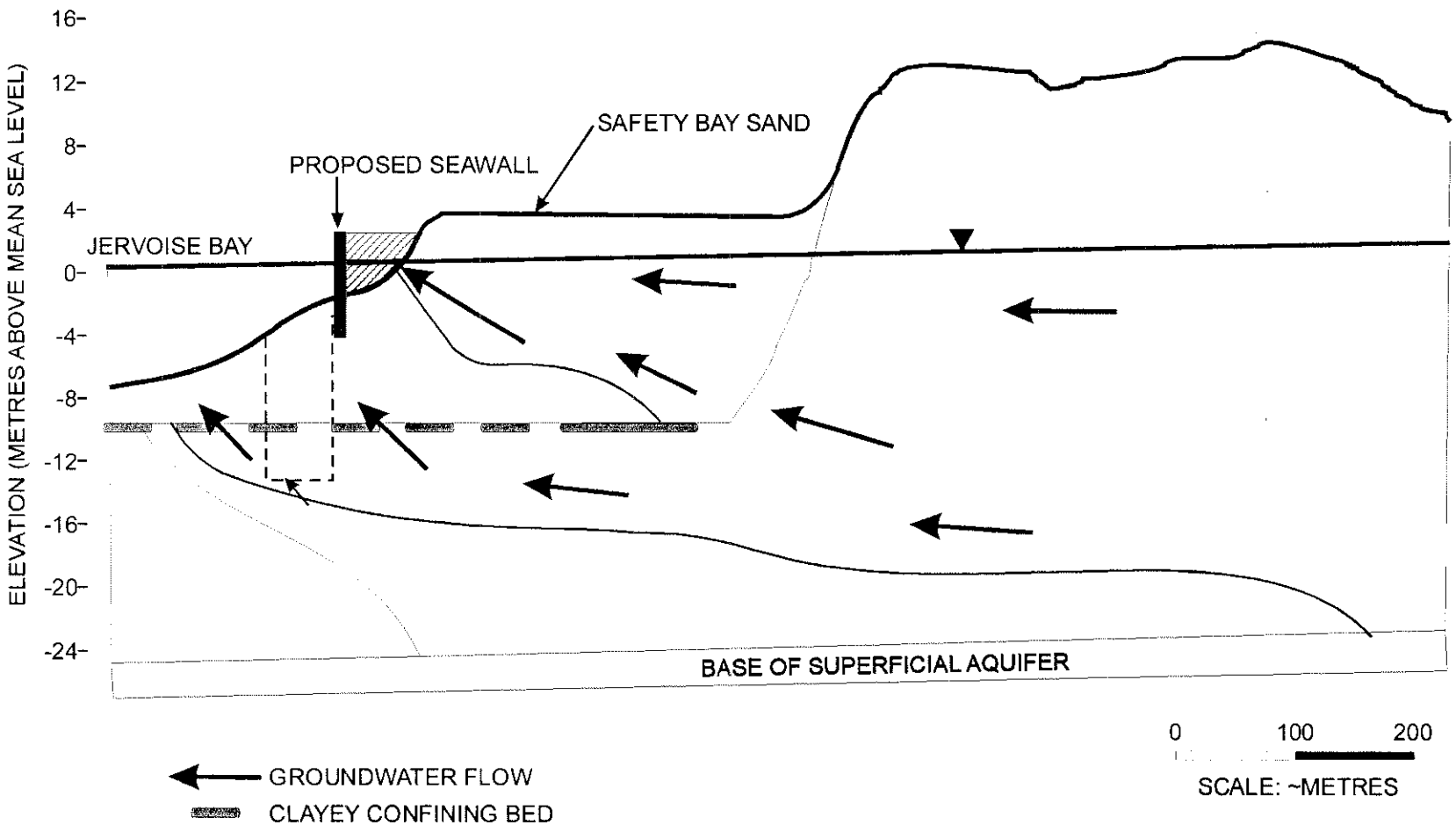

FIGURE 3

SOURCE : PPK

DEVELOPMENT OF LOTS 165 TO 168
COCKBURN RD, HENDERSON
CONSULTATIVE ENVIRONMENTAL REVIEW
CLIENT : LANDCORP
GEOLOGICAL CROSS SECTION
AT JERVOISE BAY

BSD CONSULTANTS

V98027 V65-SK19

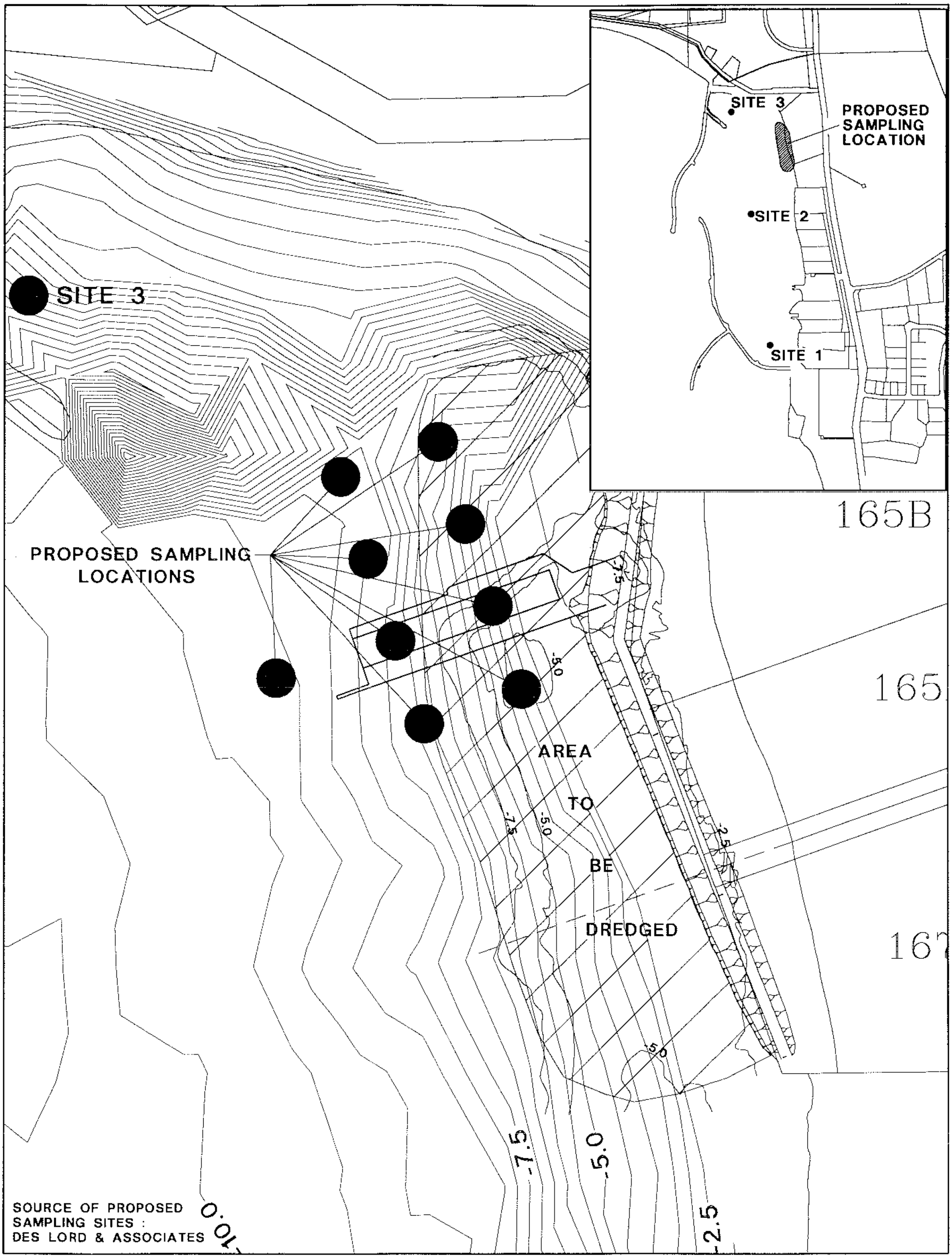

FIGURE 7

DEVELOPMENT OF LOTS 165 TO 168
COCKBURN RD, HENDERSON
CONSULTATIVE ENVIRONMENTAL REVIEW

CLIENT : LANDCORP

PROPOSED SAMPLING SITES
SHIPLIFT MONITORING PROGRAM

BSD CONSULTANTS

Date 26.08.99 Scale 1:3,000
Designed Checked
Drawn Approved
Local Authority CITY OF COCKBURN Sheet 1 of 1
Project Number V98027 Drawing Number V65-SK18 Revision A