Albany Waterfront Development - Protected Harbour Development

Construction Environmental Management Plan

Prepared for
LandCorp
by Strategen

September 2008

Albany Waterfront Development - Protected Harbour Development

Construction Environmental Management Plan

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Client: LandCorp

Report	Version	Prepared by	Reviewed by	Submitted to Client	
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Final Report	V5	LC/KH		Public release with EPS	2 Sep 08

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1. INTRODUCTION

LandCorp proposes to construct a boat harbour for commercial and recreational craft through the extension of the existing Albany Town Jetty with a breakwater that will effectively shelter a 6.6 ha area of water. The proposal will include construction of boat harbour structures, a main breakwater and an internal cutoff breakwater, parking, hardstand areas and boardwalks.

The project is designed to complement the Albany Foreshore Redevelopment Project which will create a tourism and entertainment precinct on the adjacent foreshore area.

The Protected Harbour Development proposal is located immediately south of the Albany town centre, within Princess Royal Harbour.

1.1 PROJECT SUMMARY

The Protected Harbour Development proposal affects approximately 6.6 ha of water area and includes:

- provision for approximately 130 boat pens (including large pens for charter operators) that will be built in two stages with Stage 1 comprising about 74 boat pens and Stage 2 the remainder
- a total of 3.4 ha of reclamation within Princess Royal Harbour (Figure 1) which includes:
    - reclamation of 0.3 ha adjacent to the Albany Foreshore Redevelopment area to create a marina edge wall (sea wall and revetment)
    - reclamation of about 0.85 ha for fishing industry hardstand including, a sea wall and revetment, fishing industry wharf, jetty with fuel and sullage pump out
    - construction of two breakwaters with a total footprint of 2.25 ha; one to widen and extend the existing Albany Town Jetty (1.8 ha) and one internal cutoff breakwater (0.45 ha), which will separate the boat harbour from the existing tug boat harbour
- excavation of the harbour area using earthmoving equipment working from a temporary sand platform. Total excavation will include around 15,000 m^3 of sediment over an area of 1.4 ha to give a maximum depth of -2.8 m AHD
- public fishing platform with disabled access
- public boat ramps and trailer parking.

Material excavated from the harbour will be used in the reclamation and construction of the fishing industry reclamation area. Any material that is found to not meet the geotechnical specifications due to organic matter will be taken to landfill.

1.2 APPROVALS PROCESS

LandCorp submitted an Environmental Protection Statement (EPS) to the EPA in April 2006 prepared in accordance with Administrative Procedures for environmental assessment prescribed under the *Environmental Protection Act 1986* (EP Act). The EPA will report on its assessment of this proposal to the Minister for the Environment pursuant to section 44 of the EP Act.

The expedited EPS procedure was considered appropriate due to the amount of community consultation that has been undertaken previously for the project and the high level of understanding of the issues involved. In addition to broad consultation with the community of the Albany Waterfront Structure Plan, LandCorp has consulted extensively with Government agencies and other key non-government organisations as part of the EPS process.

1.3 PURPOSE AND STRUCTURE OF THE CONSTRUCTION ENVIRONMENT MANAGEMENT PLAN

The overall purpose of this Construction Environmental Management Plan (CEMP) is to provide environmental measures for LandCorp and its contractors to follow to protect the marine environment and ensure that activities associated with development of the site do not affect adjacent landowners and the local community.

The implementation of this CEMP will ensure that any environmental impacts arising from the development are managed in accordance with proponent commitments. The CEMP includes stand alone component plans, prepared to manage various environmental factors, specifically:

- water quality and benthic habitat (includes seagrass)
- seagrass rehabilitation
- noise
- dust
- heritage.

The plans have been prepared in accordance with Department of Environment and Conservation (DEC) guidelines and in consultation with DEC.

Each of the component plans:

- defines management objectives for the environmental factor it addresses
- describes management measures required to give effect to the environmental commitments and to achieve management objectives related to the environmental factor
- provides a description of monitoring, targets and performance indicators, as required, for meeting environmental commitments and management objectives
- describes contingency measures to be implemented in the event of unexpected or unacceptable environmental impacts
- outlines responsibilities and timing of implementation of described measures.

1.4 OTHER DOCUMENTS

A detailed Heritage Management Plan is being prepared by a maritime archaeological consultant.

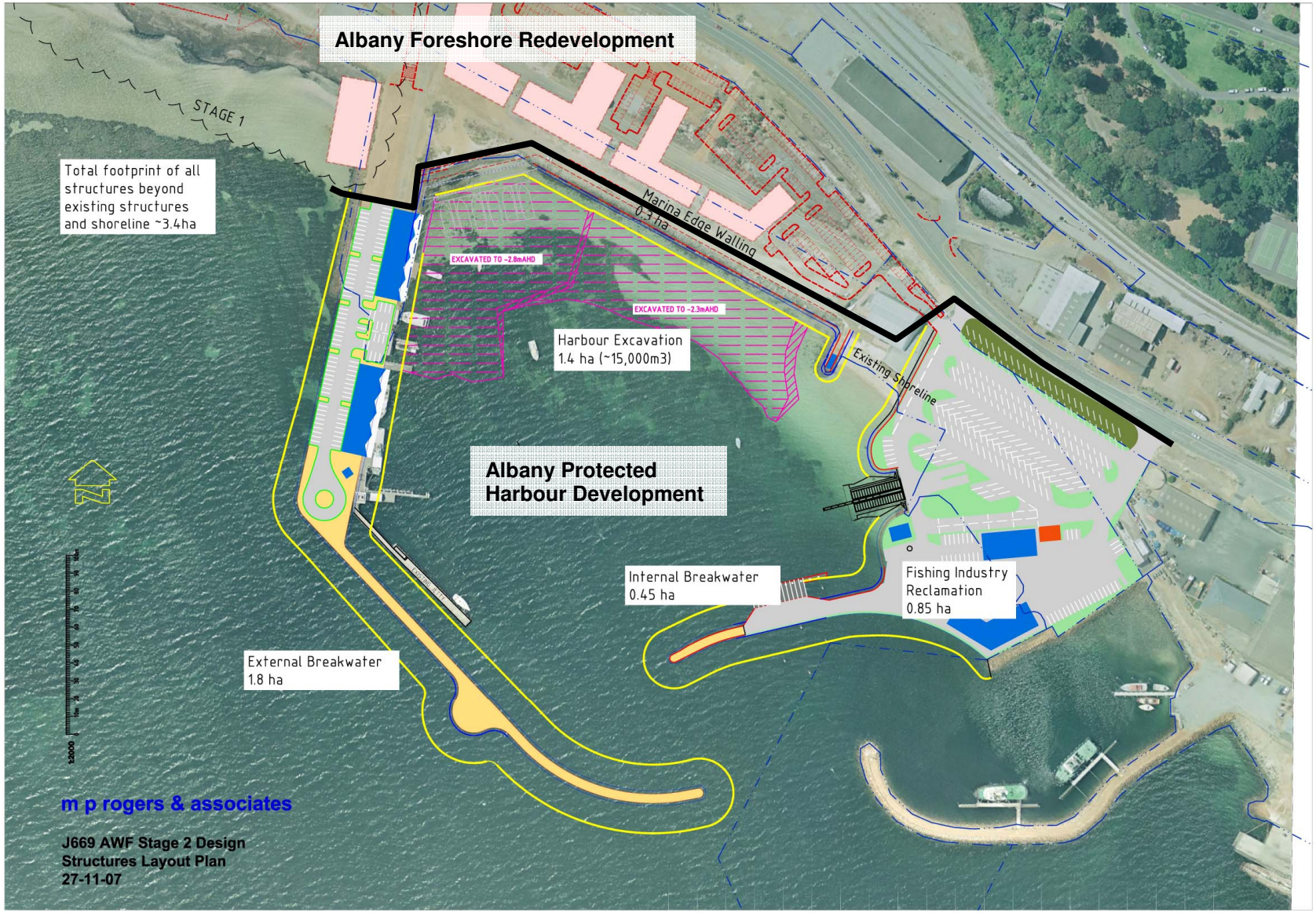
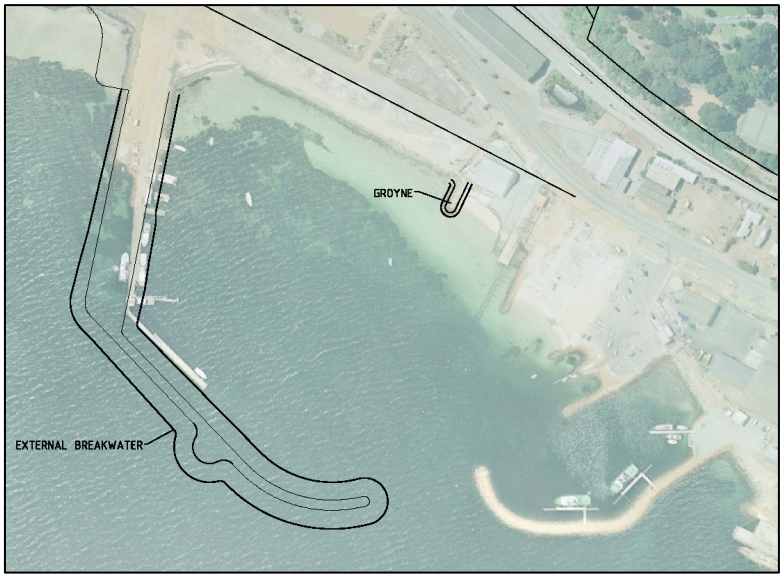
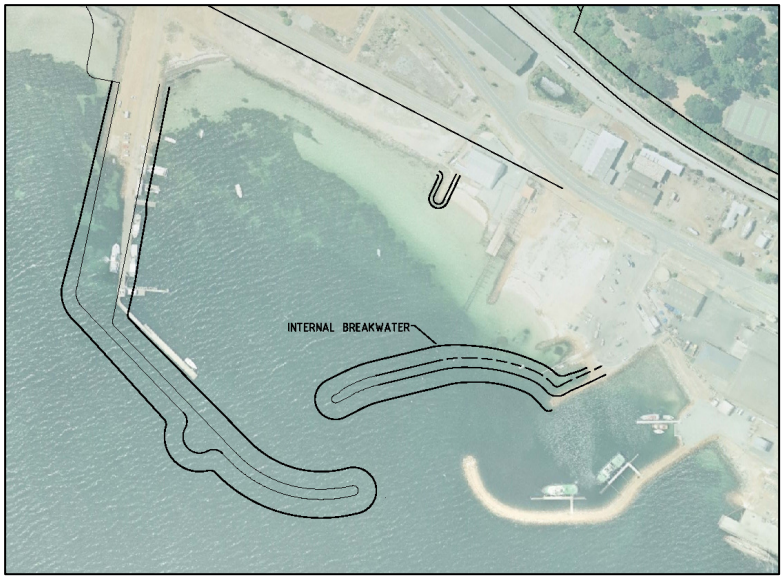


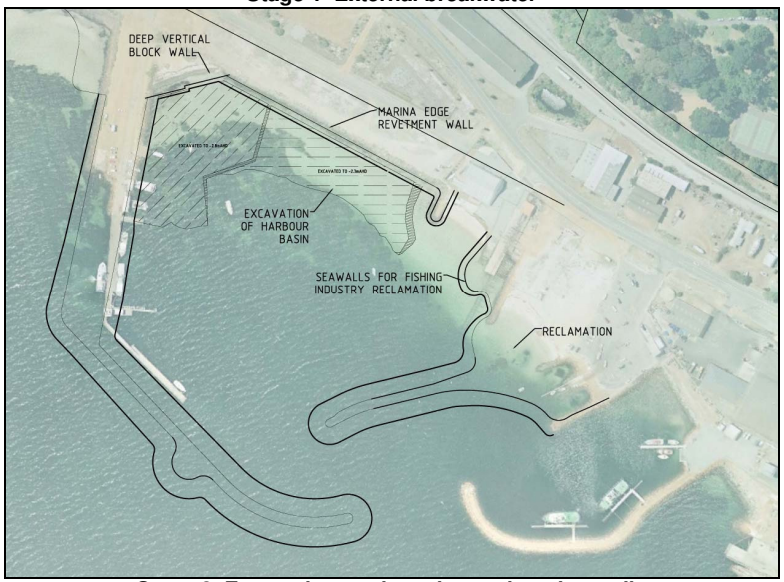
Figure 1 Protected Harbour Development Layout Plan



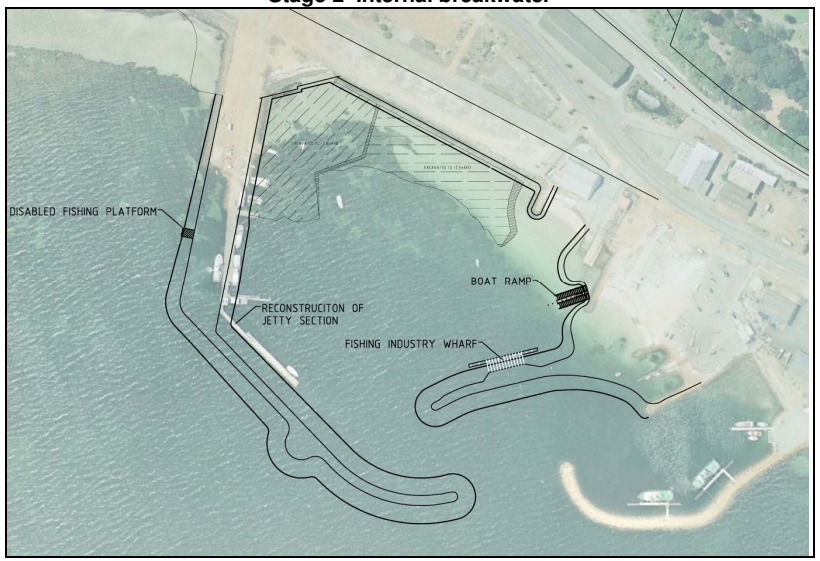
Stage 1 External breakwater



Stage 2 Internal breakwater



Stage 3 Excavation, reclamation and marina walls



Stage 4 Boat ramp, fishing platform and wharf

Figure 2 Staging of construction

2. OVERVIEW OF ENVIRONMENTAL SETTING

2.1 SOCIAL ENVIRONMENT

The Protected Harbour is proposed for the Albany foreshore within Princess Royal Harbour. The adjacent Albany Port and its associated activities are major employers in the Albany region, comprising the Albany Port Authority, Co-operative Bulk Handling, tug boat operators, stevedoring companies, shipping agents and shipping contractors.

Albany is one of the State's leading tourist bases for marine-related activities, including tours of the scenic south coast, whale watching, recreational diving (especially around Michaelmas and Breaksea Islands and the HMAS Perth dive site), fishing and the 'Whaleworld' museum. The waters and beaches of King George Sound, Princess Royal Harbour and Oyster Harbour are also used heavily for recreation by local residents.

Commercial fishing and aquaculture industries operate out of King George Sound.

2.1.1 Land tenure and land use

The project area is zoned "Foreshore Development" under the City of Albany Town Planning Scheme No. 1A. The project area includes the existing Albany Town Jetty which is primarily utilised by boat charter companies with boat pens and some sheds along the jetty. The northern portion of the jetty is reclaimed land used for temporary car parking. The area of Princess Royal Harbour to be included in the project is Location 7601.

The Foreshore Development zone under the City of Albany Town Planning Scheme No. 1A does not contain any reference to specific land uses. The Scheme required that a Structure Plan be developed to show the general distribution of land uses within the plan area and that a Precinct Plan show the proposed use of all land within the area. Once adopted by Council, the Precinct Plan will become binding on development within that precinct.

The adjacent land to the north of the project area is currently undeveloped vacant land that will become part of the Albany Foreshore Redevelopment. Further north is Princess Royal Drive and a railway line that services the Albany Port. The Albany Port Authority exists to the east, with the Duyfken workshops and slipway located closest to the project area. To the west of the site is the area to be developed as Anzac Peace Park by the City of Albany. The southern boundary abuts and extends into Princess Royal Harbour.

2.1.2 Heritage

There are no Aboriginal heritage sites listed on the State or Federal lists for the project area and surrounds.

Albany is the oldest European settlement in Western Australia and was founded in 1826. The Albany Town Jetty within the project area is listed as site 3607 on the Western Australian Register of Heritage Places. The jetty was first built in 1862 and the site was registered as it is believed to be the oldest jetty in Western Australia in continuous use and it has historical, landmark and archaeological

significance. All pre 1900 maritime archaeological material is protected under the *Maritime Archaeology Act 1973.*

2.2 NATURAL ENVIRONMENT

Princess Royal Harbour and Oyster Harbour are embayments connected to King George Sound via narrow channels. Princess Royal Harbour is 28.8 square kilometres in area, with gently sloping, shallow, sandy margins surrounding a deeper (5-10 m) basin. Roughly half of Princess Royal Harbour is less than 2 m deep (Bastyan 1986, EPA 1990).

The shallow margins of Princess Royal Harbour in water depths less than 5 m support meadows of seagrasses, plus dense stands of unattached macroalgae. The main seagrass species in the project area are *Posidonia australis* and *Posidonia sinuosa* (Masini et al 1990). An estimated 90% of the seagrass in Princess Royal Harbour was lost between 1960 and the mid 1980's (EPA 1990). Monitoring in the last ten years indicate that the area and density of seagrass in the harbour is gradually increasing (Strategen 2008).

The foreshore adjacent to the project area is cleared vacant land and is currently used for car parking.

3. PROTECTED HARBOUR AND POTENTIAL CONSTRUCTION IMPACTS

3.1 KEY CHARACTERISTICS

The key characteristics of the Albany Protected Harbour Development are outlined in Table 1. The total reclamation area for breakwaters, construction of sea walls and revetments, groyne and fishing industry reclamation is approximately 3.4 ha. The excavated material will be used in the reclamation of the fishing industry hardstand area.

The Protected Harbour proposal is adjacent to the Albany Foreshore Redevelopment and both projects are part of the overall Albany Waterfront Development.

Table 1 Key characteristics of the Albany Protected Harbour Development

Aspect	This Proposal
Project timeframe	Construction to commence in 2008 and first stage completed in 2009. Second stage (additional pens) completion depends on demand
Location	Northern edge of Princess Royal Harbour, south of the Albany town centre
Boat harbour	
Capacity	Total of approximately 130 boat pens, with about 74 built in the first stage and the remainder when there is demand.
Boat harbour depth	Excavated to -2.8 m AHD
Protected water area	6.6 ha (excluding the existing Albany Port Authority tug harbour 2.2 ha)
Excavated sediment	About 15,000 m3
Area excavated outside proposed seawalls	1.4 ha
Disposal of excavated material	Used in land reclamation, or if geotechnically unsuitable, it will be taken to a licensed landfill site.
Breakwaters, reclamation on eastern side of breakwater, groyne, fishing industry reclamation	
Location	Refer Figure 1
Total reclamation and breakwaters area	Approximately 2.9 ha
Reclamation area fill material	Excavated material from onsite and imported sand fill from a local licensed sand pit.
Breakwater material	Quarried rock core - granite or ferricrete.
	Quarried granite armour

3.2 CONSTRUCTION PROCESS

The order of construction is shown in Figure 2

Breakwater construction

The main breakwater extension of the Albany Town Jetty and the cut-off breakwater will be constructed in the same way as many of the existing breakwaters around Western Australia. The breakwaters will consist of quarried rock core and armour stone (the exposed rock) from licensed quarries in the district. The rock core will be granite or ferricrete and will be delivered to site by trucks using public roads. The new armour stone will be granite. The rock materials will be tipped

from the truck into the water and the breakwater will be progressively lengthened. The core will be shaped as required using conventional earthmoving equipment such as front end loaders and hydraulic excavators. The armour stone will be placed on to the core and trimmed using hydraulic excavators. An access road and public walkway will be constructed along the entire length of the main breakwater.

Marina edge wall, boat ramps and deepening of parts of the marina basin

Geotechnical investigations have shown that there is some debris such as tyres, old moorings and steel scrap on the marina seabed. This material will be removed before excavation and taken to the appropriate licensed landfill site. Where practicable, the debris will be recycled rather than put into a landfill.

The shallow parts of the marina basin will be deepened to between 2.3 to 2.8 m below AHD, using a land-based excavator working from a series of temporary sand platforms. The material to be excavated is predominately sandy and if geotechnically suitable, it will be used as compacted fill to create the hardstand area in the fishing industry precinct (Figure 1). Detailed investigation of the sediment characteristics and contaminant levels has been undertaken and the results confirm that the material is suitable for reclamation works (Strategen 2008). Any material that is found to not meet the geotechnical specifications due to organic matter or fines content will be taken to landfill.

Following excavation and construction of the edge walling, the temporary sand platforms and underlying material will be removed to a depth of -2.3 to -2.8 mAHD using excavators and trucks. The silt curtain will be left in place to contain turbidity generated during removal of the sand platform. The material removed may be stockpiled and will be used (if geotechnically suitable) in the reclamation in the fishing industry area (Figure 1). The excavated natural sediments (i.e. not the imported sand bund) will be placed above the watertable within the fishing industry area.

Revetments and reclamation in the fishing industry area

Reclamation and establishment of revetments around the fishing industry area will be progressively undertaken following construction of the breakwaters and marina edge wall. Excavated material will be transported directly to the fishing industry hardstand area to be used in that reclamation along with imported material from a licensed sand mine. The revetment construction will include an initial sand/rock structure to allow construction of the revetment. Subsequent reclamation will occur behind the revetment. The reclamation revetment for the fishing industry will have granite armour.

Jetties and floating pens

The various jetties and floating pens will be supported and/or anchored using piles driven into the seabed. The pile driving activities will be managed to minimise the impacts of noise and vibration and will be completed in accordance with the various legislative and local Government requirements.

Timing

The sequence, timing and duration of construction activities are anticipated to be as follows:

1. Construction of main breakwater to commence in June 2008, expected duration 16 to 20 weeks
2. Construction of cut-off breakwater to commence in September 2008, expected duration 8 to 12 weeks
3. Marina revetment construction to commence in January 2009, expected duration 8 weeks
4. Excavation of a small portion of the marina basin using temporary sand platforms to provide access for the land based excavators. Works to commence in March 2009, expected duration 4 weeks
5. Fishing Industry area revetments and reclamation to commence in April 2009, expected duration 8 weeks

3.3 POTENTIAL IMPACTS

Potential impacts during the construction of the Protected Harbour expected to arise from the following activities:

- localised, short-term affects on water column turbidity during:
    - construction of the breakwaters
    - construction of the temporary sand access platforms
    - excavation to deepen the Protected Harbour and removal of the sand platforms once excavation is completed
    - drainage and runoff from reclamation areas (using the excavated material as compacted fill)
- total direct and indirect losses of 0.11 ha of dense seagrass (*P. australis*) and 1.44 ha of very sparse seagrass (Strategen 2008)
- effects on the amenity of nearby residents from noise generated by vehicle movements and machinery operation including earth moving machinery, trucks and small vehicles
- effects on environmental values or human health due to dust generated by earthworks, traffic or dust lift off from stockpiles and dry areas.

Breakwater construction is the most likely aspect of the project to cause increases in turbidity during construction. Turbidity generated during construction is not expected to cause any loss of seagrass, but has the potential to cause short-term effects on the growth rates of seagrasses immediately west of the Protected Harbour.

The sediments to be excavated meet marine guidelines for healthy ecosystem, but a small proportion of the sediments in the western end of the excavation area have higher levels of lead and mercury compared to the majority of the sediments. Temporary contamination of bivalves on existing structures in the project area may occur if excavation of these sediments coincides with an extended period of calm weather (which would reduce the level of dispersion of any suspended fine sediments generated during excavation).

4. IMPLEMENTATION OF CEMP

4.1 ROLES AND RESPONSIBILITIES FOR IMPLEMENTATION

All personnel managing or working on construction of the Protected Harbour shall be responsible in some form for environmental management. All personnel associated with the project shall at least undergo basic environmental management training as part of the initial safety and environmental induction to inform them of their responsibilities. Personnel in supervisory roles may undergo more extensive training as described in Section 4.6.

The proposed organisational structure of the Protected Harbour construction environmental management team is shown in Figure 3. Finalisation of this structure will be undertaken in conjunction with construction and supervising engineer contractors.

The following section details the roles and responsibilities of LandCorp personnel and its contractors involved in managing the environmental aspects arising from the construction of the Protected Harbour.

LandCorp (Responsible Officer)

LandCorp will have overall responsibility for development of the Protected Harbour and implementation of the CEMP. The person responsible will be the Project Manager/Officer assigned to the project. It shall be LandCorp's responsibility to report serious environmental incidents (Level 3) to Government agencies where appropriate.

Contractor Supervising Engineer

The Contractor Supervising Engineer will have overall responsibility for design of the Protected Harbour and administration of the contract for construction. The Supervising Engineer will have the power to stop work on site if he/she views it necessary. He/she is responsible for reporting environmental incidents to LandCorp and to assist LandCorp and its consultants in providing recommendations to contractors to avoid further incidents.

Contractor Construction Superintendent

The Contractor Construction Superintendent will be responsible for administration of the construction contractor's involvement in constructing the Protected Harbour. This person will be the manager of the Contractor Supervisors/Foremen employed by that company during construction. He/she will be responsible for overall environmental management of construction activities.

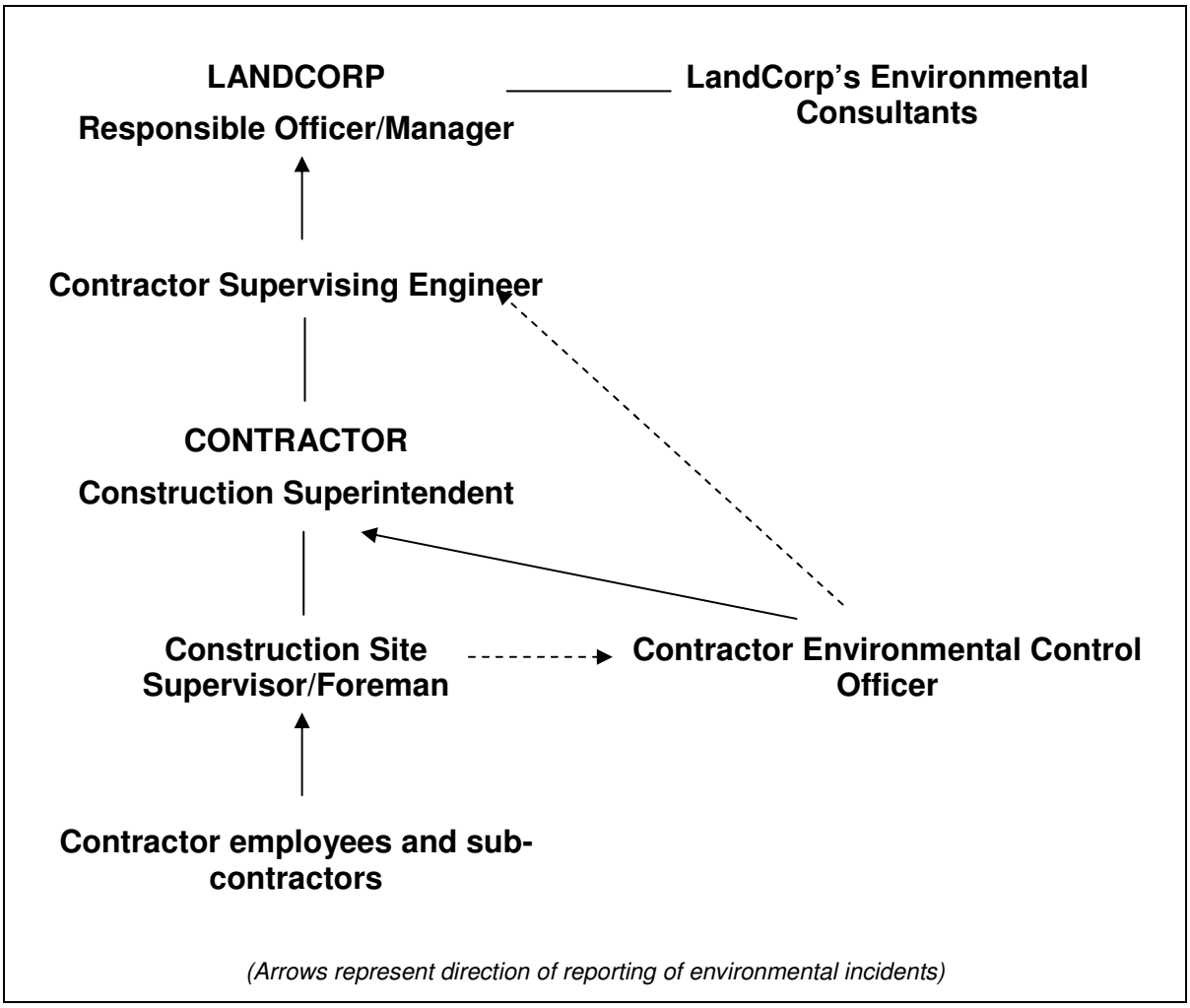


Figure 3 Organisational structure of environmental management responsibilities

Contractor Environmental Control Officer

The Contractor Environmental Control Officer will be responsible for monitoring the on-site day to day environmental compliance and management of the project. It is possible this person may have other titles and functions, such as site safety, not restricted to those of the Environmental Control Officer. This person shall however, be responsible for the following environmental functions:

1. Conducting initial safety and environmental inductions for all on-site personnel.
2. Completing Construction Inspection Checklists as described in Section 4.2.
3. Completing Environmental Incident Report forms following incidents.
4. Reporting incidents to the Contractor Construction Superintendent and Contractor Supervising Engineer.
5. Conducting additional monitoring as described in component plans of the CEMP.
6. Auditing of compliance.

Contractor Supervisor/Foreman

The Contractor Supervisor/Foreman will be responsible for:

- supervising the construction workforce on-site
- informing the Contractor Environmental Control Officer of environmental incidents
- assisting the Contractor Environmental Control Officer in completing environmental incident report forms
- ensuring the contractor workforce has responded to environmental incidents and recommendations following incidents as instructed.

Contractor workforce

All personnel will be responsible for proper environmental conduct, which will include the reporting of environmental incidents.

LandCorp's consultants

LandCorp may call on its specialist environmental consultants for assistance in auditing of compliance and preparing environmental briefing/training material of site personnel and advice following any significant environmental incidents.

4.2 MONITORING PROCEDURES

During earthworks and construction of the Protected Harbour development all areas will be subject to audits and to fortnightly (or as determined by LandCorp in consultation with its environmental consultants) site inspections. The Contractor Environmental Control Officer shall conduct these inspections of the active and constructed sections of the site, including monitoring of factors addressed in the component management plans (e.g. noise, dust). Construction Inspection Checklists will be utilised during these inspections (see Appendix 1 for an example). Inspection will include noting of such details as date, time, locations covered in inspection, relevant work activities being undertaken and environmental incidents. This will also include an inspection of all relevant documentation including the Environmental Incident Reports and previous week's inspection sheets to check whether problems or non-conformances with the CEMP have been rectified.

4.3 ENVIRONMENTAL INCIDENTS

Environmental Incidents are defined as being any breaches or non-adherences to objectives and procedures prescribed in the CEMP and environmental management procedures applied to the site by LandCorp. These incidents are to be reported to the Contractor Supervisor/Foreman and the Contractor Environmental Control Officer by the person responsible for the incident or the first person at the site of an incident. The Contractor Environmental Control Officer shall notify the Contractor Supervising Engineer who shall subsequently notify LandCorp. All incidents and complaints will be recorded in an Environmental Complaint and Incident Register to be kept by the Contractor Environmental Control Officer and be made available for DEC officers and other relevant parties to view.

Environmental incidents shall be managed in accordance with the contingency procedures outlined in the component management plans.

4.4 TARGETS AND PERFORMANCE INDICATORS

A series of targets and performance indicators have been established for use during construction and post-construction compliance audits of the project. Targets and their performance indicators are measurable factors that indicate if the management objectives are being met and the prescribed procedures are adequately protecting the environment. Individual targets and performance indicators have been established regarding water quality, seagrass health, seagrass rehabilitation and management of noise and dust. These have been detailed in the monitoring sections of each of the relevant management plans and the key elements listed in the Construction Inspection Checklist.

4.5 PUBLIC COMPLAINT RESOLUTION

All complaints received from the public, by LandCorp or its contractors, in relation to environmental factors associated with construction of the Protected Harbour shall be treated as Environmental Incidents as described in Section 4.3 and be recorded in the Environmental Complaint and Incident Register. They shall be referred to the Contractor Construction Superintendent, Contractor Supervising Engineer and the Contractor Environmental Control Officer for investigation.

4.6 TRAINING OF PERSONNEL

4.6.1 Technical training of personnel

LandCorp will ensure (through its contract arrangements) that the Contractor Construction Superintendent, Contractor Supervising Engineer, Contractor Supervisor/Foreman and the Contractor Environmental Control Officer have been briefed on the purpose and implementation of the management procedures described in this CEMP.

The Contractor Construction Superintendent, Contractor Supervising Engineer, Contractor Supervisor/Foreman and Contractor Environmental Control Officer shall be briefed by the Heritage Consultant (engaged by LandCorp) regarding procedures for uncovering of undiscovered heritage material sites as required.

4.6.2 Environmental inductions

An initial environmental briefing (in the form of an Environmental Induction) as part of the site induction, shall be provided by the Contractor Environmental Control Officer to all contractor personnel and other personnel involved in construction activities, prior to commencing work on site. The Environmental Induction will include the following items:

1. Explanation of the purpose and objectives of the CEMP.
2. Roles and functions of personnel on site.
3. Heritage procedures from the Heritage Management Plan (shall be prepared and appended to the CEMP).

4. Brief explanation of their responsibilities under the environmental management procedures contained within the CEMP.

4.7 DOCUMENTATION

In addition to this CEMP, other documentation relating to environmental issues associated with the Protected Harbour includes:

- Albany Protected Harbour Heritage Management Plan (in prep.)
- Albany Protected Harbour Development Environmental Protection Statement (Strategen 2008)
- Contractors' environmental management guidance/plans. These will be developed by the Contractor for review/approval by LandCorp prior to commencement of construction activities and will be required to be consistent with this CEMP.

The Contractor Supervising Engineer shall be responsible for issuing this documentation to contractor personnel and maintaining an inventory of documentation distribution. He/she shall be responsible for ensuring all document holders receive updates to the documents if forthcoming.

The following documentation/forms shall be utilised during construction of the Protected Harbour:

1. Construction Inspection Checklists (Appendix 1)
2. Environmental Incident Reports (Appendix 2)

Procedures for the use of such documentation are explained in Sections 4.2 and 4.3.

4.7.1 Review and revision of CEMP

The CEMP shall be updated if required during construction by the addition of Bulletins containing any new procedures arising from the Environmental Incident Process (Section 4.3). The Contractor Supervising Engineer shall be responsible for issuing the Bulletins and sending them to the holders of copies of the CEMP. The Bulletins will be added as addendums to the CEMP and it will be the responsibility of the holders of the documentation to ensure their copies of the CEMP have the Bulletins attached and review them accordingly. The procedures are to be communicated to construction personnel via "Toolbox" meetings (Section 4.8).

4.8 COMMUNICATIONS

'Toolbox' meetings shall be held regularly by each construction crew during construction of the Protected Harbour. During these meetings, concerns and questions raised by personnel shall be addressed and any environmental incidents that occurred previously, discussed. In addition, new environmental management procedures or information shall be discussed to ensure effective implementation. If requested by personnel or felt necessary by the Contractor Construction Superintendent, Contractor Supervising Engineer, Contractor Supervisor/Foreman or Contractor Environmental Control Officer, specific environmental management procedures already communicated to personnel will be reiterated during these meetings.

Regular meetings between the Contractor Construction Superintendent and the Contractor Supervisor/Foreman shall be undertaken to establish the progress of development and the schedule and

location of activities over the site. This information shall be forwarded to the Contractor Supervising Engineer and Contractor Environmental Control Officer.

LandCorp directions regarding works will be given in writing to the Contractor Construction Superintendent, with a copy forwarded to the Contractor Supervising Engineer.

5. STAKEHOLDER CONSULTATION

5.1 PREVIOUS CONSULTATION

Preparation of the environmental review document for the Albany Protected Harbour Development involved detailed consultation with relevant Government agencies and regulatory bodies and key environmental and community groups known to have an interest in the development (Strategen 2008).

The main issues of concern to stakeholders, relevant to the Protected Harbour, raised during this consultation process were:

- management of turbidity during construction
- protection of seagrass meadows
- flushing of the Protected Harbour
- heritage values of the Albany Town Jetty
- seagrass wrack and the management of floating debris.

5.2 CONSULTATION DURING PREPARATION OF THE CEMP

Agencies consulted included:

- Department of Water
- Department of Environment and Conservation
- Environmental Protection Authority Services Unit
- Western Australian Museum
- Heritage Council of Western Australia.

6. WATER QUALITY AND BENTHIC HABITAT

6.1 CURRENT STATUS

Water quality

Water quality in the project area is considered good and is similar to other parts of Princess Royal Harbour (Strategen 2008). Monitoring undertaken within Princess Royal Harbour during 2005/06 indicated phytoplankton growth is strongly limited by inorganic nitrogen inputs, chlorophyll *a* concentrations were similar to that of King George Sound and turbidity[1] was low with the secchi depth exceeding water depth at most sites (Table 2).

Table 2 Water quality in Princess Royal Harbour 2006

Parameter	Measured value
Dissolved inorganic nitrogen (µg/L)	10-15
Orthophosphate (µg/L)	5-8
Dissolved oxygen (August to April)	80-85 %
Dissolved oxygen (May to July)	5-125 %
Total suspended solids (mg/L)	1-4
Secchi depth	>5 m (water depth)
Chlorophyll a (µg/L)	0.6

Source: Strategen (2008)

Benthic habitat (seagrass)

Seagrass meadows have an important role in providing habitat and food for marine organisms and dispersing wave energy. There is a small area of seagrass within the Protected Harbour development area (approximately 0.11 ha of dense seagrass and 1.44 ha of sparse seagrass) and more extensive meadows exist to the immediate west of the Albany Town Jetty, most with densities of <45% (Strategen 2008). The seagrass species that are present include *Posidonia australis* and *Posidonia sinuosa*. These species occur both in isolation and mixed in the one area.

6.2 PURPOSE AND SCOPE

The purpose and scope of the water quality and benthic habitat component of the CEMP is to:

- monitor and manage turbid plumes generated during construction activities, to minimise impacts on the marine environment
- monitor and manage potential effects on seagrass health due to turbidity generated during construction activities.

[1] Turbidity is generated by fine particles that are easily dispersed (swept away by waves and currents).

6.3 POTENTIAL ENVIRONMENTAL ASPECTS AND IMPACTS

The construction of the Protected Harbour has the potential to affect water quality (through the possible mobilisation of contaminants in sediments and the generation of turbidity, which can in turn affect seagrass growth) from the following aspects:

- construction of the breakwaters
- construction of the temporary sand access platforms
- excavation to deepen the Protected Harbour and removal of the sand platforms once excavation is completed
- drainage and runoff from reclamation areas (using the excavated material as compacted fill)

The construction of the marine edge wall and excavation of 15,000 m^3 to deepen the marina basin will be undertaken in the 'wet' using temporary sand platforms for access for the land-based excavators. ,

The development footprint will also result in the direct removal of seagrass and potentially have indirect 'halo' effects around the breakwater structures.

Breakwater construction

Construction of the main breakwater core has the potential to generate the greatest turbidity, which may temporarily reduce the aesthetic value of the area for residents and/or affect light penetration to nearby seagrass communities. Turbidity will be generated on an intermittent basis as each truckload of material is end-tipped into the water. Under certain conditions, there is potential for this turbid plume to drift over seagrass communities adjacent to the construction site, potentially reducing light penetration required for growth or increasing sedimentation due to the settling of suspended material. Neither of these potential impacts would be expected to affect the long-term health of the seagrass but may affect short term growth.

Previous experience with breakwater construction using limestone indicates that turbidity plumes may intermittently shade seagrass up to about 50 m from the breakwater construction. Turbidity plumes are densest closest to the construction area and rapidly dissipate with distance and time (Figure 4). Therefore, seagrass adjacent to the main breakwater will be the most affected (less than ¼ of the breakwater length). Much of the breakwater construction for the Protected Harbour is greater than 50 m from the seagrass meadows.

Seagrasses in Princess Royal Harbour have a demonstrated capacity to withstand several months of continuous conditions of minimal light (EPA 1990); and the seagrass meadows adjacent to the project area are in shallow nearshore waters and therefore less vulnerable to light reduction from turbidity than meadows further offshore in deeper waters. Additionally, the main breakwater is expected to be constructed in four months, ensuring any causal increase in turbidity is short-term. Therefore, no loss of seagrass meadow is expected, but there is the potential for short term effects on the growth rates of seagrass close to the breakwater.

Construction of the cut-off breakwater shall occur after construction of the main breakwater. This structure is located greater than 50 m from the closest seagrass meadows west of the proposed Protected Harbour, and these meadows will also be protected by the main breakwater. No direct or indirect loss of seagrass meadow is expected from construction of the cut-off breakwater, however there is some potential for short term effects on the growth rates of seagrass if a turbidity plume was

directed over the meadows. These effects should be of a much lesser degree (in relative terms) than those associated with turbidity generated during construction of the main breakwater.

Construction of sea walls, excavation and, reclamation for marina basin

Construction of the marina edge wall, excavation for the marina basin and construction of the fishing area revetments and reclamation area will commence following completion of both breakwaters. This construction phase will be carried out within the semi-confined area behind the two breakwater, providing a barrier and increased distance between active works and the seagrass west of the development area.

The revetment construction will include an initial sand/rock structure to allow construction of the revetment. Subsequent reclamation will occur behind the revetment. The reclamation revetment for the fishing industry will have granite armour.

These construction works are expected to be conducted over a period of six months, across all seasons.

If large environmental changes occur for a period of several months, light attenuation can temporarily affect the density and vigour of the seagrass meadow. Seagrass meadows are capable of recovering from short-term (several months) changes in the environment (EPA 1990).

Seagrass loss

Direct (development footprint) and indirect (halo effect around development breakwaters) losses of seagrass due to construction of the Protected Harbour are estimated to be 0.111 ha of dense seagrass (*P. australis*) and 1.436 ha of very sparse seagrass (*P. sinuosa* or mixed *P. australis and P. sinuosa*). These losses will be offset through the rehabilitation of seagrass within Princess Royal Harbour as discussed in Section 7.

6.4 CONSTRUCTION MANAGEMENT OBJECTIVES, TARGETS AND PERFORMANCE INDICATORS

The environmental objectives, targets and performance indicators relevant to water quality and benthic habitat are shown in Table 3.

The performance indicators for seagrass will apply to the leading edge of the seagrass meadow closest to, and west of, the construction area. This seagrass meadow is the only area of seagrass that is close enough to be affected by the construction and the leading edge will be the first area affected if the turbidity plume moves in this direction. The leading edge of the seagrass meadow is also in the deeper water and therefore most vulnerable to light reduction from turbidity.

The leading edge of the seagrass meadow is shown in Figure 5 and will be marked with buoys prior to commencement of construction. The buoys will be spaced 50 m apart, starting 50 m from the breakwater and extending to 500 m from the breakwater.

The performance indicator for contaminants in naturally occurring bivalves will apply to any bivalves (e.g. mussels) likely to be harvested and consumed by members of the public. Whilst the public will not be allowed access to the site during construction (due to construction safety requirements), it will be important to confirm that any bivalves that could potentially be harvested by the public after construction are safe for consumption. A survey of the project area will be undertaken immediately

prior to construction, to confirm the presence (or otherwise) of any such bivalves, as these tend to be seasonally and annually variable due to natural factors (recruitment, predation) and fishing pressure.

Table 3 Environmental targets and performance indicators

Management objectives	Target	Performance indicator
To ensure that turbidity does not adversely affect the environmental values or amenity of Princess Royal Harbour outside the Protected Harbour	Prevent exposure of seagrass to extended periods of turbidity.	Visual extent of plume in relation to seagrass meadows outside of the Protected Harbour during construction period. Specifically; leading edge of seagrass (as marked by buoys and shown on Figure 5) not obscured continuously by turbidity plume for more than 7 consecutive days.
To ensure that turbidity does not affect the abundance, diversity, geographic distribution and productivity of seagrass species and the ecological values supported by seagrass.	Prevent a decrease in seagrass cover, density or health based on underwater photography due to turbidity external to the Protected Harbour	Cover, density and health of seagrass at leading edge of meadow outside the Protected Harbour (marked as monitoring sites in Figure 5)
To ensure that any contaminants present in the fine suspended particles of turbid plumes do not accumulate in naturally occurring bivalves (eg mussels) and adversely affect the health or welfare of bivalves consumers	Prevent exposure of naturally occurring bivalves to contaminants in turbid plumes	Contaminant levels in naturally occurring bivalves on existing structures in the project area.

Figure 4 Examples of turbidity plumes associated with breakwater construction (photos of Hillarys Boat Harbour breakwater extension, August/September 2006, supplied courtesy of Don Froome, DPI)

6.5 MANAGEMENT

6.5.1 Management strategies

The following management strategies are being employed during construction of the Protected Harbour based on the principles outlined in the previous discussion of potential impacts:

1. The greatest potential impacts on turbidity are expected to be due to breakwater construction. To minimise impacts from breakwater construction, clean material (i.e. rock core comprised of granite or ferricrete, and granite used for armour stone) with minimal fines content will be used. No more than 20% of the core material used in the construction of the breakwaters will have a diameter less than 0.1 m (approximately 1 kg). However, there will still inevitably be a turbid plume generated during construction, although this will be minimised as no limestone will be used in the breakwaters construction.
2. Both breakwaters will be largely completed before construction works relating to the marina edge wall and fishing industry area reclamation commence. This will ensure that any turbid plume will be largely contained within the Protected Harbour, allowing much of the suspended material to settle within the sheltered project area.
3. Excavation of sediments to deepen the marina basin will take place behind a silt curtain. Excavated material will be temporarily stockpiled so that any drainage water discharges into the protected harbour within the area contained by the silt curtain.

6.5.2 Management actions

The generation of some turbidity during construction of the Protected Harbour is unavoidable. However, the turbidity generated by the proposal is not expected to have any significant adverse impacts given construction methods employed. Therefore, other than the strategies outlined in the previous section, the focus of management will be to monitor and implement contingencies if unexpected changes occur.

The Contractor Environmental Control Officer will have responsibility for ensuring the management actions and various monitoring is undertaken (see Table 4).

The excavated material will be transported in trucks directly to the reclamation area and used in the reclamation. The material will not be double handled and will not therefore be an additional source of turbidity.

6.6 MONITORING

The proposed monitoring for water quality, benthic habitat and contaminants in bivalves is shown in Table 4. To assist in the visual assessment of the proximity of the turbidity plume to the seagrass meadow, by construction personnel, floating markers will be installed by the seagrass monitoring team to indicate the southern edge of the seagrass meadow. The monitoring of turbidity has also been informed by the results of monitoring of turbidity and seagrass health undertaken during and after two months of reclamation for the Albany Foreshore development in late 2007, which found no impact on seagrass health.

Table 4 Monitoring program for turbidity and associated contaminants during construction activities

Parameter	Frequency	Location	Purpose	Responsibility
Visual assessment (location, length, width, and direction) [1] of any turbid plume from the construction site. Visual assessment of proximity of plume to buoys indicating the leading edge of the seagrass meadow.	To be logged twice daily throughout construction period.	Leading edge of seagrass meadow to be marked by buoys Vantage point for visual monitoring to be determined by Contractor and agreed with DoW (new pedestrian overpass may be appropriate)	To ensure any excessive turbidity generated during construction is identified, and initiate contingency action if turbidity triggers are exceeded.	Contractor Environmental Control Officer
Photographic record of visual extent of turbid plume.[1]	Daily, during breakwater construction.	Photograph to be taken from a high vantage point above the site (e.g. pedestrian overpass).	To provide a photographic record to confirm observations logged during the visual assessment.	Contractor Environmental Control Officer
Light attenuation (a measure of water clarity) as documented by in situ light loggers	Continuously, from two months prior to construction to two months after construction	Four monitoring sites (Figure 5): Two sites to be on the deep, southern edge of the seagrass meadow immediately west of the breakwater, 50 m and 100 m from the nearest point of the breakwater. Two reference sites ~50 m apart to be established on southern edge of the seagrass meadow approximately 450-500 m from the nearest point of the breakwater.	To monitor the degree to which turbidity affects the amount of light reaching seagrass meadows.	LandCorp Project Manager will be responsible but the monitoring is to be undertaken by a qualified marine scientist
Public complaints about turbidity.	As required.	Not applicable.	To monitor and respond to any public concerns about the amenity of the area.	Contractor Environmental Control Officer
Seagrass density as documented via a series of 24 random fixed quadrants (20cm x 20cm) within a radius of 20m from each site using Standard Operating Procedures endorsed by the EPA (EPA, 2004).	Within two weeks prior to commencement and again within two weeks following the completion of the works. Additional seagrass monitoring will be conducted during the construction period if triggered by exceedance of the LAC monitoring criteria..	Four monitoring sites (Figure 5), as for light attenuation.	To monitor potential effects on seagrass due to turbidity generated during construction activities.	LandCorp Project Manager will be responsible but the monitoring is to be undertaken by a qualified marine scientist
Seagrass health (e.g. smothering of seagrass by sediment, exposure of rhizome mat, presence of blackened rhizomes, leaf necrosis, excessive epiphyte growth) as documented in underwater photographs.	Monthly from two months prior to construction to two months after construction, but increasing to fortnightly during breakwater construction.	As above	To monitor potential effects on seagrass due to turbidity generated during construction activities.	As above

Parameter	Frequency	Location	Purpose	Responsibility
Contaminant levels in (i) naturally occurring bivalves and (ii) in deployed 'sentinel' mussels	(i) In naturally occurring mussels, immediately prior to excavation, immediately after the completion of excavation, and two months after excavation.[2] (ii) Sentinel mussels to be deployed immediately before excavation starts, and harvested after completion of excavation (expected duration 4 weeks). Fresh sentinel mussels to be deployed at monthly intervals for 2 months after completion of excavation, and each batch harvested after 4 weeks. [3]	(i) From existing structures within the project area (ii) From 3 sites located within the construction site, 3 reference sites and 3 sites immediately adjacent to the construction site.[3]	To monitor potential effects on contaminant levels in bivalves that could potentially be harvested by members of the public for consumption	As above.

[1] noting date, relevant weather and sea state conditions, and proximity of plume to the nearest edge of dense seagrass meadows adjacent to the construction site.

[2]. The focus is on the excavation period as it has the most potential to cause bivalve contamination. Two months after excavation will be close to the end of construction activities (and re-opening to public access).

[3] The sampling design and sites will be finalised based on advice from the Department of Fisheries.

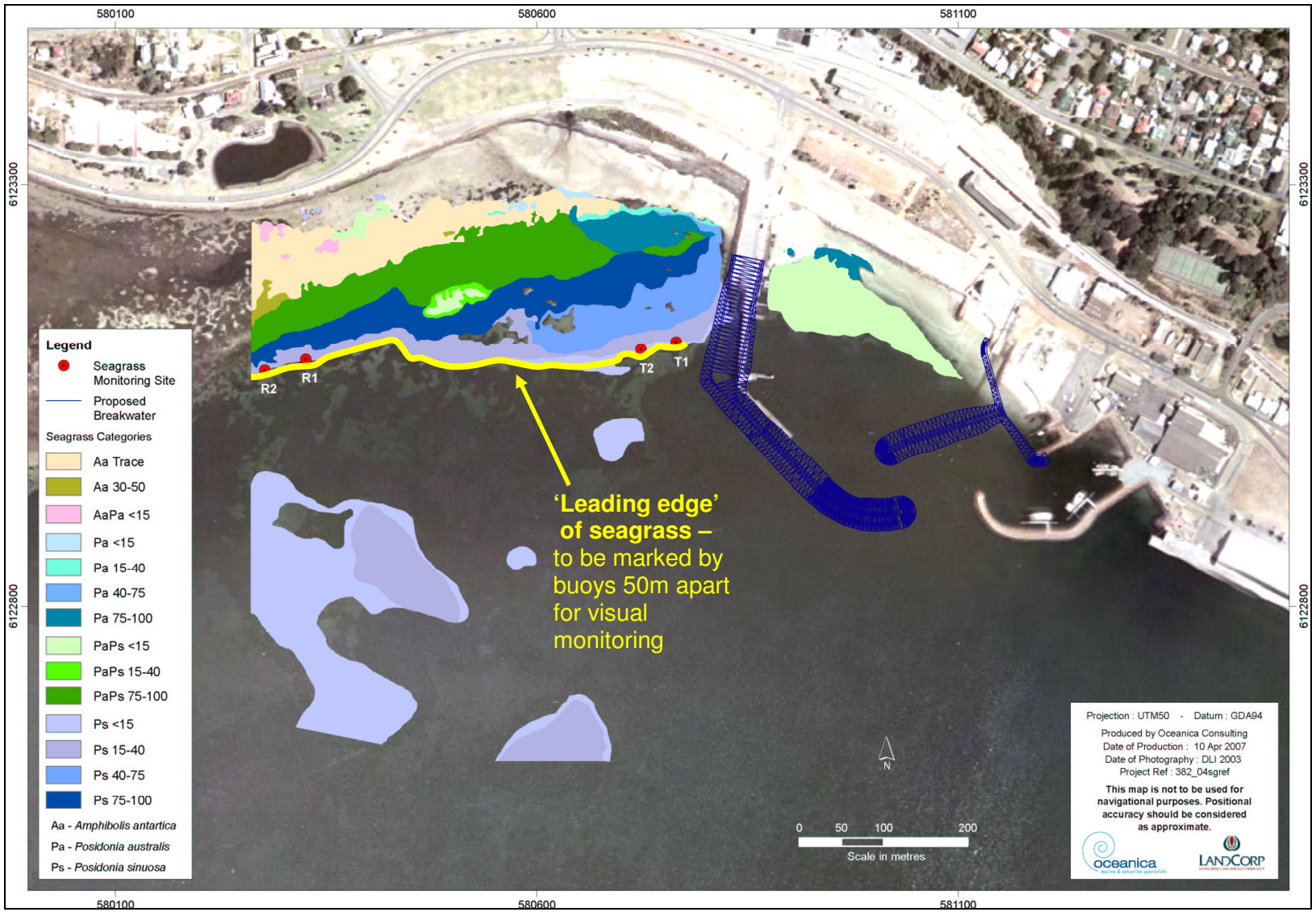


Figure 5 Location of seagrass monitoring sites, seagrass species and densities (%) and development footprint

6.7 CONTINGENCIES

Contingency actions for managing water quality and benthic habitat if performance indicators are exceeded are shown in Table 5. The triggers have been informed by the results of monitoring of turbidity and seagrass health undertaken during and after two months of reclamation for the Albany Foreshore development in late 2007, which found no impact on seagrass health.

Table 5 Contingency actions for managing turbidity during construction activities

Trigger	Action	Responsibility
The weekly median light attenuation coefficient (LAC[1]) at an impact site exceeds the 80th percentile of the reference site for 2 consecutive weeks.	1. Alert responsible person on site. 2. Stop work on site. 3. Initiate fortnightly monitoring of seagrass shoot density at monitoring sites. 4. Determine the causes of high turbidity, including checking: • the amount of fines in the material • the placement technique/rate of material • ambient conditions (weather, sea state). 5. Implement methods to reduce turbidity levels which may include: • reducing the fines content of the material selected for breakwater construction • placing the material more slowly • changing work methods and timing (eg restricting activities until suitable conditions arise, such as current flow away from seagrass meadows) • Notify the DEC/DoW South Coast Region and other party if necessary. 6. In addition, if an effect on seagrass shoot density is identified[2] then the proponent will commit to undertake monitoring of the effected seagrass monitoring sites (and the reference site) bi-monthly until such time as the criteria is not exceeded at the monitoring site during two consecutive surveys. If after one year of ongoing monitoring the seagrass shoot density at the impacted site does not meet the criteria then the requirement for further work will be discussed with the DEC/DoW South Coast Region.	Contractor Environmental Control Officer
Visible change in seagrass cover, density or health (eg smothering of seagrass by sediment, exposure of rhizome mat, presence of blackened rhizomes, leaf necrosis, excessive epiphyte growth).	1. Alert responsible person on site. 2. Investigate source of turbidity/contamination. 3. Cease work on site. 4. Instigate measures to prevent further deterioration of conditions. 5. Initiate more detailed monitoring of ambient water quality (eg turbidity) and seagrass (eg shoot density counts). 6. Inform the DEC / DoW South Coast Region and other party if necessary. 7. Revisit site procedures and re-brief all workers 8. Monitor on site work activities.	Contractor Environmental Control Officer
Average mercury levels in bivalves exceed 0.4 mg/kg[3] two months after cessation of excavation activities.	1. Seek advice from the Department of Fisheries and Department of Health. If required, ban the taking of mussels in potentially affected areas, and extend sampling to include fish. 2. Inform the DEC/DoW South Coast Region.	Contractor Environmental Control Officer

[1]. LAC to be calculated daily using data collected between 11.00 and 14.00

[2]. The seagrass shoot density criteria is that the median shoot density at a test site should not fall below the 20th percentile of the reference site

[3]. Based on results for at least 20 mussels. Trigger level based on Joint FAO/WHO Expert Committee on Food Additives provisional tolerable weekly intake (PTWI) for methyl mercury of 1.6 µg/kg body weight, assuming Australian median fish consumption of 0.49 kg/week by a 60 kg adult

7. SEAGRASS REHABILITATION

7.1 INTRODUCTION

Under EPA Guidance Statement No. 29, Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment, Princess Royal Harbour is designated a 'Category F' management area, described as "Areas where cumulative loss thresholds have been significantly exceeded, and therefore proposals must not cause any net loss of seagrass".

The construction of the Protected Harbour will cause both direct losses of seagrass due to the development footprint, and indirect losses of seagrass through the development of a bare sand halo adjacent to the proposed breakwater. LandCorp has made a commitment to offset these losses by replanting seagrass in other areas of Princess Royal Harbour.

Previous rehabilitation at Albany

Seagrass rehabilitation using manual techniques has an established track record in successfully transplanting species of *Posidonia* in the sheltered marine embayments of Princess Royal Harbour and Oyster Harbour at Albany (Bastyan 2001 and 2004). Trials have been conducted involving transplanting sprigs[2], which has achieved a survival rate in excess of 90%. In some areas, rehabilitation has been hampered by currents sufficient to scour/deposit sediments or the intense activity of sand-dwelling worms (Strategen 2008).

Additional seagrass research in the Albany region has included the collection of *Posidonia australis* seeds that were grown out in an aquarium before transplantation. The survival rate after one year was 60% for the plants raised from seeds and 80% for seedling transplants (Strategen 2008).

7.2 PURPOSE AND SCOPE

The purpose and scope of the seagrass rehabilitation component of the CEMP is to:

- ensure that direct and indirect losses of seagrass associated with the construction of the Protected Harbour are properly quantified, and offset by at least an equivalent area of rehabilitated seagrass.

7.3 POTENTIAL IMPACTS

Direct (development footprint) and indirect (halo effect around development breakwaters) losses of seagrass due to construction of the Protected Harbour are estimated to be 0.111 ha of dense seagrass (*P. australis*) and 1.436 ha of very sparse seagrass (*P. sinuosa* or mixed *P. australis and P. sinuosa*) (Table 6). The majority of the losses are areas of sparse seagrass, and so for the purpose of seagrass rehabilitation Table 6 also shows the estimated seagrass losses in terms of an equivalent area of 75% seagrass cover.

[2] A section of underground rhizome about 10 cm long containing one to four leaf-bearing shoots.

Table 6 Direct and indirect seagrass loss associated with the Protected Harbour development

Category of seagrass cover	Seagrass area (hectares)			
	Direct loss, marina footprint	Direct loss, breakwater footprint	Indirect loss, breakwater halo*	Total loss
90% cover *P. australis*	0.111	0	0	0.111
20% cover *P. sinuosa*	0	0.036	0.113	0.149
<15% cover *P. sinuosa***	0	0.017	0.011	0.028
5% cover *P. australis / P. sinuosa*	1.259	0	0***	1.259
Total area (varying density of cover)	**1.370**	**0.053**	**0.124**	**1.547**
Total area, as 75% cover 'equivalents'	**0.217**	**0.011**	**0.031**	**0.259**

* Note: assuming a 15 m halo around the breakwater

** Note: for calculation of 75% cover equivalents, a value of 7.5% cover was used

*** Note: losses on west side of breakwater included under direct loss due to marina footprint

Total anticipated losses of dense and sparse seagrass meadow are equivalent to 0.259 ha of 75% cover seagrass. The area of seagrass affected is predominantly sparse (5% cover) and is likely to be of little habitat value for marine fauna as it comprises little more than bare sand with the occasional small clump of seagrass (G. Bastyan, pers. comm.). For this reason, the planned 0.4 ha of rehabilitation has been defined and based on an expectation of eventually achieving at least 75% seagrass cover, which will have greater habitat value than the area of sparse seagrass lost[3].

Rehabilitation of seagrass meadows will be undertaken predominantly through the transplantation of seagrass from those areas that will be lost due to the marina development. Supplementary planting may be required in the future, with the seagrass material being supplied by nearby donor seagrass beds. Previous studies have indicated no detrimental changes in meadows at donor beds after the limited removal of donor material; such as core or plug removal and of the removal of the leading edge on both *P. australis* and *P. sinuosa* meadows (DAL 2005).

7.4 CONSTRUCTION MANAGEMENT OBJECTIVES, TARGETS AND PERFORMANCE INDICATORS

The management objective, targets and proposed performance indicators for seagrass rehabilitation are shown in Table 7.

[3] Note: The Anzac Peace Park and the Foreshore Redevelopment will result in a total loss of 0.06 ha of approximately 75% density seagrass. Therefore, the planned rehabilitation for the Protected Harbour will also offset the losses of these other projects even though there is no requirement for these losses to be offset.

Table 7 Environmental targets and performance indicators

Management objectives	Target	Performance indicator
To offset any loss to the abundance, diversity, geographic distribution and productivity of seagrass species and the ecological values supported by seagrass from construction of the Protected Harbour	Identify any seagrass losses above those predicted that need to be offset by seagrass rehabilitation.	Seagrass loss (hectares)
	Rehabilitate an equivalent area of seagrass to offset that lost due to direct and indirect effects of construction of the Protected harbour	Area planted, rehabilitation density, and % survival of rehabilitated seagrass
	Greater than 70% of transplanted sprigs have an annual growth rate sufficient to attain shoot densities of natural meadows within 10 years of planting*	Seagrass shoot density

* Note: the work of Bastyan & Associates and Edith Cowan University indicates rehabilitated meadows develop shoot densities similar to natural meadows within 8 years.

The performance indicators will be finalised in consultation with the DEC and DoW South Coast Region.

7.5 MANAGEMENT ACTIONS

Table 8 outlines the management actions required to undertake seagrass rehabilitation and achieve the performance targets. LandCorp has responsibility for ensuring the seagrass rehabilitation is undertaken.

Table 8 Management actions for seagrass rehabilitation

Topic	Action	Timing
Transplanting seagrass from the Protected Harbour	An appropriately qualified marine scientist to remove seagrass material (rhizome sprigs) from the development footprint area and transplant seagrass in rehabilitation areas (0.4 ha). Harvested material to be transplanted on the same day it is harvested, preferably within several hours of harvesting.	Preferably during spring 2008, but planting through summer 2008/2009 also acceptable.
Maintenance	Undertake supplementary planting as required to achieve targets	Summer 2009/2010 and beyond as necessary

Sourcing seagrass material

Approximately 0.111 ha of dense *P. australis* meadow shall be cleared for the Protected Harbour development as part of the excavation undertaken in 2009. This material will be used as the source of donor seagrass material being collected by scientific divers prior to the commencement of construction and immediately planted in rehabilitation areas. This patch contains more than sufficient material for the 0.4 ha of rehabilitation that is planned (Geoff Bastyan, pers. comm., March 2007), within Princess Royal Harbour (Figure 6).

The scientific divers will harvest rhizome sprigs (plus attached leaves) from the edge of the seagrass patch by hand and the sprigs will be stored in water during transit to the rehabilitation site for planting on the same day.

Transplanting method

The seagrass sprigs will be tied to U-shaped wire pegs using biodegradable twine or similar. To plant each sprig, a small depression will be made in the sand by hand, the peg will be inserted into the sand, and sand gently fanned back over the rhizome to level the seabed surface.

Based on the considerable body of work undertaken by Bastyan & Associates (2006) on seagrass transplantation methods in this area, sprigs of seagrass will contain at least 3 shoots/sprig. A planting pattern of 1.5 m between sprigs in staggered rows (offset by 0.75 m) 1 m apart will be used, giving a planting density of 7000 sprigs/ha, with each sprig approximately 1 m (diagonally) from the four nearest adjacent sprigs. This planting pattern allows meadows with shoot densities similar to natural meadows to be attained within 8-10 years (Bastyan & Associates 2006).

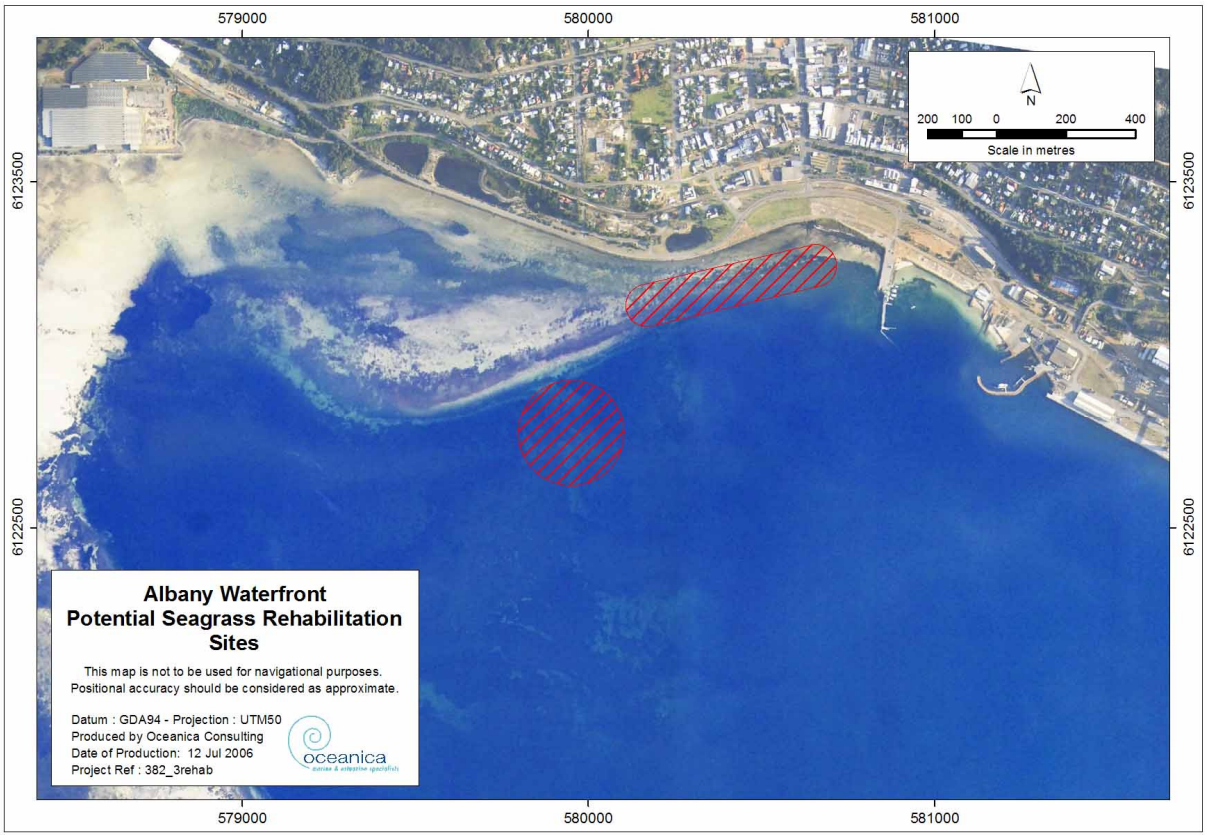


Figure 6 Potential sites where seagrass rehabilitation will be undertaken within

Maintenance

Infill planting may be required to ensure the performance targets are met. Seagrass material will be sourced from nearby seagrass communities and transplanted using the same technique outlined above. These donor beds will be monitored to ensure the removal of seagrass for supplementary planting has not detrimentally affected the community.

7.6 MONITORING

The proposed monitoring program is outlined in Table 9, and includes

- activities to confirm seagrass losses are as predicted
- monitoring of the survival and growth of the rehabilitated areas planted to offset the seagrass losses.

LandCorp has responsibility for ensuring monitoring in relation to seagrass rehabilitation is undertaken.

Table 9 Monitoring program for seagrass rehabilitation

Parameter	Frequency	Location	Purpose
Area of seagrass loss due to development footprint	Monitored annually for the first two years, with monitoring requirements thereafter to be determined in consultation with the DoW South Coast Region and DEC	Construction area and immediately adjacent seagrass meadows.	To quantify direct and indirect losses of seagrass due to the development footprint and halo effect.
% survival of rehabilitated seagrass planting units	Monitored in the first autumn after planting, and annually in summer thereafter for three years.	Rehabilitated seagrass sites in Princess Royal Harbour.	To confirm that seagrass planting units will meet rehabilitation performance criteria of 60% survival
Shoot density of rehabilitated seagrass planting units	Monitored annually in summer for four years.	Rehabilitated seagrass sites in Princess Royal Harbour.	To confirm that seagrass planting units are actively growing and expanding and are meeting targets

7.7 CONTINGENCIES

Contingency actions that will be implemented if monitoring indicates that performance targets will not be, or aren't being, met are outlined in Table 10. LandCorp has responsibility for implementing these actions.

Table 10 Contingency actions during seagrass rehabilitation

Trigger	Action
Direct loss of seagrass due to development footprint >10% of predicted loss. Width of halo region exceeds 15 m.	1. Identify any direct or indirect seagrass loss in excess of that predicted. 2. Determine cause of loss. 3. Excess seagrass loss to be offset by seagrass rehabilitation of an equivalent area, and subject to the same performance criteria as the main rehabilitation program for the Protected Harbour. 4. Inform the DoW South Coast Region and DEC of any seagrass losses above that predicted and the offset being applied.
% survival of seagrass planting units falls below 60%* More than 30% of sprigs have growth rates insufficient to attain shoot densities similar to natural meadows within 10 years.	1. Investigate cause/reason and determine mitigation measure, if any, which shall be implemented. 2. Determine the extent of infill planting required in the rehabilitated areas and undertake the transplanting. 3. Monitor donor beds to confirm their recovery (infill planting will require harvesting of material from seagrass meadows outside the Protected Harbour). 4. Revise monitoring requirements in consultation with DEC/DoW South Coast Region.

* Note: 60% survival of planting units within the 0.4 ha of rehabilitated seagrass will still ultimately result in 0.32 ha of 75% cover seagrass (i.e. 60/75 * 0.4), which still exceeds the predicted loss (equivalent to 0.259 ha of 75% cover seagrass) due to the Protected Harbour development.

8. WASTE

8.1 INTRODUCTION

Sources of waste during construction include:

- general solid waste
- sea floor debris
- excavated material unsuitable for use on-site as fill.

8.2 CONSTRUCTION MANAGEMENT OBJECTIVES, TARGETS AND PERFORMANCE INDICATORS

The management objective for the waste component of the CEMP is to:

- dispose of waste in an environmentally acceptable manner, and in a manner that protects nearby conservation and amenity values.

The environmental targets and performance indicators developed to achieve the management objective are outlined in Table 15.

Table 11 Environmental targets and performance indicators

Management objectives	Target	Performance indicator
To dispose of waste in a manner that protects nearby conservation and amenity values	No waste or rubbish from construction activities is detected offsite, All on-site waste is disposed of in designated waste disposal facilities	Construction site inspections
To dispose of waste in an environmentally acceptable manner.	All excavated sediments unsuitable for use as fill will be disposed of to an appropriately licensed landfill facility.	Sampling results Landfill acceptance documents

8.3 MANAGEMENT

8.3.1 Management strategy for excavated sediment

Sediments being disposed of to landfill would generally be sampled prior to being removed offsite to characterise the waste and determine whether it is suitable for Class I landfill. However, the sediments being excavated from the Protected Harbour have previously been extensively sampled. Sampling of the sediments has been carried out in 2004, 2006 and 2008 and has included sampling of the following parameters (Oceanica 2008):

- Arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, zinc
- Total petroleum hydrocarbons, standard suite of polycyclic aromatic hydrocarbons, total polychlorinated biphenyls, BTEX (Benzene, Toluene, Ethylbenzene, Xylene), standard suite of organochlorine pesticides, total organic carbon.

- Total nitrogen and total phosphorus
- Tributyltin
- Acid sulphate soil potential

In summary, the results of these investigations found (Oceanica 2008):

1. No results for any of the above parameters exceeded any Environmental Investigation Limit (EIL) or Health Investigation Limit (HIL).
2. Metals: The only metals that exceeded any EQG values were lead and mercury. Those few samples that exceeded EQG values in 2004 were subjected to a leachate test. The subsequent leachate tests were below reporting limits and therefore suitable for Class 1 landfill.
3. Organics: BTEX were below detection limits and would easily meet the criteria of Class 1 landfill. All petroleum hydrocarbons and polycyclic aromatic hydrocarbons were below EILs.
4. The Titratable Peroxide Acidity (TPA – net acidity) and Chromium Reducible Sulphur (S_{CR}) were determined for the sediments to be excavated and used in reclamation. There were no exceedances of TPA, but several exceedances of oxidisable sulphur. However excess acid neutralising capacity at all sites was high, and it is unlikely the sediments would become acid generating.

On this basis, all sediments to be excavated meet the Class 1 landfill criteria. Therefore, if excavated sediment requires disposal to landfill (on the basis that it does not meet geotechnical criteria), no further testing will be undertaken prior to disposal.

8.3.2 Management actions

The management actions for waste are outlined in Table 12.

Table 12 Management actions for waste

Topic	Action	Timing
General waste disposal	Waste disposal facilities (e.g. bins) should contain waste and prevent waste from blowing out.	Throughout construction
	During inductions all personnel shall be made aware of individual responsibilities in regards to waste management. That is, all personal rubbish and incidental construction rubbish generated is to be properly disposed of in designated disposal facilities.	Throughout construction
Stockpiled material	All debris recovered from the sea floor shall be stockpiled on site to allow inspection (to identify items with heritage value or reuse/recycling potential) prior to disposal to landfill.	Prior to excavation
	All excavated material unsuitable for use as fill shall be stockpiled so that drainage from the stockpile drains into the area of the Protected Harbour that is within the silt curtain. I.e. back into the area it was excavated from.	During excavation

8.4 MONITORING

The monitoring program for waste is outlined in Table 9.

Table 13 Monitoring program for waste

Parameter	Frequency	Location	Responsibility
All bins are covered	Weekly site inspections	Construction site	CECO
No rubbish observed outside of bins	Weekly site inspections	Construction site	CECO
All runoff from stockpiled sediments is draining to the Protected Harbour within the silt curtain	Weekly site inspections	Drainage flows from stockpiled sediments	CECO

8.5 CONTINGENCIES

Table 14 identifies the contingency actions to be initiated in the event that the objectives for waste management are not, or will not, be met.

Table 14 Contingency actions for waste management

Trigger	Action	Responsibility
Waste not being disposed of in designated disposal facilities	1) Investigate cause. 2) Alter management actions accordingly (eg. relocate disposal facilities). 3) Re-inform all personnel of waste management responsibilities. 4) An Environmental Incident Report shall be completed if greater than one cubic metre of waste in open.	CECO
Disposal facilities not properly containing waste	1) Investigate cause. 2) If due to misuse re-inform all personnel of proper use of facilities. 3) If due to facility fault mitigate immediately (eg. replace or modify facility). 4) An Environmental Incident Report shall be completed if greater than one cubic metre of waste in open.	CECO
Public complaints relating to waste	1) Investigate cause. 2) Alter management actions accordingly to mitigate. 3) If waste accumulated offsite prompt collection of the waste shall be arranged. 4) An Environmental Incident Report shall be completed.	CECO

9. NOISE

9.1 INTRODUCTION

The main existing sources of noise near the project area are the Albany Port and road traffic along Princess Royal Drive. The Protected Harbour development is outside the Albany Port Noise Buffer Area that was established in 2000.

Noise, during construction of the Protected Harbour, will be generated by vehicle movements and machinery operation including earth-moving machinery, trucks and small vehicles. A water pump will also be operated.

Noise emissions from construction of the protected Harbour will vary in intensity and tonality (e.g. vehicle reversing beacon or running engine) characteristics depending upon the combination of equipment in operation at any one time, and the location and duration of the individual activities. Construction traffic will cause minor increases in traffic noise along roads, particularly Princess Royal Drive.

9.2 CONSTRUCTION MANAGEMENT OBJECTIVES, TARGETS AND PERFORMANCE INDICATORS

The management objective for the noise component of the CEMP is to:

- minimise impacts on nearby residents from noise generated during construction of the Protected Harbour.

The environmental targets and performance indicators developed to achieve the management objective are outlined in Table 15.

Table 15 Environmental targets and performance indicators

Management objectives	Target	Performance indicator
Minimise impacts from noise generated during construction of the Protected Harbour.	Comply with the Noise Regulations and section 6 of AS2436-1981.	Construction times Equipment/machinery being used
	No complaints received from the public in regards to noise outside the hours of 0700 to 1900, Monday to Saturday.	Environmental Complaint and Incident Register

9.3 MANAGEMENT

The legislative framework for managing noise impacts is the EP Act, specifically sections 51, 62(4), 65 and 74(3)/50, 51 and 75. The noise limits cited by the Act are prescribed in the *Environmental Protection (Noise) Regulations 1997* (Noise Regulations) and are provided in Table 16.

Table 16 Prescribed noise limits

Type of premises receiving noise	Time of day	Assigned level (dB)		
		LA 10	LA 1	LA max
Noise sensitive premises within 15 m of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises further than 15 m from a building directly associated with a noise sensitive use	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

Whilst these noise limits are prescribed in the regulations, construction sites are exempt from these as detailed in Part 2 Regulation 13 of the Noise Regulations:

> *Regulation 7 does not apply to noise emitted from a construction site as a result of construction work carried out between 0700 hours and 1900 hours on any day which is not a Sunday or a public holiday if the occupier of the premises or public place, shows that –*
>
> *(a) the construction work was carried out in accordance with control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction , Maintenance and Demolition Sites;*
>
> *(b) the equipment used on the premises was the quietest reasonably available; and*
>
> *(c) if the occupier was requested to prepare a noise management plan under sub regulation (4) in respect of the construction site-*
>
> > *(i) the noise management plan was prepared and given in accordance with the requirement, 7 days prior to construction commencement, and approved by the Chief Executive Officer; and*
> >
> > *(ii) the construction work was carried out in accordance with the management plan.*

Therefore, the noise limits outlined in Table 16 do not apply for the construction work being undertaken as part of the Protected Harbour development between the hours of 0700 and 1900 from Monday to Saturday, however any work conducted out of these hours or during Sunday and public holidays will need to comply with the standards.

The management actions to be implemented during the entire construction period of the Protected Harbour development include:

- construction is to be carried out in accordance with section 6 of AS2436-1981
- the equipment used on the premises will be the quietest reasonably available.

Implementation of these management actions is the responsibility of the Contractor Construction Superintendent, Contractor Supervising Engineer, Contractor Supervisor/Foreman and Contractor Environmental Control Officer.

9.4 MONITORING

Provided construction is undertaken between the hours of 0700 and 1900 from Monday to Saturday or in accordance with the Noise Regulations, no monitoring is anticipated to be required.

Noise monitoring may be required if construction is required outside these times and complaints are received.

9.5 CONTINGENCIES

Contingency actions for managing noise if performance targets are not being achieved are outlined in Table 17. The Contractor Construction Superintendent, Contractor Supervising Engineer, Contractor Supervisor/Foreman and Contractor Environmental Control Officer have responsibility for the implementation of contingency actions, if required.

Table 17 Contingency actions during seagrass rehabilitation

Trigger	Action
Construction work required to occur on Sundays or public holidays; or before 0700 and after 1900 hours on any other day.	1. Determine requirement for additional management measures, which may include: • developing a noise management plan • limiting the quantity of machinery/vehicles in operation • utilising noise attenuating measures (e.g. mufflers) on equipment and machinery/vehicles. 2. Determine the requirement for monitoring noise levels in accordance with additional management measures that may be implemented. 3. Receive approval from the relevant authorities in relation to any proposed additional noise management measures. 4. Implement additional management measures.
Justified complaint received from the public.	1. Any complaints shall be considered Environmental Incidents and shall be managed in accordance with Section 4.5. Noise monitoring and data recording may be initiated to provide information to support development of a management response. 2. Mitigation measures shall be implemented as required.

10. DUST

10.1 INTRODUCTION

Dust may be generated during construction of the Protected Harbour by earthworks, vehicle movements or lift-off from stockpiled material. Approximately 15,000 m^3 of sediment will be excavated to deepen the marina basin. The material will be used for reclamation in the fishing industry area.

The excavation will be undertaken 'wet' (i.e. without dewatering) and the material to be excavated will still be moist and thus not generate dust. Additionally, particle size analysis indicated that the majority of sites comprised either fine – medium sands or coarse sands – gravel, with only small percentages of silts and clays (Table 18).

Table 18 Particle size composition of sediments to be excavated

Site and sediment layer to be excavated	Fines content	Main size fraction/s*
0.7W: surface 0–1 m layer	1.06%	Fine/medium sand
0.7W: 1–2 m layer	0%	Medium sand
0.7M: surface 0–1 m layer	6.54%	Fine/medium sand
0.7M: 1–2 m layer	0%	Fine/medium sand
0.7E: surface 0–1 m layer	2.69%	Medium sand
0.7E: 1–2 m layer	2.79%	Fine/medium sand
1.5W: surface 0.65 m layer	2.49%	Fine sand & gravel
1.5W: 0.65–1.25 m layer	0%	Fine/medium/coarse sand & gravel
2.0W: surface 0–0.375 m layer	12.12%	Coarse sand
2.0W: 0.375 –0.75 m layer	2.44%	Gravel
2.0M: surface 0–0.375 m layer	2.75%	Fine sand & gravel
2.0M: 0.375 –0.75 m layer	1.57%	Coarse sand & gravel
2.0E: surface 0–0.375 m layer	6.05%	Fine sand & gravel
2.0E: 0.375 –0.75 m layer	1.04%	Gravel
2.5M: surface 0.25 m layer	5.26%	Fine sand
2.5E: surface 0.25 m layer	3.66%	Fine sand

*Fine sand (particle diameter 62–250 µm), medium sand (particle diameter 250–500 µm), coarse sand (particle diameter 500–2000 µm) or gravel (particle diameter 2000–10000 µm)

Source: Strategen (2008)

10.2 CONSTRUCTION MANAGEMENT OBJECTIVES, TARGETS AND PERFORMANCE INDICATORS

The management objectives, targets and performance indicators relevant to dust are outlined in Table 19.

Table 19 Environmental targets and performance indicators

Management objectives	Target	Performance indicator
To minimise the temporary impact of dust emissions from construction of the Protected Harbour.	No visible dust crossing the site boundary.	Visual inspections
	No justified complaints received from the public in regards to dust.	Environmental Complaint and Incident Register

10.3 MANAGEMENT ACTIONS

Construction of the Protected Harbour is likely to generate little dust as vehicle movements will be largely restricted to bitumised areas. Excavated sediment that will be used for reclamation will have low potential to generate dust as initially it will be moist and there is very little fine material in the sediment that would easily be lifted by wind.

The following dust suppression measures will be adopted (in combination or isolation):

- dust generating activities shall not be conducted during unfavourable weather conditions (e.g. high wind speed and dry conditions)
- spray unsealed roads or stockpiles (with low moisture content) with water or other dust suppressants under dust prone conditions.

Other measures that may be applied if dust targets may not be met:

- limit the quantity of machinery/vehicles in operation
- install wind fencing.

10.4 MONITORING

The proposed monitoring for dust emissions is outlined in Table 20. The Contractor Environmental Control Officer shall have responsibility for ensuring the monitoring is conducted.

Table 20 Monitoring program for dust

Parameter	Frequency	Location	Purpose
Visible dust	Daily	Site boundary	To determine if dust is being generated from earthworks, vehicle movements or stockpiles and affecting users outside the site boundary.

10.5 CONTINGENCIES

Proposed contingency actions for managing dust if performance targets are not being achieved are outlined in Table 21. The Contractor Construction Superintendent, Contractor Supervising Engineer, Contractor Supervisor/Foreman and Contractor Environmental Control Officer have responsibility for the implementation of contingency actions, if required.

Table 21 Contingency actions for dust

Trigger	Action
Excessive dust generation as determined by visual observation	1. Investigate cause. 2. Implement appropriate dust control measures, which may include: • limit the quantity of machinery/vehicles in operation • install wind fencing. 3. Monitor success of control measure. If the measure is inadequate, seek alternative measures (consultation with relevant agencies may be required).
Justified complaint received from the public.	1. Any complaints shall be considered Environmental Incidents and shall be managed in accordance with Section 4.5. Dust monitoring and data recording may be initiated to provide information to support development of a management response. 2. If deemed necessary, mitigation measures shall be implemented.

11. HERITAGE

11.1 INTRODUCTION

The foreshore of Princess Royal Harbour at Albany is one of the earliest sites of European settlement in Western Australia. The Albany Town Jetty was first built in 1862 as a timber and iron finger jetty with a landing and steps on each side of the jetty head. The jetty is believed to be the oldest jetty site in Western Australia in continuous use. The jetty and the sea bed under and adjacent to it has cultural significance (Strategen 2008) and is registered as site 3607 on the State Register of Heritage Places.

The Albany Town Jetty has been determined to fall within the jurisdiction delegated to the Western Australian Museum by the Western Australian *Maritime Archaeology Act 1973*. There is the potential for archaeological material related to the early settlement of Albany to be located on the seabed or in existing foreshore area.

The Protected Harbour Development will extend the existing jetty structure. As the extensions will increase the footprint of the structure, there is the potential to disturb the seabed and any historical material that exists there. The breakwater has been designed to preserve the existing town structure where possible by either locating the breakwater next to the existing structure or carefully building the breakwater around the existing piles.

Some excavation for the marina basin and marina edge wall construction will occur but the majority of earthworks will cover rather than remove seabed material.

11.2 CONSTRUCTION MANAGEMENT OBJECTIVES, TARGETS AND PERFORMANCE INDICATORS

The management objectives, targets and performance indicators relevant to heritage are outlined in Table 21.

Table 22 Heritage targets and performance indicators

Management objectives	Target	Performance indicator
To protect the heritage and maritime archaeological values of the Albany Town Jetty and surrounding seabed during earthworks carried out during construction	No unauthorised disturbance of the jetty or archaeological material Compliance with heritage management plan	Reporting by the qualified archaeological consultant present on site during construction Preparation of management plan by archaeological consultant prior to construction

11.3 MANAGEMENT, MONITORING AND CONTINGENCIES

A Heritage Impact Statement has been prepared for LandCorp by Tom Stevens, Heritage Consultant regarding the Albany Waterfront Structure Plan and Adam Wolfe and Associates prepared a heritage impact statement specifically on the Albany Town Jetty and Foreshore maritime heritage values (Stevens 2007, Adam Wolfe and Associates 2007). These reports recognised that any land reclamation, including the construction of a stone breakwater, would cover the artefact deposits and ensure their long term protection. The reports also recommended that planning and construction for the project was carried out with advice from a quality archaeological consultant.

Management actions will include:

1. Appoint a qualified archaeological consultant, approved by the Western Australian Museum to undertake an archaeological assessment of the areas to be disturbed, utilising past survey results and additional survey work if required.
2. Archaeological consultant to prepare a detailed management plan to ensure that the archaeological heritage values of the area are protected during construction.
3. Submit management procedure to the Western Australian Museum and obtain permit to disturb ground under the *Maritime Archaeological Act 1970*
4. Submit management procedure and detailed plans to the Heritage Council of Western Australia.
5. Appoint a qualified consultant to be on site during all phases of construction that disturb the original Albany Town Jetty structure and the surrounding seabed.

All material encountered during construction will be dealt with according to the management plan as directed by the archaeological consultant with advice from the Western Australian Museum. All material encountered will be recorded prior to removal (if required).

12. REFERENCES

Adam Wolfe and Associates 2007, *Albany Waterfront Heritage Impact Statement, Albany Town Jetty and Foreshore*, January 2007.

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Masini RJ, Cary JL, Simpson CJ & McComb AJ 1990a, *Effects of light and temperature on the photosynthesis of seagrasses, epiphytes and macroalgae and implications for management of the Albany Harbours*, Environmental Protection Authority Technical Bulletin 32.

Stevens T 2007, *Albany Waterfront Structure Plan Heritage Impact Statement*, prepared for LandCorp, February 2007.

Strategen 2008, *Albany Protected Harbour Development, Environmental Protection Statement*, prepared for LandCorp.

Appendix 1
Construction Environmental Inspection Checklist

CONSTRUCTION ENVIRONMENTAL INSPECTION CHECKLIST	
Name:	Date:
Location/Sections of development inspected:	Weather:
(indicate on attached map)	

Yes if statement is checked and true, No if statement is not true or unchecked

ISSUE	YES	NO	COMMENTS
General			
No unauthorised personnel on site			
Training			
All personnel have undergone Environmental Induction			
Access			
Access points clearly marked			
Signs erect and legible			
All vehicles within designated access tracks			
Access tracks maintained			
Erosion control in place			
Drainage structures in place			
Water quality and benthic habitat			
Visual assessment of turbidity plume has been undertaken and recorded twice daily during construction in accordance with CEMP			
Photographic record of turbidity plume has been kept daily in accordance with CEMP			
Public complaints regarding turbidity received and responded to?			
Seagrass			
Check with LandCorp that seagrass transplantation has occurred prior to construction			

ISSUE	YES	NO	COMMENTS
Dust/Noise			
No obvious signs of excessive dust emissions			
Vehicles/machinery in good working order			
Noise/Dust Management plans followed			
Heritage			
Workforce aware of the possibility of uncovering Aboriginal or maritime heritage materials			
Complaints			
Summary and number of complaints received			
ADDITIONAL COMMENTS / Environmental Incidents			

Appendix 2
Environmental Complaint and Incident Register

ENVIRONMENTAL COMPLAINT AND INCIDENT REPORT	
Reported by:	Date of incident:
Time of incident:	Associated activity:
Location of incident: *indicate location on attached map*	
Investigated by:	Date investigated:

COMPLAINT OR INCIDENT DETAIL

___ Turbidity related issue	____ Heritage material disturbed without authorisation	____ Erosion issue
____ Fire prevention issue	____ Water pollution	____ Hydrocarbon spill
____ Noise complaint/issue	____ Dust complaint/issue	____ Chemical spill
		____ Other

Description of incident:

Description of environmental damage/impact:

Contributing factors of incident occurring:

Controls, Procedures, Response plan, and/or Monitoring in place to prevent/address occurrence:
Corrective action taken immediately:
Relevant training or instructions given to personnel prior to incident:
Did this incident occur as a result of non-conformance with construction environmental management plan? ___ Yes ____ No **What related procedures were not conformed to?**

INCIDENT COMMUNICATION

People informed (contractors, supervising engineer, LandCorp, authorities):
Information provided:

SPILL RESPONSE

If a spill has occurred: **Details of material cleaned up/recovered – specific type, quantity/volume:**

Method of clean-up
Test and Results after clean-up (if applicable)

RECOMMENDATIONS AND CLOSE OUT

Further remedial action required to address this specific incident:			
Action required	Person responsible	Due date	Date completed
Recommendations to prevent reoccurrence			