



Appendix C

Spoil Disposal Options Assessment

Spoil Ground Site Selection Port of Hay Point
(WBM 2004)

Assessment for Land Disposal Options for
Dredge Spoil at the Port of Hay Point
(WBM 2004)

Assessment for Land Disposal Options for Dredge Spoil at the Port of Hay Point

Prepared For: PORTS CORPORATION OF QUEENSLAND

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	Synopsis: Evaluation of options for the disposal of dredge spoil on land or in reclamation areas at the Port of Hay Point

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EXECUTIVE SUMMARY

Introduction

Ports Corporation of Queensland (PCQ) are currently proposing to increase the accessibility of the Port of Hay Point to ocean going vessels in order to increase the Port's capacity to export coal. This is to be achieved by deepening the access/departure channel to the wharves through a capital dredging program. It is expected that some 9 million m³ (Mm³) of material will need to be dredged for this program. An on-going maintenance dredging program will also be required. Disposal of the resulting spoil from the capital and maintenance dredging programs thus requires consideration.

Previous studies by WBM Oceanics (WBM 2004) identified potential spoil disposal options in off-shore areas within the Port limits. In accordance with the requirements of the National Ocean Disposal Guidelines for Dredged Material (NODGDM), PCQ also required that the examination of potential land disposal options for the spoil be undertaken. This report thus presents the findings of this assessment. The study has been undertaken as a desktop investigation and included a review of existing information, an identification of potential sites (both in on-shore areas and as reclamation within the tidal zone) and an assessment of issues and impacts associated with disposal to the identified sites.

The area of investigation incorporates PCQ holdings at Hay Point and Dudgeon Point and adjacent lands held by Hay Point Services.

Potential Spoil Disposal Sites- Hay Point

Investigations for land at Hay Point indicated that:

- All terrestrial areas are highly constrained due mainly to a combination of existing or proposed uses, existing environmental values, steeply sloping terrain and/or potential impacts on nearby residential uses. No land at Hay Point was identified as having any potential suitability for dredge spoil disposal.
- There is limited potential for the establishment of reclamation areas within the Port limits due to major environmental and social/ amenity issues, however two potential areas of reclamation (herein Areas A and B) have been identified immediately adjacent to both the Hay Point Coal Terminal (HPCT) and Dalrymple Bay Coal Terminal (DBCT) stock yards.
- There is some uncertainty over the existing environmental values in the potential impact area of these identified sites however it is likely that the adjacent rocky shoreline is of significant environmental value. There have been previous proposals for the development of reclamation in the general area of these identified sites, however, such proposals generated significant local opposition and accordingly development did not proceed.

Area A is located adjacent to the HPCT stock yards and, based on the deposition of spoil to create a useable landform for future stock yard development, a volume of 1,200,000m³ of spoil could be contained within an existing tidal footprint area of approximately 18.4 ha.

Area B is located adjacent to the previously reclaimed area of the DBCT stockyards. As for Area A, to create a useable land surface, approximately 520,000m³ of spoil could be contained in a tidal footprint area of approximately 8ha.

Based on the existing bathymetry charts, a large dredger such as the *Pearl River* would need to anchor at least 3.5 km off-shore from the discharge point and pump without a booster pump to either Area A or B via a pipeline placed on the seabed. This report has identified that there are likely to be significant engineering/ geotechnical constraints on the establishment of a reclamation area that would be suitable for subsequent use for the coal handling facilities. Furthermore, the cost of establishment has been identified as \$16.5M for Area A and \$13.5M for Area B. Given the additional costs associated with disposal of spoil by piping and placement in the reclamation versus costs associated with off-shore disposal, the total costs (over and above off-shore disposal costs) have been estimated to be \$18M and \$14.15M respectively.

Potential Spoil Disposal Sites - Dudgeon Point

Investigations for PCQ lands at Dudgeon Point have indicated that:

- There are major terrain, environmental, tenural and cultural heritage constraints to spoil disposal for most lands held by PCQ at Dudgeon Point
- A total of 47.7 ha within three areas (herein Areas C, D and E) has been identified as having nil to moderate constraint to spoil disposal within the PCQ lands, and a further 67.6 ha (Area F) as having significant constraints (mainly due to the terrain). All other lands were identified as being absolutely constrained due mainly to a combination of terrain and environmental issues.
- There are significant constraints to pumping spoil from a dredger located off-shore to the areas potentially suitable for disposal, due in part to the major environmental values of the intertidal zones near to where the dredger and pipeline would need to pass, the length of the pipeline (up to 6km in length) and the associated risks of pumping over such a distance.
- The disposal of spoil within the lands deemed suitable for disposal may have implications for any future land use developments that may be proposed for the Dudgeon Point land.

For Areas C,D and E, the potential volume of spoil that could be disposed of has been estimated to be approximately 2.4Mm³. Costs to establish these areas suitable for the containment of spoil have been estimated to be \$4.23M. The additional pumping costs would add an estimated \$3M over and above off-shore disposal costs, ie a total of \$7.23M. It should be noted however that the actual volume that can practically be disposed of at Dudgeon Point may be significantly lower than the figure stated should it be necessary that the resulting filled landform be suitable for other forms of development. For Area F, costs for disposal have been estimated at \$29.6M. Area F would be ruled out for economic reasons alone.

Conclusion

This report has indicated that there are significant environmental, engineering and cost constraints to spoil disposal in any of the designated Areas A to E. Even if all Areas A to E could be utilised for spoil disposal, the bulk of spoil material would still need to be disposed off-shore. While the environmental assessment of the impacts of off-shore disposal has yet to be completed, it is clear that there are no clear environmental benefits in undertaking on-shore disposal nor are there any suitable

options for reuse of the spoil material. Indeed, the impacts of on-shore disposal are likely to be significant, particularly on areas adjacent to the disposal areas. Such disposal would also have major cost and timing implications for the dredging program.

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1 INTRODUCTION

1.1 Background

The Port of Hay Point is undergoing a significant expansion of output in response to increasing demands for export coal. Dredging of the port area to facilitate access to the wharves by large ocean-going vessels for shipping of coal is undertaken by the Ports Corporation of Queensland (PCQ).

At present some 79 million tonnes per annum (Mtpa) of coal is exported from the Port and this volume is expected to increase significantly in the next 5 years. PCQ are proposing to improve Port efficiency and lower coal transport costs by deepening the departure path from the Port. This deepening will require the dredging of up to 9Mm³ of material from the seabed. Dredge material from capital and maintenance dredging is currently disposed of at a designated spoil ground located approximately four kilometres to the north/north-west of the existing wharves. This existing spoil ground is approaching maximum capacity.

PCQ have previously commissioned a study to identify prospective new spoil disposal areas in off-shore areas in proximity to the Port (WBM 2004). To complement that study, PCQ also require the examination of potential land disposal options (including reclamation) for uncontaminated capital maintenance dredge spoil. This report outlines the land disposal study which has been undertaken in accordance with the National Ocean Disposal Guidelines for Dredged Material (NODGDM) (Environment Australia 2002) and with consideration of the application requirements for a permit under the *Environmental Protection (Sea Dumping) Act 1981* to dispose of dredge material at sea. Potential land-based disposal sites were to be identified in accordance with PCQ's Land Use Strategy for the Port of Hay Point.

An Environmental Impact Statement (EIS) has also been recently commissioned by PCQ which will assess all environmental issues and impacts associated with the proposed major capital dredging program for channel deepening. This land disposal options study is intended to provide supporting information for the preparation of the EIS.

This report presents the findings of this review of potential spoil disposal sites on land or as reclamation adjacent to on-shore areas. It identifies :

- potential areas for spoil disposal;
- the implications and potential impacts associated with disposal in the identified potential areas;
- the approval processes that may need to be followed in order to gain approval for any new land-based spoil disposal area; and
- the gap-filling studies that may need to be undertaken to supplement existing technical information in order to meet the requirements of the approval agencies.

1.2 Objectives of Investigation

PCQ is committed to the determination of an appropriate spoil disposal site that meets the objectives of its Environment Policy and complies with the requirements of the various agencies that regulate the activities of PCQ in regard to spoil disposal. Of primary importance are the National Ocean

Disposal Guidelines for Dredged Material – NODGDM (Environment Australia 2002), which outline generic guidelines on the process to be followed when selecting a new spoil ground site. The types of investigations to be considered include:

- 1 Assessments of the physio-chemical characteristics of potential spoil ground sites.
- 2 Assessments of terrestrial and/or marine communities of potential spoil ground sites (sensitive communities and species, baseline conditions etc.).
- 3 Development of baseline conditions of contaminants.
- 4 Determination of other uses of any potential spoil ground area.
- 5 Assessments of the suitability of the site for disposal (based on the capacity of the potential site and nature of the spoil to be dumped).

At this stage, PCQ required a preliminary desk-top assessment of potential spoil disposal areas in on-shore areas. However, this assessment will involve consideration of the required investigation areas as outlined in Section 4 of the NODGDM (Environment Australia 2002). It is understood that this preliminary assessment will be used by PCQ to support agency consultation on preferred spoil ground site/s, and to identify relevant legislation and approvals that may need to be considered if the development of a new spoil ground in on-shore areas or as reclamation is undertaken.

Objectives

Accordingly, the objectives of the study, as established by PCQ, are as follows:

- Identify potential areas in the Port of Hay Point area where uncontaminated dredge spoil could be economically disposed of on land, or potential areas to be reclaimed, taking into account cost and environmental considerations. Limitations of sites, such as suitability for only capital or maintenance material are to be provided. Any possible environmental impacts of the disposal are to be documented and are to be considered in the site selection.
- Undertake a waste audit and identify waste management options (as per NODGDM and Sea Dumping Permit application requirements).
- Provide PCQ with the relevant information to support agency consultation on land disposal or reclamation.
- Identify any relevant legislation and approvals that may be required should PCQ proceed with land disposal or reclamation.
- Provide an estimate of costs associated with disposing of dredge spoil to land for each option identified.

1.3 Scope and Methodology

This study comprises a general scoping study based on a comprehensive desk-top review, analysis and interpretation of all available information pertaining to the existing environment within the study area described in Section 1.4. This study includes information sourced as part of the investigation into potential off-shore spoil disposal areas presented in WBM Oceanics (2004) – *Spoil Ground Site Selection – Port of Hay Point* and has been undertaken in five phases.

Phase 1 – Waste Audit

The initial phase of the study involved an audit of the quality of material likely to be dredged.

Under the *1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972* (the London Convention), and reiterated in Section 1.3.4 of the NODGDM, the assessment framework requires permit applicants to conduct a waste assessment of dredged material, a waste prevention audit, and examine waste management options.

The waste assessment requires consideration of any contaminants in the dredged material, the suitability of the material for alternate disposal methods (including the comparison of the merits of sea and land disposal options) and characterisation of the waste regarding the biological, physical and chemical nature of the material.

The waste prevention audit aims to evaluate the various types/amount/hazard of wastes, their sources, and feasibility of reduction or prevention of waste.

Phase 2 - Development of Criteria for the Selection of Potential Spoil Ground Areas

An initial set of criteria for spoil ground selection was developed by WBM, based partly on elements in the site selection guidelines (Section 4.2 of the guidelines) in the NODGDM (Environment Australia, 2002). These criteria included a range of technical, economic, social, environmental risks, and legislative requirements. These initial criteria were forwarded to PCQ for review, and a final set of criteria then developed.

Phase 3 – Environmental Assessments

A desk-top review of existing information was undertaken, primarily to collate information necessary to assess the criteria developed in Phase 2 of the study. Information and data were sourced from literature searches of published and non-published material as well as liaison with PCQ representatives, and included the following:

- Existing reports, including previous environmental studies commissioned by PCQ, in addition to academic and government reports.
- Spatial data, including ‘PCQ-Map’ spatial data, conservation zone boundary spatial data and nautical charts.
- Government databases (e.g. EPBC database, Heritage Register, Register of the National Estate).
- Liaison with researchers that have worked in the study area, and the Mackay Region Harbourmaster (Captain John Ellyett).

At the request of PCQ, no liaison was undertaken with State or Federal government agencies or the community at this stage. Appendix A lists the main information sources used in the preparation of this report.

Phase 4 - Assess & Select Preferred Spoil Ground Site/s

Potential or feasible spoil disposal sites were identified on the basis of these results. The process of selection of a potential area was initially based on the development of criteria that addressed all

environmental, planning, administrative and engineering/logistical issues associated with dredging operations and impacts at the Port.

On the basis of criteria developed in Phase 2, and the information collated in Phase 3 investigations, a preliminary opportunities and constraints map was developed and presented to PCQ. Discussions were then held between WBM and PCQ study team members to further refine the spoil site selection criteria, and clarify key port operational issues relevant to the study.

Based on the results of this Phase 3 review and the constraints mapping, a number of potentially suitable spoil disposal sites (land-based or reclamation) were identified. The costs for establishment of the spoil disposal areas were then estimated and compared to the equivalent costs for off-shore disposal.

Phase 5 – Environmental Approvals and Recommended Staging of Spoil Disposal Activities

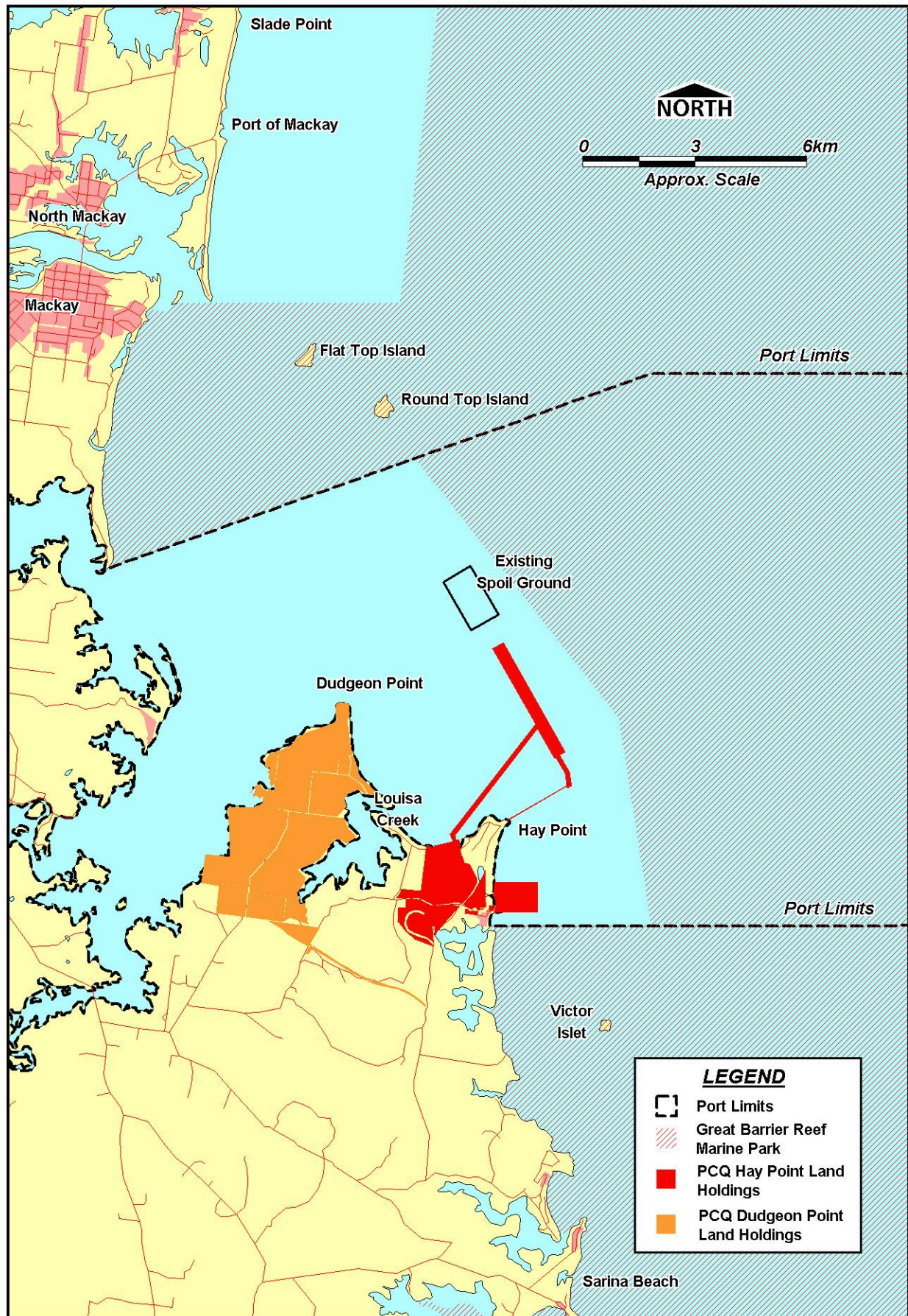
A review was undertaken of the regulatory mechanisms that may be triggered if PCQ proceed with the development of the identified land-based spoil disposal areas. In this assessment it was assumed that legislation and approvals for capital and maintenance dredging had already been considered, thus the review concentrated on mechanisms relevant to the disposal of dredge spoil on land or in a reclamation area within the coastal zone.

Based on the outcomes of this review, a summary of findings and recommendations were provided in regard to possible development of land-based spoil disposal areas.

1.4 Area of Investigation

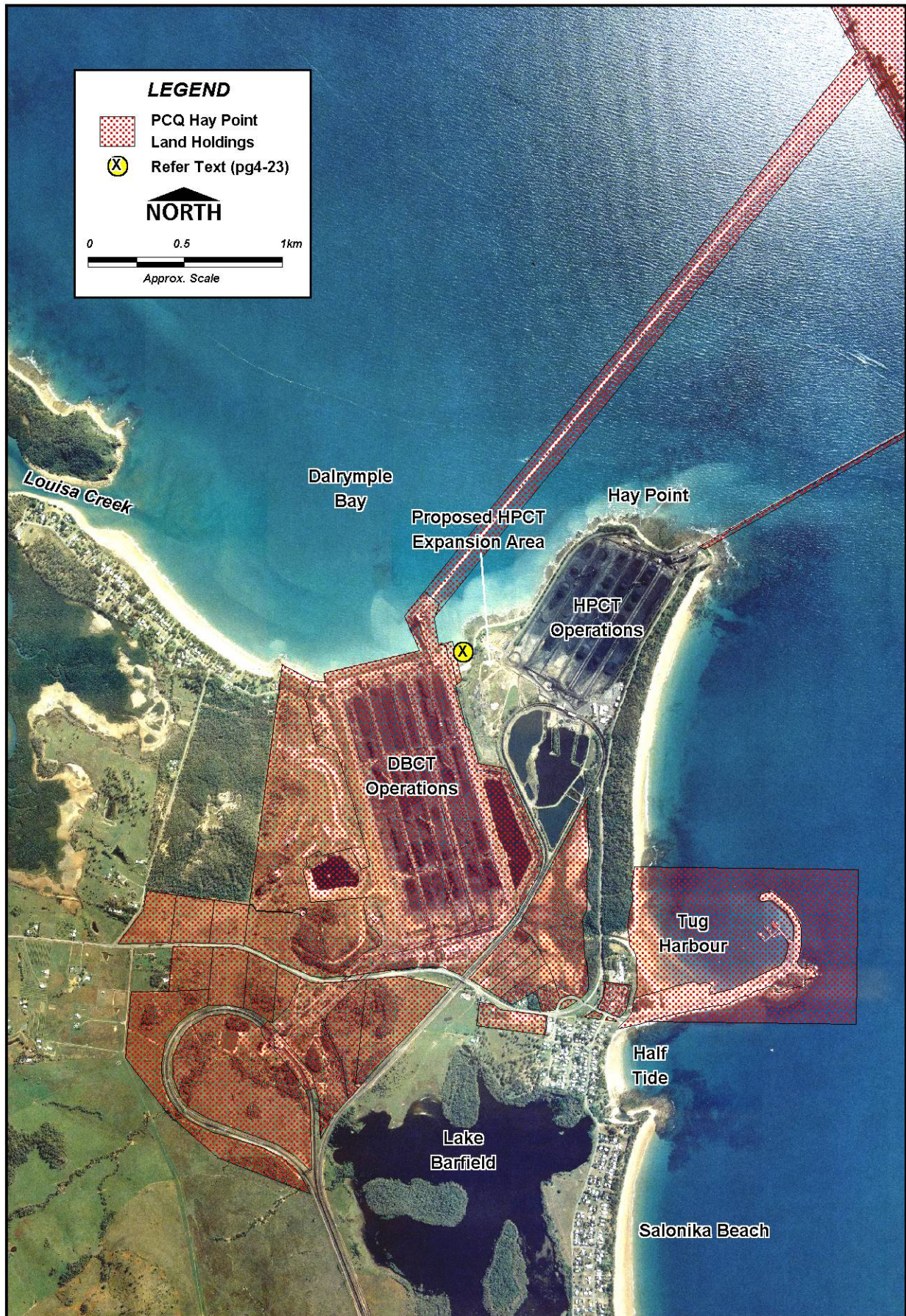
Figure 1-1 indicates the location of the Hay Point operations and study area. The area of investigation incorporates all land held by PCQ at and near the Port of Hay Point. This includes two separate areas as follows:

- at Hay Point specifically, as indicated in Figure 1-2 incorporating the PCQ holdings, the Dalrymple Bay Coal Terminal (DBCT), Tug Harbour and associated infrastructure corridors and adjacent lands. The evaluation for this study has also included lands held by Hay Point Services at the Hay Point Coal Terminal (HPCT). PCQ holdings include allotments in the residential area of Louisa Creek. Figure 1-3 indicates the boundaries of these holdings;
- at Dudgeon Point, approximately 3.5 km to the north-west of the Port (also known as Bally Keel) (refer Figure 1-4). An area of approximately 1300 ha in 36 parcels of freehold land is held by PCQ as well as an additional area of leasehold land (Figure 1-5).



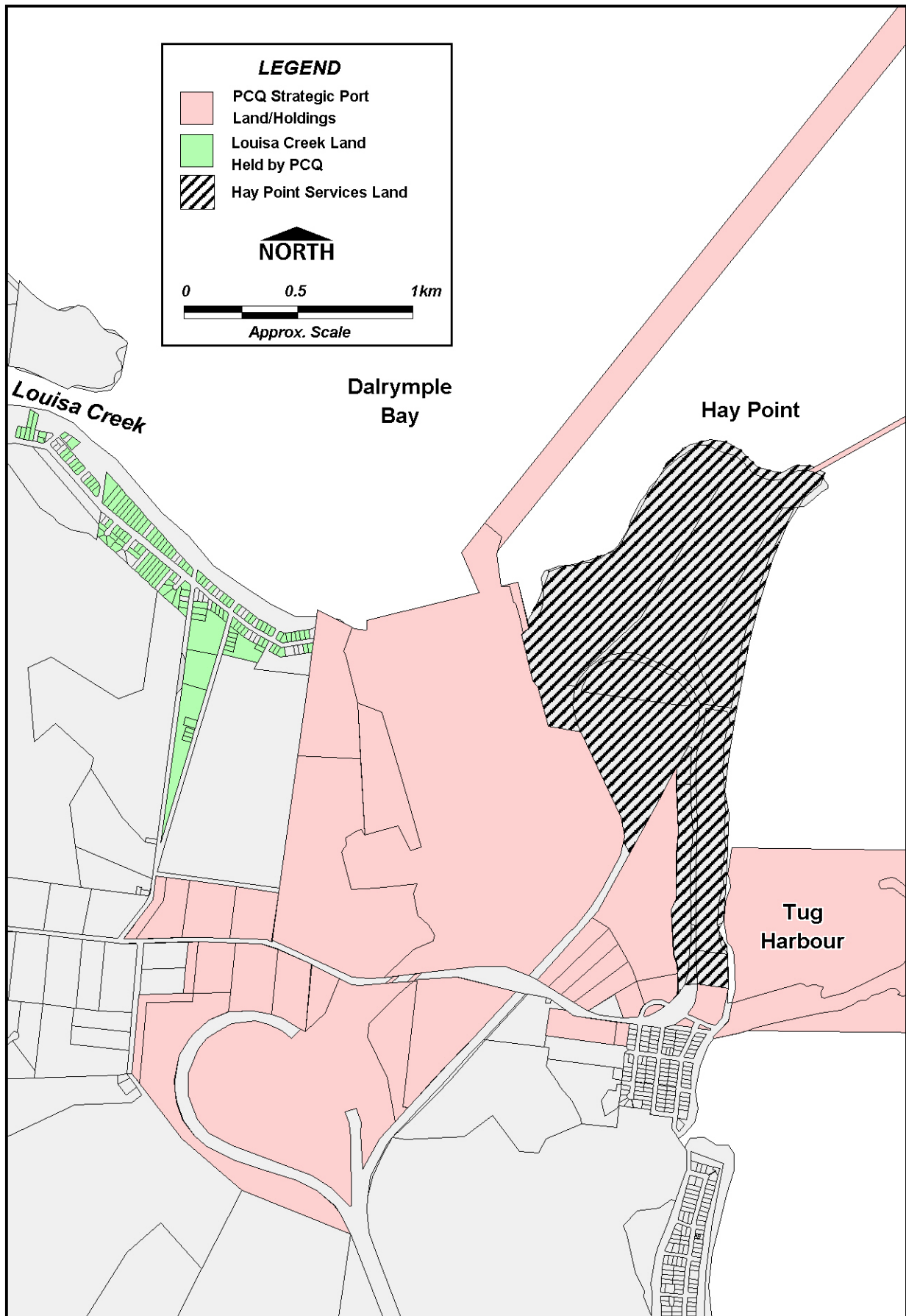
Site Location and Study Area

Figure 1-1

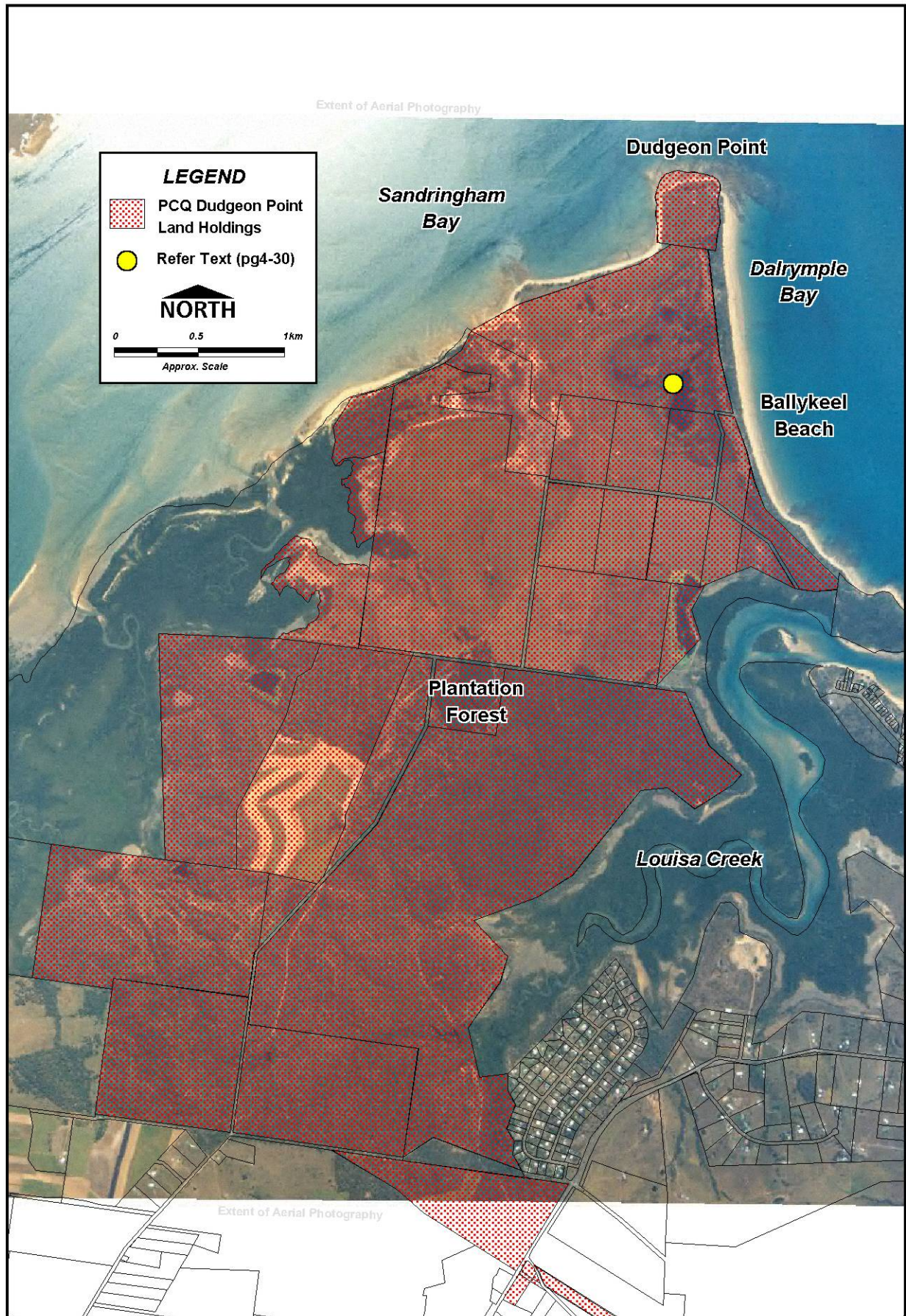


Study Area - Hay Point

Figure 1-2

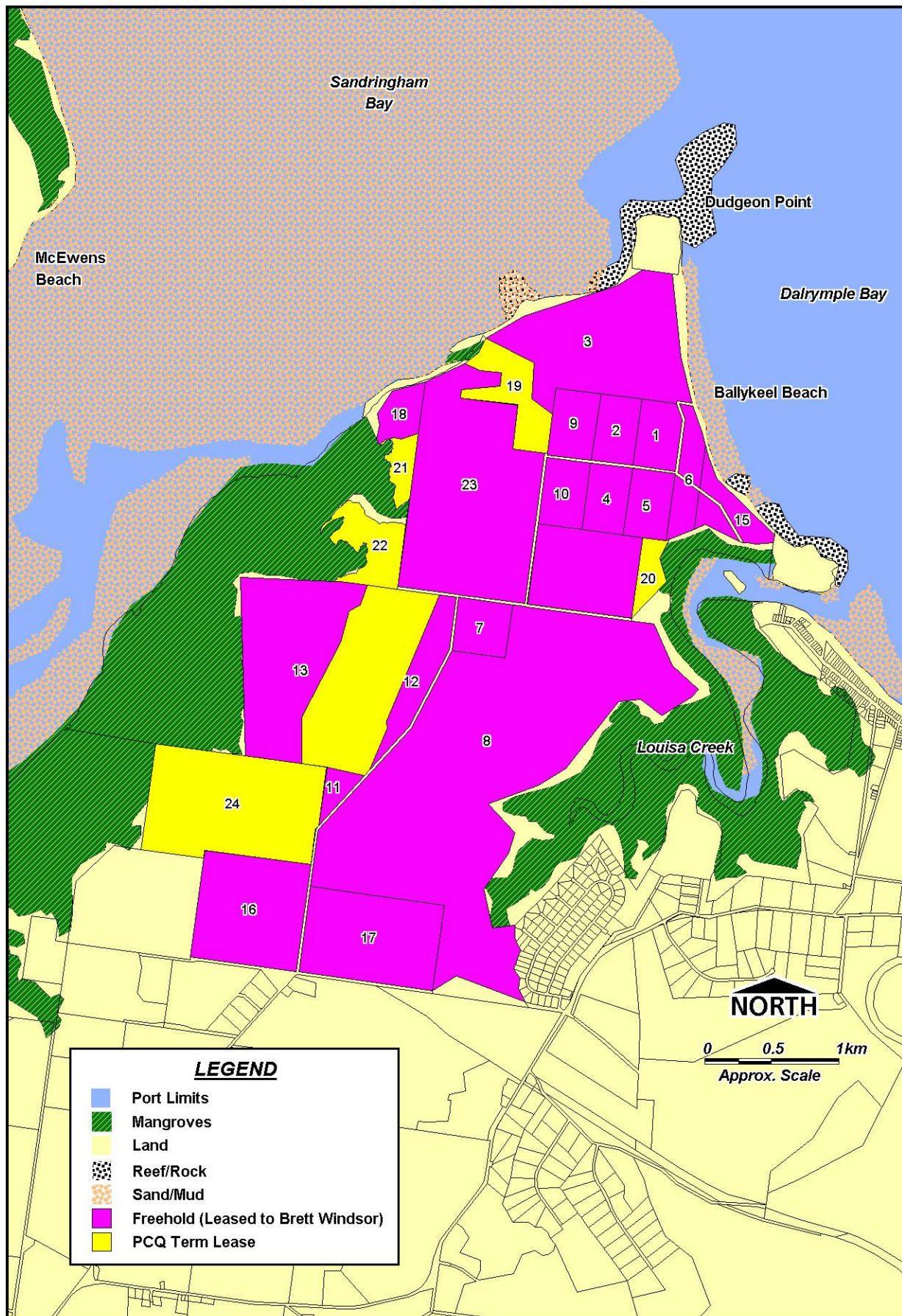


Ports Corporation Holdings - Hay Point Figure 1-3



Study Area - Dudgeon Point

Figure 1-4



Ports Corporation Holdings - Dudgeon Point

Figure 1-5

In addition to this, potential areas of reclamation immediately off-shore from the PCQ land but within the boundaries of the Port of Hay Point limits have also been included in the investigation. This includes areas potentially accessible by a dredger or by a spoil pipeline running from the dredger.

Clearly, it is advantageous to have the spoil disposal area as close as possible to the laden dredger to maximise operating efficiency. Due to the nature of the terrain and bathymetry at Hay Point, there are no easily accessible areas by dredger to the Port.

Most major port development (and, consequently, the associated dredging activity) on the eastern seaboard of Australia is located in deep water at the mouths of major rivers or coastal inlets. Hay Point is different in that there are no major rivers or estuaries in proximity to the Port (the nearest being the mouth of the Pioneer River, approximately 25 km to the north west) and there is a relatively broad near shore zone. Due to this factor and the high tidal variation at Hay Point (up to 7m), there are no potential berthing points for a large dredger within 3 km of shore. This has significant implications for disposing of material to shore. This aspect is addressed in Section 5 of this report.

1.5 Nature of the Spoil to be Dredged

Volume of Material

Table 1-1 provides a summary of the likely volume of dredge spoil requiring disposal (either off-shore, on-shore or as a combination), the timing for such disposal and the specific dredger proposed to be used for each.

Table 1-1 Spoil disposal quality, volumes and timing

Dredging Requirement	Volume	Timing/ Disposal rate	Dredger
Departure channel (capital)	Up to 9 Mm ³	Single campaign/ 0.75Mm ³ /week	‘Pearl River’ or similar (refer Table 1-2)
Stage 7 DBCT Port berth (capital)	0.2 Mm ³	As above	‘Pearl River’ or similar
Hay Point Services berth (capital)	0.25 Mm ³	As above	‘Pearl River’ or similar
On-going maintenance plus contingency	0.9 Mm ³ per year (over 20 yr period)	Annual campaign	In the upper limits of the ‘Brisbane’ economic capacity

As indicated in this table, the total amount proposed for capital dredging and, correspondingly, for disposal will be up to 9.45 million m³ (Mm³) of spoil. Maintenance dredging is expected to be up to 0.9 Mm³/year. The depth of dredging for the capital works will generally be to a depth of 14.9 m (or up to 1.8 m below the existing level of the sea floor).

Dredgers used

It is proposed that the *Pearl River* (or equivalent large dredger) will be used for the capital program and the *Brisbane* (or equivalent) be used, as is currently the case, for the maintenance program.

Details of each of these dredgers of relevance to this study are show in Table 1-2.

Table 1-2 Dredger Details

	Pearl River	Brisbane
Draft (laden) ¹	11.5 m	6.25 m
Required depth for pumping ²	12.5m	7
Max. Capacity ³	24146 m ³ (17400)	2900 (2100)
Pumped Discharge rate ⁴	13000 m ³ /hr	5360 m ³ /hr

¹ part loads would reduce draft requirement but increase duration and costs of dredging

² minimum depth during calm conditions

³ equivalent sand load in brackets

⁴ based on a predominantly sand mixture – clays and gravels significantly increase pumping time

The *Pearl River* (or equivalent dredger) is required for use during the capital dredging program due to the large volumes of material involved. The hiring of this dredger from overseas represents a major investment by PCQ and any extension or delays in the dredging program by this vessel would have significant cost implications.

Nature of the spoil

The nature of the spoil likely to be dredged is addressed in Section 2.1. Spoil quality is likely to be variable depending on the origin of the material and depth below the surface of the seabed.

2 WASTE AUDIT

In accordance with Section 1.3.4 of the NODGDM (Environment Australia, 2002), the requirements of the Waste Prevention Audit are to evaluate:

- waste sources;
- types, amounts and relative hazard of wastes generated; and
- feasibility of waste reduction and prevention techniques.

These requirements are considered in the following sections.

2.1 Sources, Types, Amounts and Contaminant Hazards of Generated Wastes

2.1.1 Previous Investigations

The planned capital dredging of the new entry channel to the Port of Hay Point will result in the removal of approximately 9.45 Mm³ of dredged material, most of which (probably in excess of 98%) would consist of parent material not previously disturbed by dredging or by any anthropogenic activity. As indicated in Section 1.4, on-going maintenance dredging will also be required and will thus need to be considered in the audit.

The collection of sediment samples for contaminant analysis of the material to be dredged (*via* core sampling) has not yet been conducted, so the waste audit presented herein will focus on the available results of studies previously completed to describe the nature of the material to be dredged.

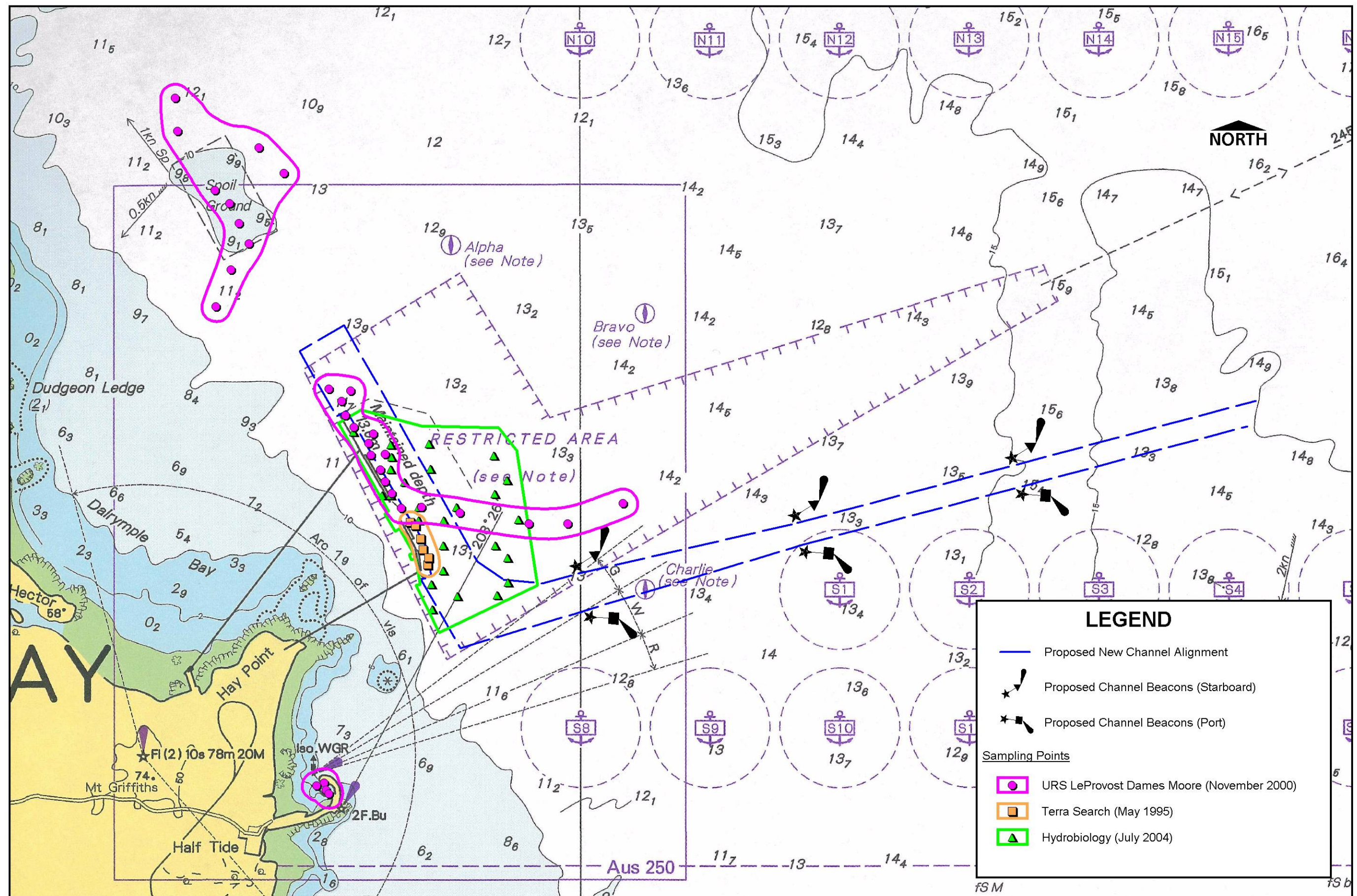
Past studies conducted at the Port of Hay Point have focussed principally upon the potential for contamination of surface sediments in those areas of the Port requiring maintenance dredging. The sediments investigated were principally the thin veneer of surficial sediments overlying the undisturbed capital material. From a potential contamination perspective, the reported sediment qualities therefore probably represent a 'worst case' when compared to the qualities of the underlying parent materials. This is because the fine textured mobile sediments within the uppermost sediment horizon are those most likely to contain contaminants from recent catchment or port-related pollutant sources.

The previous investigations of sediment quality conducted with relevance to the planned area of capital dredging include:

- Hydrobiology Pty Ltd (2004a) Maintenance Dredging SAP Implementation for the Departure Apron Area, Port of Hay Point.
- Hydrobiology (2004b) Macroinvertebrate Sampling – Port of Hay Point September 2003. Report for PCQ.
- URS Le Provost Dames and Moore (2000) Port of Hay Point Seafloor Survey for Stage 6 and 7 Expansions of Dalrymple Coal Terminal.
- Terra Search Pty Ltd (1995) Sediment Sampling and Analysis to Support a Sea Dumping Permit Application – Port of Hay Point.

The areas of investigation and sediment sampling locations from each of the reports are illustrated in Figure 2-1.

It should be noted that the investigations addressed in this report cover only part of the prospective dredging area and a major portion of the new proposed channel alignment has not been investigated yet in terms of sediment quality. It is expected that this new alignment will be investigated as part of the EIS process currently being undertaken.



Areas of Previous Sediment Sampling, Port of Hay Point

Figure 2-1

The most recent investigations undertaken by Hydrobiology (2004) covering the departure apron area utilised surface grab sampling equipment to address the nature of sediments within the upper 10-15cm of the sediment profile. The sampling area included port sediments from the outer margins of the berth pockets extending approximately 1.8km seaward of the berth faces.

2.1.2 Sediment Characteristics

Data on the nature of the seabed sediments and those likely to be dredged have been obtained through previous investigations (WBM 1993, URS 2000, WBM 2001, Hydrobiology 2004a).

The sediments sampled by Hydrobiology (2004) were typically sand with less than 10% silt and variable quantities (approximately 5-30%) of gravel and shell material.

The records from the inner sector of the proposed shipping path show that the surficial layers comprise a veneer of mostly silts and silty fine sands of variable thickness (1-30cm) overlaying very stiff layers of yellow, grey and occasionally orange-coloured clays and sandy clays >30cm thick. The seafloor characteristics in the Stage 6 and 7 berth pocket and approach area were very similar, although the diver coring revealed the underlying stiff clay layer to be more uniformly grey with a marked crumbly structure (refer URS 2000 for details).

Samples from the existing berth pockets were predominantly fine to very fine silts.

With regard to the nature of the material to be dredged, the results of the various borehole and coring studies undertaken for the Stage 6 and 7 Expansion point to a high level of variability in the relative proportions of the sands, clays and rocky fractions that occur across the dredging area and with sub-surface depth. Dry weight percentage ranges of the particle size classes in the main depth zones sampled by borehole at the DBCT terminal have been listed in Table 2-1.

Table 2-1 Particle distributions

Depth	Clays	Silts	Sands	Gravel/Rock*
0-1m	14-24%	8-23%	39-71%	3-12%
1-3m	11-20%	11-26%	26-34%	12-39%
3-5m**	3-32%	3-26%	39-69%	2-34%

Source: URS (2000)

*weathered bedrock from the deepest horizons (>RL -18m).

** below dredging depth.

It is noted from previous studies (eg. Terra Search 1995) that stiff indurated clays underlie the surface sand sediments in the study area. As a result, the opportunities for reuse of the dredged material may be limited.

2.1.3 Potential Contaminants

All 26 sediment samples were analysed for likely potential contaminants including trace metals and organotins. Selected samples (five of the 26) were also analysed for polycyclic aromatic

hydrocarbons, petroleum hydrocarbons, organochlorine and organophosphate pesticides and nutrients.

The sediment quality analysis results (Hydrobiology 2004) indicated that:

- the screening level criterion (5 ng Sn/g) for the organotin compound tributyltin (TBT) was exceeded in 5 of the 26 samples. All five samples of these samples were located at the margins of the berth pockets;
- overall, the upper 95% confidence limit for TBT calculated by Hydrobiology (2004a) (4.9 ng Sn/g) was 0.1 ng Sn/g below the screening level criterion (5 ng Sn/g);
- the screening level criterion for arsenic (20 mg/kg) concentrations was exceeded in 2 of the 26 samples;
- overall, the upper 95% confidence limit calculated for arsenic by Hydrobiology (2004a) (11.5 mg/kg) was below the screening level criterion (20 mg/kg); and
- The concentrations of all other contaminants in collected samples were below relevant screening level criteria.

Overall, the sediments from the Port departure apron area were assessed by Hydrobiology (2004) as being suitable for ocean disposal. These results were largely consistent with the results of previous sediment sampling programs in the area, which demonstrated:

- TBT concentrations in 4 of the 20 samples collected by URS (2000)¹ exceeded the screening level criterion of 5 ng Sn/g. Overall, the upper 95% confidence limit for TBT (7.30 ng Sn/g) exceeded the screening level criterion of 5 ng Sn/g.
- The concentrations of all other contaminants in samples collected by URS (2000) and Terra Search (1995) were typically below relevant screening level criteria. It should be noted that several analytes (mercury, cadmium and copper) examined by Terra Search (1995) had concentrations below laboratory detection limits, but these laboratory detection limits exceeded screening levels.

These results suggest that there is a nil to minimal risk of contaminant impacts if sediment was to be disposed of to sea. Contaminant concentrations were also lower than respective Queensland Department of Environment (1998) '*environmental investigation levels*' used to assess the risk of land contamination, hence there is nil to minimal risk of contaminant impacts associated with land disposal options.

There are numerous other risks associated with disposal of dredged material to land, and these are considered in subsequent sections. An example is the disposal of spoil with seawater salinity levels on lands some distance from the tidal zone.

¹ Sampling locations included in this assessment were: centre of approach channel to DBCT (CA1-CA7), new DBCT area (DB2-DB4), existing DBCT Berths (DEB1-5) and south of DBCT (BT01)

2.2 Spoil Reduction and Possible Alternate Uses

As part of the waste audit process, the NODGDM indicate that waste production strategies and alternate uses of spoil should be considered. PCQ, with the support of the State Government, is committed to a program that will allow increased coal exports from the Hay Point coal terminals. This program involves the deepening of the departure path and apron areas, primarily to allow ships to be fully laden with coal, without restrictions imposed by shallow depths affecting the ship's draft (and therefore load capacity). By necessity, this would involve extensive capital dredging works.

Reducing the amount of spoil dredged would have a range of economic, environmental and technical benefits. Consequently, capital dredging works would involve the extraction of the minimum quantity of sediment necessary to meet navigational requirements for the larger Cape class vessels. The channel depth and alignment has been developed after lengthy consultation with port users, pilots and the Regional Harbourmaster. Modelling of the path options has been carried out to develop the design and to optimise the path depth.

The potential beneficial re-use of spoil will depend largely upon its physical and chemical characteristics, as well as a range of technical, legal and economic factors. HR Wallingford (1996) identified the following categories of dredged material re-use:

- coastal protection;
- construction industry (excluding port development, which is considered in subsequent sections);
- agriculture;
- horticulture and forestry;
- amenity;
- habitat; and
- capping.

In addition to beneficial uses, other alternate uses of spoil can be considered, such as sacrificial (non-beneficial) land-fill (BMT Reliability Consultants Limited 1999).

A preliminary assessment was made of the suitability of sediments for various beneficial uses of dredged material, and whether there are any potential opportunities for use of dredged material (Table 2-2). This assessment should be considered as indicative at this stage², recognising that liaison with stakeholders (e.g. Council, EPA, local farmers, construction industry) and detailed cost/benefit analyses would be required to gain a full appreciation of issues associated with various dredged material re-use options.

² Preliminary assessment is based on WBM's understanding of local conditions and issues associated with dredged material placement and management.

Table 2-2 Suitability of dredged sediments for various beneficial uses and potential opportunities for re-use

Beneficial Use	Sediment characteristics	Suitability	Demand/Opportunities
Physical properties of sediments to be dredged (surficial only; >0.3 m depth unknown)	Predominantly sand, <10% silt, variable quantities (~5-30%) of gravel/shell material.	-	-
Coastal protection requirements	Sand with low silt content	Yes	Limited local demand
Construction industry	Sand with low silt content	Processing probably required, saline content restricts application	Probably limited local industry demand – only very small volumes
Agriculture	Dependent on nature of activity	Salt content restricts potential applications	Probably limited local demand, potential use in grazing lands as sacrificial land fill
Horticulture/forestry	Dependent on nature of activity	Salt content restricts potential applications	Probably none locally
Amenity (e.g. recreation parks)	Sand with low content of silt	Yes, would require washing	Probably none locally
Habitat creation/restoration	Similar to recipient areas	Yes	Existing inshore sedimentary habitats – generally in good condition, currently used by species of conservation significance (e.g. sea turtle nesting areas) – therefore limited opportunities/demand Negligible opportunities for the creation of near-shore islands as bird roosts
Capping	Sand	Yes, (refer later sections of report for reclamation)	Possible port/coal terminal infrastructure (refer later sections)

The dredged material (at least the surficial sediments) may be suitable for a range of applications. However, the demand for such material is likely to be limited (with the possible exception of port infrastructure development – see Section 5 regarding use for extension to the DBCT and HPCT stock yards). From an economic perspective, there are no established construction industries at Hay Point with the necessary facilities to process this material. Hay Point lies approximately 40 km by road from Mackay, the main area likely to have a demand for construction material (primarily sand). Based on a Mackay region resident population of approximately 86,000 persons (2001 census) and a

per capita utilisation of sand of between 1.8 to 2.2 t/person/year (Economics Associates, 2004), the total average demand for sand as an aggregate would be between 97,000 m³ and 120,000 m³/yr. Given that there are understood to be no major shortfalls in sand supply for construction purposes in the region, the low volumes required and the need to wash the dredged material to provide a suitable sand aggregate, this alternative is clearly not a viable option or would have little effect on the total volumes of dredged material being considered.

The sediments are also unlikely to provide a beneficial use to local farmers (predominantly grazing and sugar cane), and there is no forestry industry in the local area. The surficial material may be useful for beach nourishment given the high sand content, but there is little evidence of a significant need for such nourishment in the local area. From an ecological perspective, any on-shore placement will need to carefully consider the potential impacts on sea turtles which nest in the area. The on-shore habitats of the region are in generally good condition, and would probably not benefit from any beach nourishment works.

There may be opportunities to create small islands in nearshore areas for enhancing wader bird habitat values, although the costs and benefits and environmental impacts of any such options would need to be carefully examined. The long-term suitability of the dredged material for habitat enhancement is doubtful given the need to effectively stabilise the placed material to prevent or limit its movement during sustained south easterly trade winds and/or tropical cyclones.

An alternative locally feasible beneficial reuse for the dredged material might involve the relocation of dredged material to the Central Queensland coalmines. The alkaline dredged material could potentially be used as capping material to minimise acid mine drainage, as fill for final voids or (subject to the nature of the material) potentially as construction material to construct berms or dams. This scheme would potentially make use of the empty (unladen) coal wagons returning from the Port to the mines. However the major costs and time associated with establishing suitable loading facilities to stockpile and handle the dredged material at the Port and at each of the selected mines would make the scheme financially impractical. The time required to backload the trains with dredged material would also place a limitation on the viability of this option, since it would be necessary to match the throughput of the coal unloading process to the loading of dredged material to minimise any disruption to existing coal delivery schedules at the Port. There would also be major effects on rail cycle times and possible contamination of the rail haulage equipment.

2.3 Summary of Audit

The audit of possible dredge spoil material has indicated that:

- there are no significant levels of potential contaminants in the material;
- there should nil to minimal risk, in terms of the chemical nature of the material, of contamination if disposed of on land or in the sea;
- there are major limitations to using of the material for alternative applications with the possible exception of landfill or reclamation (as is addressed later in this report); and
- the audit addresses only a portion of the potential area of dredging and additional investigations will need to be conducted in this regard to confirm the overall risk to the environment.

3 SITE SELECTION PARAMETERS AND CONSTRAINTS

3.1 Criteria for Selection Process

In order to establish criteria to use as a basis for determining whether suitable areas were available for disposal of spoil material, key factors for consideration were selected by the study team. These factors were broken into ecological, legislative/planning, social/land use and physical/technical/engineering constraints.

Table 3-1 presents the selection criteria used as a basis for determining possible suitable sites for spoil disposal and the relative level of constraint that would apply depending on the location. Rankings for each criteria were determined based on absolute constraint (i.e. the particular factor would eliminate any prospect of spoil disposal area development), significant constraint (i.e. significant impediments likely in gaining the requisite approvals) or nil to moderate constraint. A description of each of the criteria and relevance to the study area are listed below.

3.1.1 Ecological Factors

Intertidal flats – vegetation - the presence of marine plants were considered to preclude spoil disposal area development while unvegetated intertidal flats were considered to be a significant constraint.

Intertidal flats – fauna habitat values and reefs/rocky shores – species of conservation significance that would invoke an absolute constraint on spoil disposal would include turtle nesting and associated access area, significant shorebird foraging or roosting areas (including for JAMBA/CAMBA species) and areas potentially utilised by dugong.

Terrestrial vegetation and terrestrial habitat – Endangered Regional Ecosystems as classified under the biodiversity assessment process of the EPA or under the *Vegetation Management Act 1999* are considered to be areas of absolute constraint. Areas identified as of high floristic or habitat value were also considered an absolute constraint. Other areas of remnant vegetation (as mapped by the Queensland Herbarium or other site specific studies) were also considered to be a significant constraint.

Receiving environmental significance – wetlands of recognised high conservation value were considered to be an absolute constraint. An important issue is the potential contaminant concentrations of the dredge spoil. Section 2.1 has indicated that such concentrations are likely to be low and not present a significant environmental risk with land disposal. However, the seawater salinity levels of the spoil impose an absolute constraint should the receiving environment be freshwater wetlands.

Table 3-1 Selection criteria used to determine potential spoil disposal sites on land or as reclamation

Constraint	Absolute Constraint (A)	Significant constraint (B)	Nil to moderate constraint (C)	Comments
Ecological (E)				
1. Intertidal Flats - vegetation	Marine plants (seagrass, saltmarsh, mangroves, marine algae)	Unvegetated intertidal flats in natural condition	Disturbed areas/ artificial substrate with minimal values	
2. Intertidal Flats – fauna habitat values	Habitats for species of conservation significance incl. Shorebirds, Turtle nesting areas	Important habitat areas for common species	Limited habitat value	
3. Reefs/rocky shores	Identified sites of high conservation significance	Other natural reef/ rocky shore areas	Disturbed areas with minimal values/ artificial substrate	
4. Terrestrial vegetation	Endangered Regional Ecosystem; area identified of high floristic value	Other remnant vegetation	Non-remnant/ cleared	
5. Terrestrial Habitat/ fauna values	Key species habitats	Important habitat areas for common species	No/ minimal habitat value	
6. Receiving environment significance (waterbodies)	Wetland/ waterbody of recognised conservation value	Wetland/waterbody in natural condition	Disturbed receiving environment with no significant natural values	
7. Buffer Requirement	Critical buffer for protection of areas of significant ecological value (generally 100 m)	Important buffer for land use/ environmental protection	No buffering required	
Legislative/ Planning /Tenure (L)				
1. Conservation/National Parks	X			
2. Fish Habitat Areas / DPI tenure	X			
3. Dugong Protection Area	X			
4. Great Barrier Reef Marine Park		X		Investigation area is outside GBRM Park
5. Queensland Heritage (incl. cultural heritage) site	X			
6. Ramsar wetland	X			
7. Places on Register of National Estate/ GBR World Heritage Area		X		Constraint will depend on other site specific factors

SITE SELECTION PARAMETERS AND CONSTRAINTS

Constraint	Absolute Constraint (A)	Significant constraint (B)	Nil to moderate constraint (C)	Comments
8. Wetlands of National Importance	X			
9. Outside Hay Point Port limits and/or Ports Corporation land		X		
10. Within Strategic Port Land		X		Will depend on other use opportunities at site – refer Strategic Plan
11. Environmentally Sensitive Areas (EPA rating)	X			Refer to EPA rankings
Social/ Land Use (S)				
1. Proximity to residences	Residences within 100m of spoil area	Residences within 500m of spoil area	Residences > 500m from spoil area	
2. Existing use effects	Public use/ access area	Area actively used by local population; agriculture; forestry	Area not actively used or for low intensity rural uses	
3. Recreational areas/ fishing		Area used for recreational purposes	Area not actively used	
4. Noise/ dust	EPP noise/ dust compliance criteria likely to be exceeded		EPP criteria not likely to be exceeded	
5. Visual/ landscape		Area of significant visual / landscape value	No landscape values	
6. Cultural heritage	Significant cultural heritage value		No identified values	
7. Future land use opportunities		Proposed development area (including for strategic port purposes)	Area not subject to future use plans or opportunities	
Physical/ Technical/ Engineering (P)				
1. Slope / stability of disposal site	Slopes > 5%; identified significant stability problems	Slopes 2 to 5%;	Slopes <2%; no stability issues	
2. Area/ volume/ consolidation available	Highly fragmented landform, no consolidated areas <1ha	Consolidated areas 1 to 4 ha	Consolidated area > 4 ha	
3. Drainage	Major drainage impediments/ catchment effects incl. Drainage to significant waterbody		No effects on drainage regimes	

SITE SELECTION PARAMETERS AND CONSTRAINTS

Constraint	Absolute Constraint (A)	Significant constraint (B)	Nil to moderate constraint (C)	Comments
4. Erosion prone areas (coastal processes)	Designated erosion prone area (EPA)	Area subject to significant coastal action	No significant coastal erosion risk	
5. Dredge manoeuvrability (currents, etc) –discharge point/ dredger access	Access for dredger or spoil pipeline not practical or feasible	Significant access constraints that would affect operating efficiency	No access constraints	
6. Pumping distance/ material handling*	> 2.5km to potential discharge point or shore-based booster pump (<i>Pearl River</i>)	Double handling of spoil required		Based on use of <i>Pearl River</i>
7. Establishment/ set up issues	Major set-up costs (refer Section 6)		Cost have minor effect on project feasibility	
8. Risks/ equipment failure	Pumping likely to have high risk of failure due to distance or other impacts	Pumping distance > 2.5km requiring booster pump for <i>Pearl River</i> ; 2km for <i>Brisbane</i>	Distance short with no booster required- low risk exposure	Risk of pipeline damage due to external causes/ interference
9. Opportunities for material reuse/ reclamation area		No or limited future use opportunities and of limited community benefit		
10. Navigation areas/moorings/anchorages	Major effect on existing or potential vessel movements		No effect on existing or potential vessel movements	
11. Currents and waves	Coastal hydrodynamics with major effects or risks to operations		No significant current or wave action	

Buffer requirement – the designation of a suitable buffer width for the protection of sensitive environmental resources is dependant on a range of factors. For the purposes of this study, a 100 m buffer width has been used as an absolute constraint. The actual width required by government agencies for the protection of intertidal wetlands, waterways of ecological value and other sensitive ecological areas may, in certain circumstances, be wider than this figure.

3.1.2 Legislative/Planning/Tenure

Administrative constraints that were identified as potentially affecting the options for spoil disposal were as follows:

- Fish Habitat Areas/DPI Tenure: Areas so designated by the Department of Primary Industries and Fisheries and protected under the *Fisheries Act 1994*. Such areas generally have significant expanses of marine plants also protected under this Act.
- Conservation/ National Parks: Such areas (under *Nature Conservation Act 1992*) are clearly recognised as being of significant environmental value.
- Dugong Protection Areas: These areas have been designated along the Queensland coastline (under the *Nature Conservation Act 1992* and *Fisheries Act 1994*) for the protection of dugong. Such areas generally have high ecological values associated with seagrass communities which provide the foraging resource for dugong.
- Great Barrier Reef Marine Park (GBRMP): This constraint refers to the particular administrative processes associated with the gaining of approvals within the park area and on-going management responsibilities. Activities within the GBRMP are controlled under the Commonwealth's *Great Barrier Reef Marine Park Act 1975*. The different zonings of the Park impose different levels of acceptable use and management control.
- Queensland Heritage site: The Queensland Heritage Register, established under the *Queensland Heritage Act 1992*, is a list of places, trees, natural formations, and buildings of cultural heritage significance. Places entered in the Register require approvals under Queensland Heritage Council prior to being altered. The *Aboriginal Cultural Heritage Act 2003* also has implications for potential spoil disposal sites.
- Ramsar wetlands: Areas designated under the Ramsar convention provide for the protection of wetlands both from direct and indirect impacts. Ramsar wetlands are protected under the Commonwealth's *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999*.
- Places on the Register of the National Estate. The Register of the National Estate is Australia's national inventory of significant natural and cultural heritage places, and is maintained by the Australian Heritage Commission. The activities of private and state government landholders are not controlled through listing under the Register. The Great Barrier Reef World Heritage Area is on the Register.
- Wetlands of National Importance. The States and Territories, and the Commonwealth Government, have jointly compiled a Directory of Important Wetlands in Australia. The Directory identifies and recognises Australia's nationally important wetlands, and it provides information about the different wetland types and the flora and fauna that are dependent on these wetland ecosystems. Listing on the Register does not provide specific protection under state or Commonwealth legislation.

- Outside Hay Point Port limits and/or Ports Corporation land. There are obvious constraints to dispose of spoil not owned by PCQ or on lands otherwise used for or associated with the operation of the port.
- Within Strategic Port Land: Land at Hay Point held by PCQ is classified as Strategic Port Land under the *Transport Infrastructure Act 1994*. As is described in Section 4.4, there are specific uses allocated to such land which may be incompatible (particularly in terms of future development proposals) with the development of spoil disposal areas. The Dudgeon Point land is not Strategic Port Land.
- Environmentally Sensitive Areas: The EPA has designated Environmentally Sensitive Areas (ESAs) for Queensland based on a range of environmental parameters including the various forms of conservation tenure.

3.1.3 Social/Land Use Factors

Proximity to residences - various separation distances have been established in Table 3-1 to minimise the potential effects on residents to the area. Such distances are relatively arbitrary however and would depend on a range of site specific factors.

Existing use/effects, recreational areas/fishing and visual/landscaping - these criteria apply to areas frequented by the general public or readily viewed from residential areas.

Noise/dust - the establishment and operation of a spoil disposal area on land (including associated spoil pumping) is expected to generate significant noise levels. Compliance with EPA Environmental Protection Noise Policy criteria reflects the relative constraints.

Cultural heritage - cultural heritage investigations previously undertaken for both areas of investigation have indicated areas or artefacts of significant cultural heritage value. These aspects are addressed later in this report however, due to requirements of confidentiality in terms of describing the location of items of value, only general commentary has been made in this report.

Future land use opportunities - Expansion of the port development area is on-going. The HPCT stock yard area is currently proposed to be expanded and an EIS addressing this expansion is soon to be released. The deposition of spoil on land that would otherwise be suitable for other higher order forms of development has been considered to be a significant constraint for the purposes of this report.

3.1.4 Physical/Technical/Engineering Constraints

Slope/stability of disposal site

The effective and efficient deposition of spoil is most readily achieved on low sloping lands, generally <2% slope. Slopes between 2% and 5% present significant constraints in terms of achieving acceptable 'beaching' of the spoil and a consequent landform suitable for future use. Slopes in excess of 5% were considered unsuitable for the disposal of large volumes of spoil.

Area/volume/consolidation available

Spoil deposition is undertaken most efficiently over large areas. Fragmented operations significantly increase establishment, disposal and management costs.

Drainage

The location of the potential spoil disposal area may have a significant effect on existing drainage patterns.

Erosion prone areas (coastal processes)

Establishment of a spoil disposal area within the coastal zone (primarily as reclamation) may affect existing coastal processes and instigate or exacerbate coastal erosion in adjacent areas. The EPA had designated areas.

Dredge manoeuvrability – discharge point/dredge access

For disposal on land or as reclamation, the closer that the dredger can approach the deposition area, the greater the efficiency and the lower the risk in terms of possible pipeline failure. The major limitation is the draft of the dredger relative to the bathymetry of the coastal zone. Table 1-2 indicates the draft of both dredges likely to be used when fully laden. Port infrastructure (eg. coal conveyors to the wharves) also impose access impediments.

Pumping distance/material handling

In association with the above, clearly the shorter the pumping distance and minimisation of spoil material handling present significant benefits and significantly reduce risks of spillage, particularly if a booster pump is required. The volumes able to be pumped and the practical pumping distances for each of the dredgers are described later in this report.

Risks/equipment failure

As indicated above, an increased distance of pumping spoil and an increased need for handling will lead to a consequent increased risk of failure of spoil disposal with potential for discharge of material to the coastal zone.

Opportunities for material reuse/reclamation area

It is highly desirable that any area used for spoil disposal can be subsequently utilised for other land uses. The physical quality of the spoil material and ability to achieve effective deposition will have a significant effect on the range of opportunities available.

Navigation areas/moorings/anchorages

Areas used by other vessels associated with port activities may affect the efficiency of spoil discharge from the dredger. The existing wharf developments present a significant navigation constraint at the Port for access to on-shore areas.

Currents and waves

Areas exposed to significant currents or wave action can have implications for discharge of spoil from the dredger. It may also be an issue where booster pumping in an off-shore area is required.

4 EXISTING CHARACTERISTICS AND VALUES OF THE STUDY AREA

4.1 Information Sources and Literature Review

This investigation into determining a potential spoil ground site for the Port of Hay Point has been based on the following:

- liaison with PCQ and Queensland Transport representatives both in Brisbane and in Mackay;
- a review of existing PCQ information for the general area of the Port; and
- a review of published technical literature of relevance to the Port.

Studies have been desk-top with no field investigations. Similarly, no liaison has been undertaken with other State or Commonwealth government agencies or the community as this will be undertaken at a later stage. It is expected that, following determination of the preferred site/s, if any, for land based disposal detailed field investigations, liaison and reporting will be carried out.

The main data sources used as the basis for the evaluation are outlined in Appendix A, and are fully referenced in Section 8.

4.2 Ecological Values

4.2.1 Nearshore Marine Environments

Information on the characteristics of intertidal habitats in the Hay Point area were reviewed by WBM (2004), and are examined here in the context of potential issues associated with land disposal and/or reclamation proposals.

Spoil disposal can impact on marine plants through a range of processes, including direct burial, modification to sediment types and reductions in ambient light concentrations due to increased suspended solid concentrations. Seagrasses and sub-tidal algae are perhaps the most susceptible to these impacting processes, whereas it is unlikely mangroves and saltmarsh would be directly affected unless spoil was placed on or immediately adjacent to intertidal flats.

The potential impact of off-shore sub-tidal spoil disposal on seagrasses is likely to be the key marine plant management issue. URS (2000) recorded no seagrass beds within the port limits, with the nearest known beds occurring at Round Top and Flat Top islands, approximately 1.3 km and 3.2 km, respectively from the port limits at the closest point. A small patch of the seagrass *Halophila* was recorded on the north-west side of Dudgeon Point in 1993 (see Point A, Figure 4-1), but was not recorded in this same area during 2000. Many species in the genus *Halophila*, particularly *H. ovalis* and *H. ovata*, are highly ephemeral, and it is possible that patches of *Halophila* occur within the shallow sections of the study area from time to time, depending on ambient environmental conditions (i.e. turbidity, wave climate etc.). Recent studies by Rasheed, et al (2004) have indicated seagrass beds in proximity to the existing spoil disposal site, however such beds are likely to be ephemeral (refer Figure 4-2).

The northern sector of the study area (from Bakers Creek to Louisa Creek) contains a complex matrix of intertidal habitats comprised of the following:

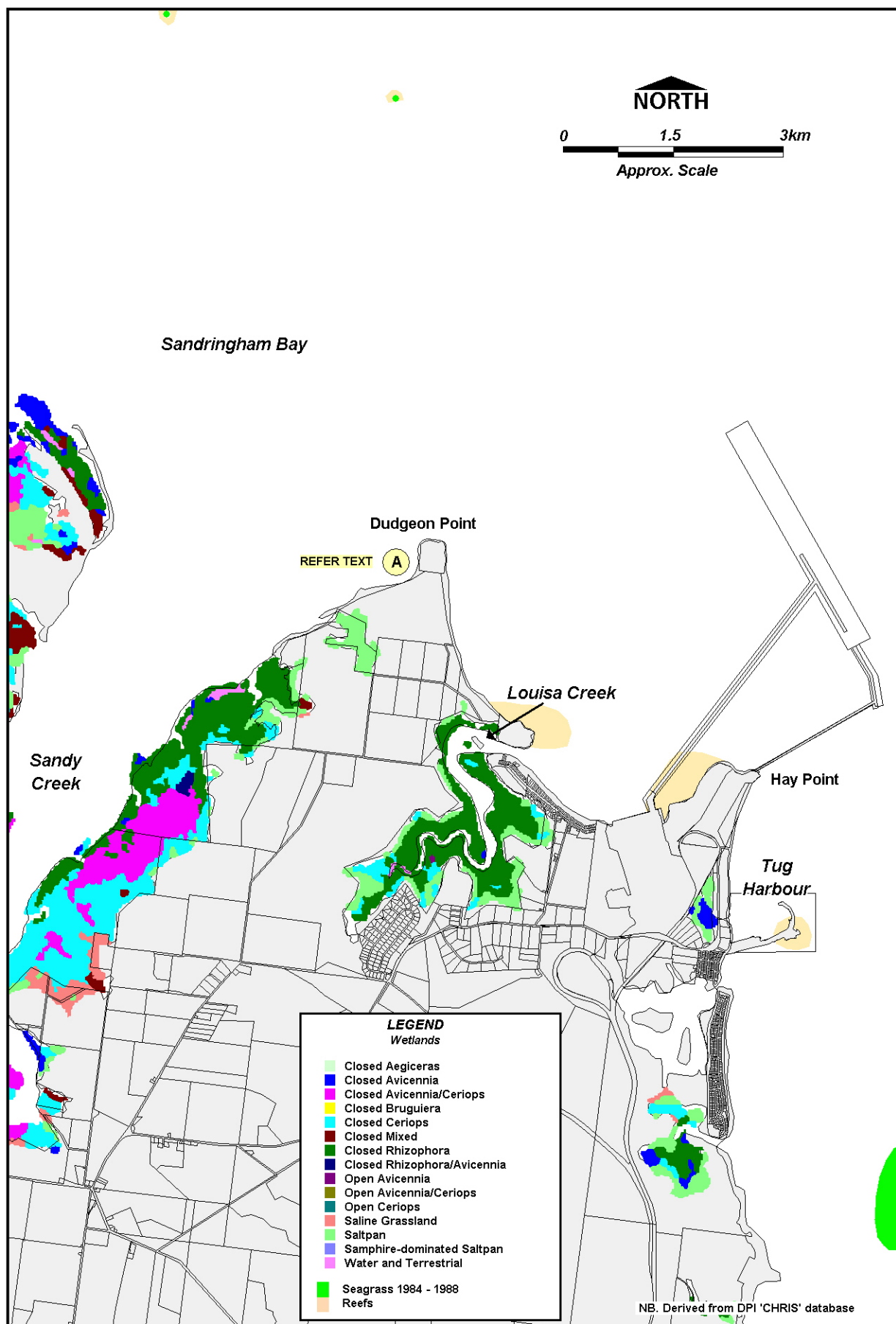
Intertidal Wetlands and Estuaries

Figure 4-1 shows the extent and type of intertidal vegetation and estuaries in proximity to the Hay Point area derived from DPI Fisheries CHRIS database information. The main areas of intertidal vegetation near the Port are as follows (from north to south):

- The Pioneer River mouth/ Bassett Basin area, located approximately 9 km to the north west of the existing spoil ground. Murphy (1994) recorded 16 species of mangroves in the Bassett Basin area, with *Rhizophora* and *Avicennia* dominating near-shore areas, while *Brugeria* and *Ceripos* tended to dominate the more landward areas. In recognition of the inherent habitat values of this stand, DPI Fisheries has listed this area as a Fish Habitat Area under the *Fisheries Act 1994*. This is the closest fisheries reserve to the existing off-shore spoil disposal site. There has been recent severe mangrove dieback in this area, and although investigations are in progress by the DPI to determine the cause/s of the problem, may be related to sewage effluent and other urban disturbances (Duke and Bell, 2003).
- Bakers Creek discharges directly into the sea north of Sandringham Bay. Bakers Creek has a well developed mangal³. Most of this mangal is situated within the Mouth of Bakers Creek Environment Park. This Environment Park has an area of 46 ha, 25 ha of which is tidally influenced (Cramer, 2000). The upper reaches of the Bakers Creek tidal zone is the site for the proposed Mackay Water Resources Project which involves the recycling of almost all of the Mackay City effluent with the aim to reduce the nutrient loads entering off-shore areas.
- Sandringham Bay is a large shallow embayment located north west of Dudgeon Point. Sandringham Bay is the receiving waters of several large creeks (Sandy, Sandringham and Alligator Creeks), and together with the main arm of Sandringham Bay, contain broad areas of intertidal flats and mangals. The wetlands provide seasonally important feeding habitats for waders and other shorebirds, particularly between August and April (WBM 1993, PCQ, 1995) and are listed as nationally important wetlands (ANCA,1996).
- Louisa Creek – is a relatively mature barrier-type estuary situated west of DBCT. The estuary is relatively shallow, with extensive shoaling within the main channel, and has well developed stands of mangrove forest. This estuary is relatively undisturbed, and would be expected to contain a broad suite of habitats of high local values.
- Hay Point. Small mangals have developed in low-lying quiescent areas within the north-western and south-eastern sections of the Hay Point peninsula.
- An intertidal wetland is located immediately to the south east of the DBCT stock yard and surface water storages and collects runoff from both the DBCT and HPCT areas. Investigations have been conducted within this wetland by McKillup & Houston (1994) and has been shown to be of significant local conservation value.

³ = mangrove forest

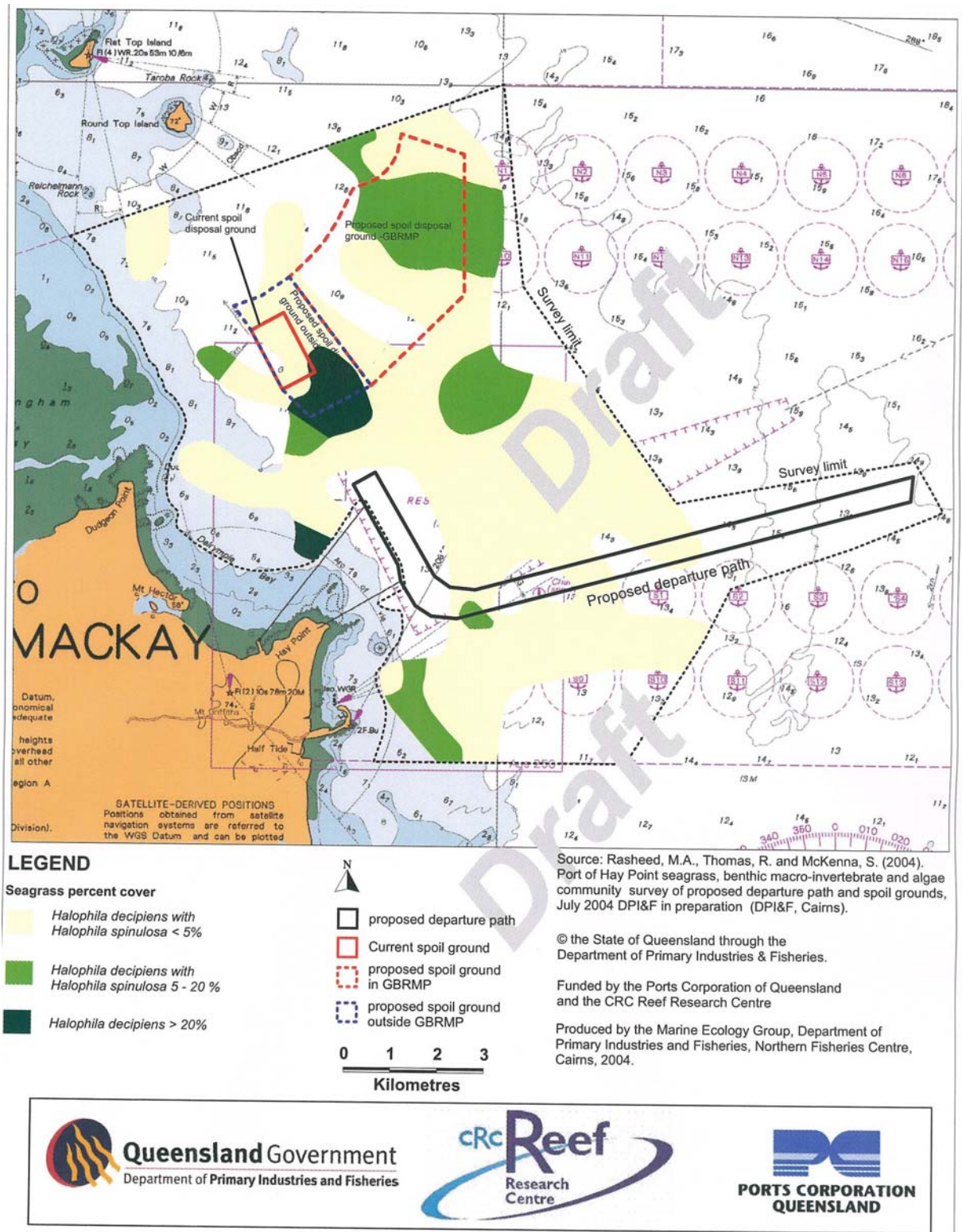
- Breens Creek. This small inlet is situated adjacent to the southern end of the rail loop at Hay Point Services Coal Terminal. The inlet is relatively shallow and is bounded by a well developed mangal.



**Map of Inter Tidal Vegetation
Communities in the Study Area**

Figure 4-1

Figure 4-2 Seagrass distribution and percent cover for the Port of Hay Point - July 2004



Unvegetated Unconsolidated Sediments

Unvegetated flats and beaches were well represented in the exposed sections of the coastline. These beaches were comprised of sediments derived predominantly from terrigenous (silica) sources. The most notable examples of unvegetated unconsolidated sedimentary habitats in the study area include:

- broad tidal flats seaward of wetland communities within Sandringham Bay;
- sandy beach located between Dudgeon Point and Mount Hector (Ballykeel Beach). This barrier beach is located on the seaward margin of the northern barrier forming the mouth of Louisa Creek;
- sandy beach located at the village of Hector. This barrier beach is located on the seaward margin of the southern barrier forming the entrance to Louisa Creek; and
- Hay Point Beach, situated between Hay Point and the Half Tide Tug Harbour.

Rocky Shores

Natural rocky outcrops and platforms, as well as constructed rocky substrates, occur throughout the study area. The natural rocky shores are of terrigenous rather than of biogenic⁴ origin. Notable rocky shores, from north to south, include:

- Dudgeon Point and Dudgeon Ledge. At Dudgeon Point⁵, the rocky shore was observed to consist of a broad, gently undulating platform, although numerous large rock ‘bommies’ occurred in places. The platform had a diverse range of micro-habitats, including the crevices and channels formed by deep weathering of the bed rock, and the boulders and cobble fields within the mid to lower intertidal zone. This rocky shore has been largely unaltered by human activities, and would represent a structurally diverse habitat type.
- Mount Hector is a steeply sloping rock outcrop situated at the northern entrance to Louisa Creek. The outcrop extends into tidal waters, and has been weathered (over geological timeframes) to form a relatively narrow rock platform. The platform is overlain by sand in places, resulting in the formation of a series of semi-contiguous intertidal platforms and sub-tidal patch reefs. Similar to Dudgeon Point, this rocky shore has been largely unaltered by human activities, and contains a broad range of structural habitats.
- Reclamation and associated jetty forming the seaward edge of coal stockpiles at DBCT. The seaward margin of the reclamation area consists of rectilinear revetments armoured with concrete hanbars. This artificial structure would provide habitats for a wide range of marine species, but are unlikely to contain similar communities or biodiversity values as natural rocky shores, given differences in structural habitat types present, micro-topographical complexity, orientation of dominant substrate faces (predominantly vertical compared to predominantly horizontal), and levels of ongoing disturbance.
- Hay Point. This broad rock platform has a wide range of micro-habitat types, resulting from deep weathering of the bedrock, and the deposition of boulders and cobble across most of the surface of the platform. The rock platform (particularly on the western side fronting Dalrymple

⁴ i.e. not coral reefs

⁵ Field inspections undertaken by WBM Oceanics Australia ecologists in 2002

Bay) is subject to low levels of ongoing disturbance from the activities at the HPCT coal loader, particularly with respect to noise impacts.

- Rock outcrops near the southern end of Hay Point Beach. The rock outcrops on Hay Point Beach appear to be relatively undisturbed by human activities, and although these have not been inspected by WBM, would probably have similar habitat characteristics as those elsewhere in the local area.
- Half Tide Tug Harbour and Highwater Islet. A natural rock outcrop extends from the shoreline near Half Tide Beach to Highwater Islet off-shore. A large seawall has been constructed on and adjacent to this outcrop to form Half Tide Tug Harbour. The natural sections of rocky shore would represent a highly disturbed environment, and similar to the reclamation at DBCT, the constructed rock walls are unlikely to be representative of natural rocky shore habitats.

4.2.2 Significant and Threatened Marine Species

Dugongs

Dugongs are marine mammals listed as Vulnerable to Extinction by the International Union for the Conservation of Nature and Natural Resources and classified as Endangered under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). Dugong populations may be impacted by pollution, hunting, entanglement in fishing nets and loss of seagrass habitat. The conservation of dugongs is managed under the *Nature Conservation (Dugong) Conservation Plan 1999*.

The status of dugong populations in the study region has been examined by Marsh *et al.* (1996). No dugongs were recorded during aerial surveys undertaken in 1987, 1992 and 1994. This result was not unexpected considering the lack of seagrass food resources in this region. Relatively small populations were recorded in areas to the north (near Port Newry) and south (Ince Bay, approximately 20 km to the south) of the study region. Dugong Protection Areas (as declared under the *Queensland Nature Conservation Act 1992* and the *Queensland Fisheries Act 1994*) have been declared for Llewellyn Bay (Llewellyn Bay Dugong Sanctuary- Type B) and Ince Bay (Ince Bay Dugong Sanctuary –Type A), approximately 35 km and 20 km from Hay Point respectively.

Overall, and given the extent of seagrass in the study area, it is considered highly unlikely that large numbers of dugong would utilise the nearshore areas of the Port.

Sea Turtles and Nesting Areas

Six species of turtles are known to occur in the study region. These species and their conservation status are as follows:

- Loggerhead (*Caretta caretta*)- Endangered (EPBC and Nature Conservation Act);
- Flatback (*Natattor depressa*) - Vulnerable (EPBC and Nature Conservation Act);
- Green (*Chelonia mydas*) - Vulnerable (EPBC and Nature Conservation Act);
- Leatherback (*Dermochelys coriacea*) - Endangered (EPBC Act) and Vulnerable (Nature Conservation Act);
- Olive Ridley (*Lepidochelys olivacea*); and

- Hawksbill (*Eretmochelys imbricata*) - Vulnerable (EPBC and Nature Conservation Act);

Green turtles are the most common in the region, and are known to frequent the harbour on occasions. The Flatback Turtle is the numerically dominant species nesting on local beaches in the area (L Gallagher, Mackay Turtle Watch, pers comm.), whereas the Green Turtle is a sporadic nester on local beaches. Recent surveys by Mackay Turtle Watch indicate that the most heavily utilised beaches for nesting are Hay Point Beach and Salonika Beach. Limited nesting is found on McKeowns, Louisa, Ballykeel and Far beaches, and no nesting has been recorded on Half Tide Beach. The major rookeries of Flatback Turtles are at Crab Island and Wild Duck Island, which are located 80 km south-east of Hay Point (PCQ, 2002).

The adult Green Turtle is herbivorous and dependent upon seagrass. Existing published information indicates that mainly ephemeral seagrass beds have been identified in the vicinity of the wider port area except near Dudgeon Point (see Section 4.2.1). The remaining turtle species are carnivorous. With the exceptions of aggregations of breeding females that occur in nearshore waters off nesting beaches during the nesting season, marine turtles are generally solitary. The abundance of turtles in the Port area is anticipated to be relatively low (URS, 2000).

Recent studies by the Queensland Park and Wildlife Service (QPWS, 2003) into turtle population dynamics in the Hay Point area found the following:

- Five green turtles were observed during transect surveys of the Hay Point port area.
- No turtles were captured within Hay Point port limits.
- The inshore areas of Hay Point area support a small foraging population of *C. myda*.
- It is likely that Green Turtles *C. mydas* are foraging on algal covered rocky substrates.
- Anecdotal observations indicate that green turtles may also be feeding on deep-water seagrass or algae off shore from the coal-loading terminal.

Whales and Dolphins

Several species of dolphins are known to occur within the study region. These include bottlenose (*Tursiops trunatus*), Indopacific humpback (*Sousa chinensis*) and common (*Delphinus delphis*) dolphins. Several whale species are also known from the study region, although they generally move along the coast well off-shore and are unlikely to affect the site selection for the disposal ground. Sei whale (*Balaenoptera musculus* – listed as Vulnerable under the EPBC Act) and the Fin whale (*Balaenoptera physalus* – listed as Vulnerable under the EPBC Act) are reported to be occasional visitors to the area. The conservation of whales and dolphins is managed under the *Nature Conservation (Whales and Dolphins) Conservation Plan 1997*.

Intertidal Avifauna

A variety of shorebirds are likely to frequent the intertidal areas within the study area, many of which are protected under the JAMBA and CAMBA agreements, which provide for the protection of migratory birds. The Beach-Stone Curlew *Esacus neglectus*, which is classified as Vulnerable under the *Nature Conservation Act 1992*, has been recorded in foreshore areas and in mangrove areas near the Hay Point Coal Terminal site (see Section 4.3.2). The Sandringham Bay flats are a major habitat for shorebirds.

4.2.3 Fisheries

Commercial Fishing

The Mackay region supports a large commercial fishery targeting a variety of fish and crustacean species. Major landings include fish, scallops, prawns (dominated by king prawns) and crabs (dominated by spanner crabs). There is likely to be periodic prawn trawling in the general area of the Port.

Queensland Boating and Fisheries Patrol officers stated that there was limited fishing by the commercial fisheries within the inner areas of the Great Barrier Reef (GBR), as well as within the areas currently excluded from the GBR Marine Park (URS, 2000). The outer areas of the GBR were more popular for commercial fisheries. The effects of spoil dumping on commercial fishing activities in the general area is unlikely to be a significant consideration in the selection of the new spoil disposal site.

Recreational Fisheries

There is no available data on recreational fishing effort and catches from the Mackay/ Hay Point region. Previous discussions with Queensland Fisheries and Queensland Boating and Fisheries Patrol officers (refer URS ,2000) indicate that:

- the main species caught in the region are snapper, cod, grunter, mackerel and trevally; and
- recreational fishing occurs throughout the General Use and other zones of the Great Barrier Reef Marine Park (except where excluded) and in the areas not yet gazetted as within the Great Barrier Reef Marine Park. It is understood most sites that are fished close to the existing off-shore disposal area are adjacent to small reefs, most particularly in the north-west side of Round Top and Flat Top islands where protected from the prevailing winds.

It is likely that shore-based recreational fishing is undertaken sporadically in the local area, mainly from readily accessible rocky point areas near the residential areas of Louisa Creek and Salonika.

4.2.4 Terrestrial Environments

Terrestrial Vegetation

Studies by URS (2000) investigated the vegetation communities and species present within the Hay Point holdings of PCQ.

Eight vegetation associations have been identified by URS (2000) in the local area:

- 1a. Mangrove-salt Flat vegetation of marine clays.
- 2a. Forest Red gum *Eucalyptus tereticornis*/Moreton Bay Ash *Corymbia tessellaris*/Paper-barked Teatree *Melaleuca nervosa* Open Forest on alluvium/alluvial parallel beach ridges.
- 2b. Forest Red Gum *tereticornis*/Moreton Bay Ash *Corymbia tessellaris*/paper-barked Teatree *Melaleuca nervosa* Open Forest on duplex soils.

- 3a. Pink Bloodwood *Corymbia intermedia*/Poplar gum *Eucalyptus platyphylla* Open forest on duplex soils.
- 4a. Mixed Eucalypt Woodland-Open Forest on gravely lithosols.
- 5a. Revegetation.
- 6a. Modified land/grasslands.
- 7a. Artificial/Modified Freshwater Waterbodies

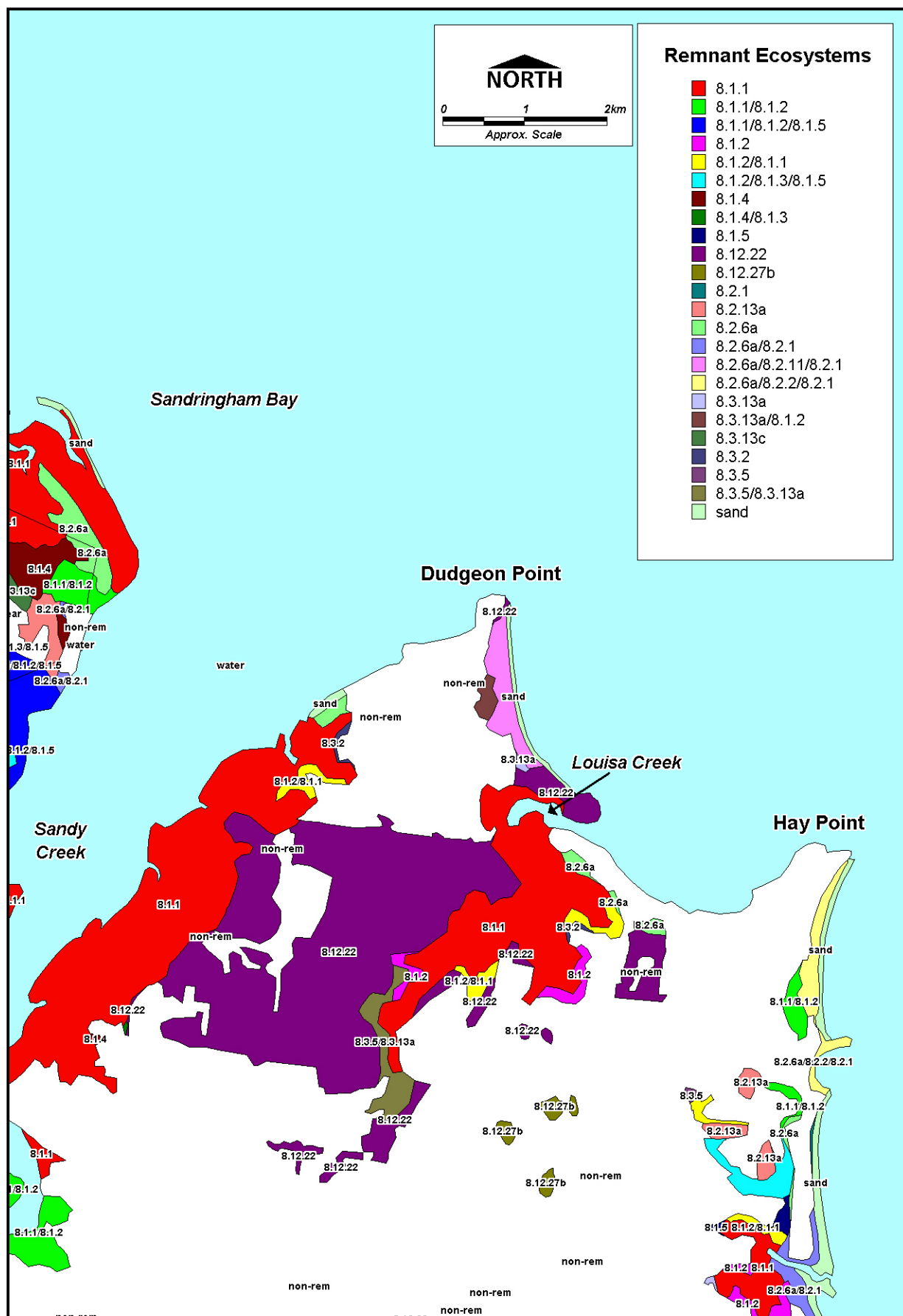
Of these, units 1a, 2b, 3a, 4a, 5a and 6a are present on the Hay Point area. Unit 5a and 6a are artificial associations being rehabilitated areas and modified grasslands respectively. PCQ commenced a major revegetation programme for port land in 1998. This programme is progressively restoring areas in the port buffer zones in accordance with the Port of Hay Point Vegetation Management Plan (PCQ, 1995). It has been estimated that approximately 113,000 shrubs and trees native to the area have been planted by PCQ representing a total area of 25 ha that has been revegetated. Most of this replanting has occurred on steeper lands unsuited to port development activities.

Mapping by the Queensland Herbarium of Regional Ecosystems (as defined in the *Vegetation Management Act 1999*) has been undertaken and is presented in Figure 4-3 to provide a summary of the remnant communities present both within the Hay Point area and at Dudgeon Point, together with a summary of the NRA (2002) flora and fauna investigations in the PCQ Dudgeon Point holdings.

The status of the vegetation under the *Vegetation Management Act 1999* classification and the EPA Biodiversity assessment process is indicated in Table 4-1. Appendix B provides a more comprehensive description. This table indicates the following characteristics:

Hay Point

- the foredune vegetation adjacent to Hay Point Beach is of major conservation value;
- the intertidal vegetation is also of significant conservation value; and
- vegetation adjacent to Lake Barfield is of Endangered status.



* Derived from QLD Herbarium V4.0

Remnant Regional Ecosystems

Figure 4-3

Dudgeon Point

All remnant vegetation was identified as having a moderate to high vegetation integrity and of significant conservation value.

Table 4-1 Summary of Regional Ecosystems – Hay Point

Vegetation Community	RE Category (equivalent)	RE Status/EPA Biodiversity Status	Vegetation Integrity*	Species of Conservation Significance*
Foredune vegetation	8.2.6a/8.2.7a/8.2.1	Of Concern/Of Concern (8.2.6 a) Of Concern/Endangered (8.2.7 a) Of Concern/Of Concern (8.2.1.)	Moderate to high	None
Open Ironbark, Poplar Gum, Bloodwood and Queensland Peppermint Woodlands	8.12.22	Not of Concern/No Concern at Present	High	None
Ironbark Brush Box Open Woodlands	Segregate of 8.12.22	Not of Concern/No Concern at Present	High	None
Eucalypt, Swamp Mahogany and Melaleuca Woodlands	8.3.5/8.3.13a/8.1.2	Of Concern/Endangered (8.3.5) Of Concern/Endangered (8.3.13a) Of Concern/Of Concern (8.1.2)	Moderate to high	None
Melaleuca and Swamp Mahogany Woodlands	8.3.2	Endangered/Endangered	Moderate to high	None
Mangrove closed forests and Salt pans	8.1.1/8.1.2	Not of Concern/No Concern at Present (8.1.1) Of concern/Of Concern (8.1.2)	High	None

Vegetation Community	RE Category (equivalent)	RE Status/EPA Biodiversity Status	Vegetation Integrity*	Species of Conservation Significance*
Eucalypt and Melaleuca Open to Closed Forest	8.2.13	Endangered/Endangered	Not assessed – likely to be high	Not assessed
Cleared fields, plantations, disturbed areas	-	No status – not remnant vegetation	Low to very low	None

*source – derived from NRA (2002) for Dudgeon Point investigation

No individual plant species of conservation significance were recorded during field surveys by NRA, (2002), although it is possible that the following species occur in the area:

- *Eucalyptus raveretiana* which occurs on creekbanks, riverbanks, alluvials, often in association with *Corymbia tessellaris* forests and is considered to be of national significance; and
- *Macropteranthes fitzalanii* which occur on beach ridges and is considered to be of state significance.

Terrestrial Fauna and Avifauna

Various studies have been conducted with the terrestrial habitat values and fauna species present in the Hay Point area including Dames and Moore (1996), URS (2000) and from the initial EIS for Hay Point (GHD 1976). Table 4-2 provides a summary of recordings for significant bird species for the Hay Point Area and their status under the *Nature Conservation Act 1992* and the EPBC Act (including the JAMBA/CAMBA International Agreement for the protection of migratory species).

Table 4-2 Significant Bird Species Recorded in the Hay Point Area

Common Name	Locality	International Agreement JAMBA [J]/ CAMBA [C]	Status		Source of Record
			NC Act (Qld)	EPBC Act	
Cotton Pygmy-goose <i>Nettapus coromandelius</i>	Lake Barfield*	-	R		Dames & Moore (1996), URS (2000)
Black-necked Stork <i>Ephippiorhynchus asiaticus</i>	Lake Barfield*	-	R		GHD (1976)
Grey Plover <i>Pluvialis squatarola</i>	Lake Barfield*	J, C	-	Mi	GHD (1976)
Eastern Curlew <i>Numenius madagascariensis</i>	Lake Barfield*	J, C	R	Mi	GHD (1976)
Common Greenshank <i>Tringa nebularia</i>	Lake Barfield*	J, C	-	Mi	GHD (1976)

Common Name	Locality	International Agreement JAMBA [J]/ CAMBA [C]	Status		Source of Record
Great Knot <i>Calidris tenuirostris</i>	Lake Barfield*	J, C	-	Mi	GHD (1976)
Bush Stone-Curlew <i>Burhinus grallarius</i>	Open woodlands and shrublands	-	V		Dames & Moore (1996)
Beach Stone-Curlew <i>Esacus neglectus</i>	Mangroves in HPCT Site, Fore-dune grassland Half Tide	-			GHD (1976), McKillop & Houston (1994), URS (2000)
Rainbow Bee-eater <i>Merops ornatus</i>	All sites & habitats	J	-	Mi	Dames & Moore (1996), URS (2000)

Statutory Conservation Status: Vulnerable [V], Rare [R], Source – *Nature Conservation [Wildlife] Regulation*; Migratory Species [Mi], Source – *Environmental Protection & Biodiversity Conservation Act [Cwth] 1999*.
Table Modified from URS (2000)

* See comment in text re Lake Barfield status

It should be noted that Lake Barfield was converted from a tidal inlet to a freshwater body in the 1960's as part of subdivisional development at Salonika/Half Tide. Accordingly, Lake Barfield now supports freshwater fauna including a range of significant bird species. There remains an on-going state of flux in the lake system (conversion from an estuarine to a freshwater ecosystem), but the lake and its margins are recognised as being of local conservation significance.

NRA (2002) also carried out terrestrial fauna studies for the Dudgeon Point holdings. Significant fauna species identified during the NRA survey include:

- Grey Goshawk, which is listed as rare under the *Nature Conservation Act (Qld)*; and
- White-bellied Sea-eagle, which is listed as a migratory species and a marine protected species under *Environmental Protection and Biodiversity Conservation (EPBC) Act (Cwth)*.

On completion of a search of the EPBC database, an additional 34 species were identified as possibly being located within the study area.

According to NRA (2002), the study area contains no threatened ecological communities which are listed under the EPBC Act.

However, NRA (2002) noted that the site does contain:

- small areas of **nationally** significant endangered regional ecosystems in the south-east and north-west corners;
- small areas of **state** significant of concern regional ecosystems along the eastern beach area and the north-west of the study area;
- exclusive regional ecosystems which are of no concern and considered to be of **local** significance; and
- substantial cleared or disturbed areas which are considered to be of **site** significance.

NRA (2002) identified four areas of high development constraint, six areas of moderate development constraint and three areas of low development constraint. These have been reincorporated in the discussion on opportunities and constraints in Section 5.2.

4.3 Planning Issues

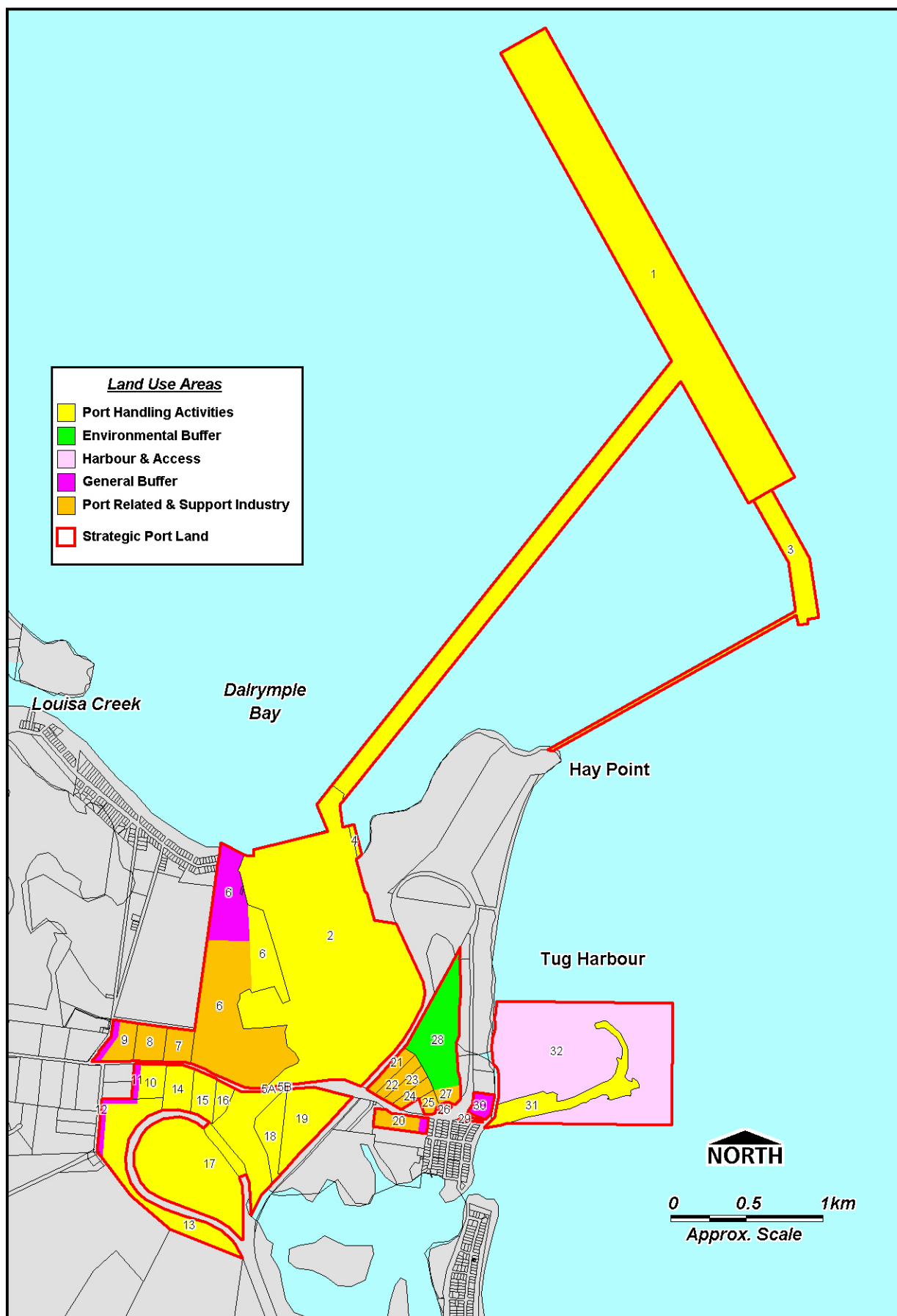
4.3.1 Statutory Planning/Strategic Planning

PCQ (2003) presents a Land Use Strategy for the Port of Hay Point which has been adopted by PCQ and being implemented under the *Transport Infrastructure Act 1994*. Figure 4-4 presents the land use strategy. Key issues considered in the preparation of the Strategy have been noted as including:

- continued development of coal exports;
- the difficulty in reliably predicting future land take up of port land for existing and new trades; and
- the need to ensure that incompatible land uses do not encroach on the Port.

The performance criteria for all developments include the following:

- areas adjoining the waterfront are to be utilised for activities which require direct port access;
- public access to the waterfront will be encouraged in areas which are not strategic to the future land use associated with port operations, where consistent with industrial and operational safety;
- public access to the waterfront will be encouraged in areas which are not strategic to the future land use associated with port operations, where consistent with industrial and operational safety;
- development shall be located and carried out in a manner which does not adversely impact on the Environmental Buffer Areas identified on the Land Use Plan Map;
- areas identified as having high environmental significance through individual site investigations are to be managed and protected from incompatible development;
- development occurring adjacent to residential areas will incorporate measures to mitigate potential adverse impacts;
- development shall comply as a minimum with water quality, air quality and noise emission standards administered through the *Environmental Protection Act 1994*. The Corporation may request higher standards based on the outcomes of an Environmental Impact Statement; and
- development is to be provided with an appropriate level of engineering infrastructure servicing (including water supply, waste disposal, transport access, telecommunications and power).



Ports Corporation Land Use Strategy - Hay Point Figure 4-4

The major portion of the plan area is allocated to Port Handling Activities with Performance criteria as follows:

- Development should significantly improve or contribute to port efficiency by:
 - not replicating existing facilities, or
 - by shortening the supply chain or providing logical benefits.
- Development should not compromise the long term efficiency of the Port.
- Development must meet all the performance criteria described above.

For the Dudgeon Point land, the zoning is currently Rural under the Sarina Shire Planning Scheme however, the Sarina Shire Council has recognised the potential for future industrial developments of the site (GHD 2003).

For both the Hay Point and Dudgeon Point land, the prospect of establishment of a significant area of spoil disposal may have significant implications for further industrial development, particularly given the geotechnical/stability issues associated with the deposited material. This aspect is addressed in Section 4.4.2.

4.3.2 Environmental Zonings

Legislation that is relevant to construction of spoil placement at either Hay Point or Dudgeon Point include the following:

State

- *Integrated Planning Act 1997;*
- *Vegetation Management Act 1999;*
- *Nature Conservation Act 1992;*
- *Coastal Protection and Management Act 1995;*
- *Water Act 2000;*
- *Fisheries Act 1994;*
- *Environmental Protection Act 1994 and Regulation 1998;*
- *Environmental Protection Policy (Water) 1997;*
- *Environmental Protection Policy (Air) 1997;*
- *Environmental Protection Policy (Noise) 1997;*
- *Aboriginal Cultural Management Act 2003;*
- *Native Title Act 1993; and*
- *Queensland Heritage Act 1992*

Commonwealth

- *Environmental Protection and Biodiversity Conservation Act 1999;*
- *Great Barrier Reef Marine Park Act 1975; and*
- *Australian Heritage Commission Act 1975.*

The implications of these pieces of legislation in terms of spoil disposal are addressed later in Section 6.

The following addresses the spatial application of these acts in the study area.

Conservation/National Parks

The Mount Hector Conservation Park lies immediately to the south-east of PCQ holdings at Dudgeon Point.

It comprises a mountain headland that supports a range of vegetation communities including open eucalypt forest and grasslands. The park is listed on the National Estate due to its geological features, flora, fauna and aesthetic values. Low lying mangroves and pandanus swamp occurs behind the dunes, some of which are important bird habitats (GHD, 2003). It is also cited as having indigenous cultural heritage significance.

Adequate buffering of this park from developments in the PCQ holdings would need to be provided for.

Fish Habitat Areas

The nearest Fish Habitat Area (FHA) is the Bassett Basin FHA near the mouth of the Pioneer River, approximately 20 km to the north of Dudgeon Point. As indicated previously, all marine plants (including microalgae) are protected under the *Fisheries Act 1994*.

Dugong Protection Area

The nearest Dugong Protection Area to the study area is at Ince Bay, approximately 20 km to the south of the Port.

Great Barrier Reef Marine Park (GBRMP)

The major proportion of the Hay Point Port limits (approximately 80%) lies within the GBRMP (see Figure 1-1). However, the GBRMP boundary does not extend closer than 3 km to Hay Point and 6 km to Dudgeon Point respectively. Consequently, in terms of consideration of reclamation or disposal in near-shore areas, the GBRMP does not have significant implications.

Queensland Heritage Site

There are no European heritage sites listed on the EPA Heritage Register for the study area. Items or places of Aboriginal cultural heritage have been addressed in Section 4.4.

Places on the Register of the National Estate/GBR World Heritage Area

As noted earlier, the Mount Hector Conservation Park is listed in the Australian Heritage Commission's Register of the National Estate. The Great Barrier Reef World Heritage area is also on the Register and extends to mean low water.

The Great Barrier Reef Marine Park Authority (GBRMPA) has co-ordinated the preparation of a 25 year Strategic Plan for the Great Barrier Reef World Heritage Area. This plan is a statement which provides direction and guidance for uses in the heritage area. The legal basis of the plan is provided by the various acts and regulations that are used to implement specific strategies contained in the plan.

The 25 year objective of the plan is *"to ensure the persistence of the Great Barrier Reef World Heritage Area as a diverse, resilient and productive ecological system, while retaining opportunity for a diverse range of experiences and uses consistent with Australia's obligations under the World Heritage Convention"*.

Wetlands of National Importance

The *Sandringham Bay – Bakers Creek Aggregation* is listed as a Wetland of National Importance. This area includes all intertidal areas associated with the Sandy Creek and Bakers Creek inlets as well as the Louisa Creek wetlands to the immediate west of the Hay Point infrastructure. The listing of the Sandringham Bay area highlights the recognised ecological importance of this area and the need to provide an adequate buffer from any development that may adversely impact on its values.

Strategic Port Land

Section 4.3.1 has indicated the implications of the Port of Hay Point Land Use Strategy (PCQ 1995). This strategy applies to Strategic Port Land as regulated by the *Transport Infrastructure Act 1994*.

Environmentally Sensitive Areas

The EPA had designated Environmentally Sensitive Areas as part of the biodiversity planning process incorporated into the agency's assessments of proposed developments under the *Integrated Planning Act 1997*. Figure 4-5 indicates the Environmentally Sensitive Area (ESA's) for the study area and land in proximity. Such areas incorporate conservation protection zones otherwise addressed by State and Federal legislation. ESAs indicated are categorized into A, B and C depending on the current status of legislative protection. As indicated in Figure 4-5, the following categories apply to the study area.

- **Category A**

Mount Hector Conservation Park.

- **Category B**

Endangered Regional Ecosystems – includes wetlands in the northern portion of the Dudgeon Point land and the perimeter of Lake Barfield.

World Heritage Area (Great Barrier Reef Marine Park).

Marine Parks.

- **Category C**

None

- **Others**

Directory of Important Wetlands – applies to the Sandringham Bay area.

4.4 Land Use and Social Factors

4.4.1 Existing Land Uses

Figure 1-2 indicates the existing uses of the Hay Point area. Hay Point Services are currently proposing an expansion to the coal stockpile area to accommodate an increased output of coal. Residential uses are in close to the existing coal handling facilities. Residences at the Louisa Creek community are located within 300 m of the operations at the closest point however a significant number of properties are owned by PCQ (see Figure 1-3). Residences at Half-Tide and Salonika Beach are also close to the coal handling facilities of DBCT (the closest is within 600 m) however, due to the prevailing winds from the south-east, such areas generally suffer less noise and dust impact from the coal handling operations than do residences at Louisa Creek. Complaints have been from these areas, however, in regard to noise and dust emissions.

Land uses at Dudgeon Point (see Figure 1-4) comprise mainly grazing on native and improved pastures, a small area of plantation pine forest and essentially undeveloped native woodland. There are a number of 'shanty' style dwellings within the northern portions of the PCQ holdings and at Dudgeon Point, however these properties have no tenure and are illegal structures. There are no permanent legal residences within the PCQ holdings. A number of gravel access tracks pass through the area but are subject to very low levels of use.

4.4.2 Proposed or Prospective Land Uses

As noted above, Hay Point Services are proposing to expand their development areas while the DBCT area recently underwent a significant expansion (2002). Both operations are significantly constrained by the area of available land suitable for infrastructure development, particularly given the expected increasing demand for export coal in the near future and the consequent need for additional coal handling facilities. Hay Point Services (J. McCorkell, pers. com. 2004) have indicated a desire to further expand their coal handling area with the main prospective area being as reclamation of the intertidal zone to the north-west of the existing stock yards.

It needs to be recognised that the proposed Stage 3 expansion of the DBCT area included two reclamation areas as presented in the EIS by Dames and Moore (1996). These reclamation areas comprised a reclamation area within a cove between the DBCT and HPCT stockyards (Proposed Reclamation Area A) and a reclamation area that extended the DBCT stock yard to the north into Dalrymple Bay (Proposed Reclamation Area B). Both proposals encountered significant opposition from the local community (mainly on amenity and visual grounds). This opposition plus the subsequent recognition of a fish trap at Reclamation Area A of cultural heritage significance (refer Section 4.4.4) resulted in the abandonment of proceeding with development of the full extent of these two reclamations. A very minor area was reclaimed however.

GHD (2003) investigated land use opportunities at Dudgeon Point but no detailed recommendations or proposals are available at this stage. The site is relatively isolated from other urban areas in terms of access and available infrastructure. The site however is proposed for some form of future port or commercial/industrial development.

4.4.3 Local Issues (including noise and dust)

The proximity of residential areas to the Hay Point coal terminals raises a number of issues relating to amenity impacts on the residents i.e.:

- noise emissions mainly related to the unloading operations, rail movement and conveyors;
- dust emissions, primarily from the coal stockpile areas and during construction activities;
- visual impacts, particularly near beachside areas; and
- recreational uses including fishing and water-based activities.

For spoil disposal, noise emissions may be an issue with the construction of the spoil disposal areas and any booster pumping that may be required (noise from the dredger is unlikely to be an issue). Dust emissions may result from any unrehabilitated spoil ground while visual and recreational aspects are likely to be an issue should development be proposed in a publicly accessible foreshore area.

4.4.4 Cultural Heritage Values

Both the Hay Point and Dudgeon Point area have been the subject of cultural heritage investigations i.e. Hattie (1996) and URS (2000) for Hay Point lands, and ARCHAEO Cultural Heritage Services (2004) for the Dudgeon Point holdings. A register of cultural places is kept on a confidential database that is not accessible by the general public. Accordingly, this study will not indicate the specific locations of items of cultural significance.

The preliminary results of the ARCHAEO (2004) investigation has proposed a cultural heritage protection zone for the Dudgeon Point area, with the general boundaries incorporated into constraints mapping presented in Section 5. The protection of this zone through land use controls is yet to be finalised. This zone includes almost all intertidal and beach areas, foredune areas and the Mount Hector area. Due to the degree of disturbance that has occurred at Hay Point, the potential for sites of archaeological significance is low. However, URS (2000) noted the presence of a fish trap in the embayment within Dalrymple Bay between the DBCT and HPCT stock yards (see Point X on Figure 1-2).

The presence of this fish trap precluded further consideration of the establishment of a reclamation area adjacent to these stock yards as presented by Dames and Moore (1996). This reclamation proposed the use of fill sourced from terrestrial areas. Constraint mapping presented in Section 5 of this report has taken account of the specific location of cultural heritage items/values that cannot be specifically indicated in mapping due to confidentiality issues.

4.5 Physical/Technical/Engineering

4.5.1 Terrain and Bathymetry

Hay Point

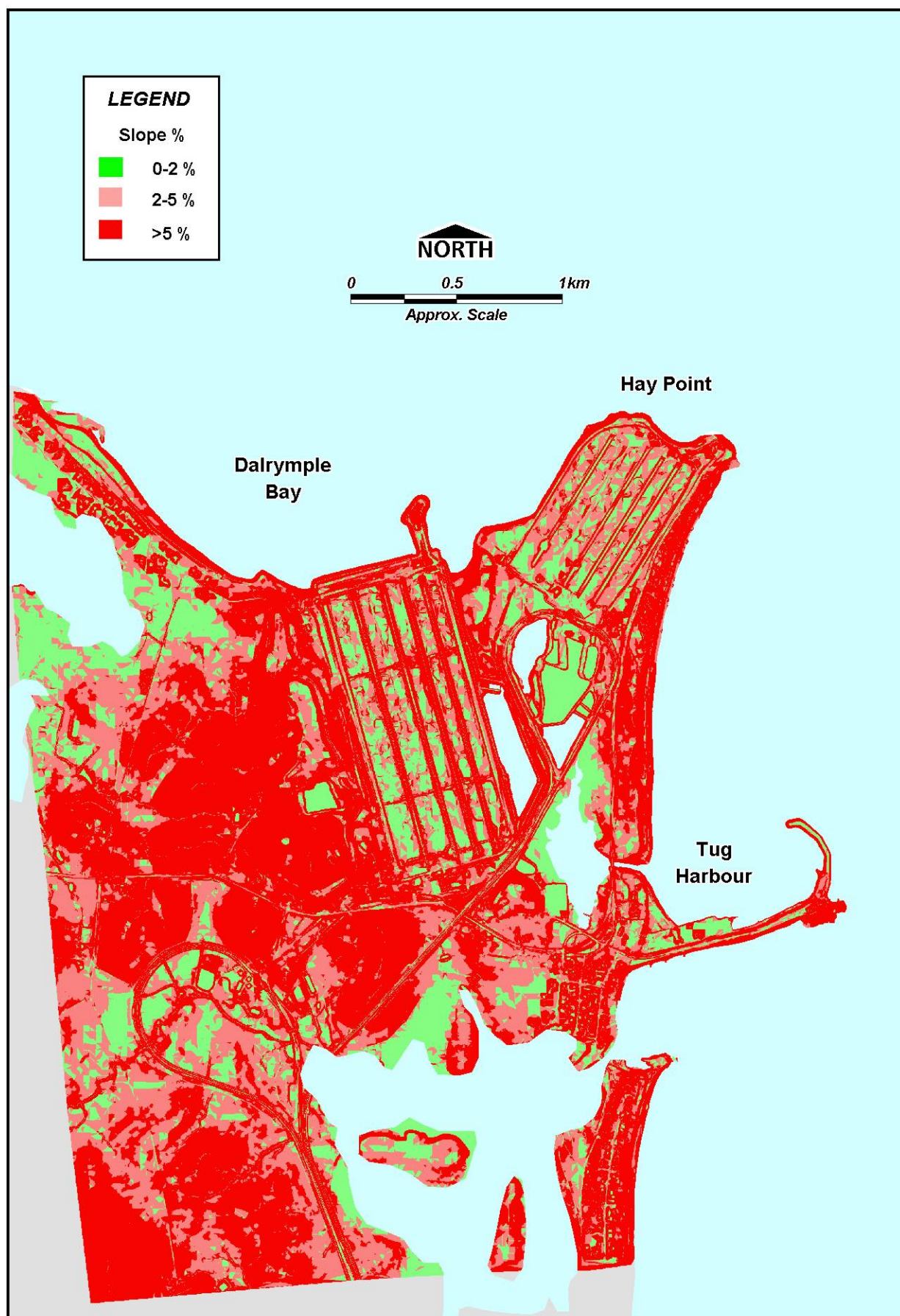
Figure 4-6 indicates the terrain of the Hay Point area. The HPCT and DBCT sites have been highly modified to facilitate the development of coal handling and stockpiling facilities and associated roadways, rail lines, water storages and extractive material sources. Modification has occurred to the

extent that there are only a few areas where the pre-development terrain in low lying areas is relatively intact i.e.:

- the narrow foredune area behind Hay Point Beach;
- the intertidal wetlands to the south/south-east of the water storage ponds and small parcels immediately adjacent to these wetlands; and
- small areas within the immediate catchment areas of Lake Barfield.

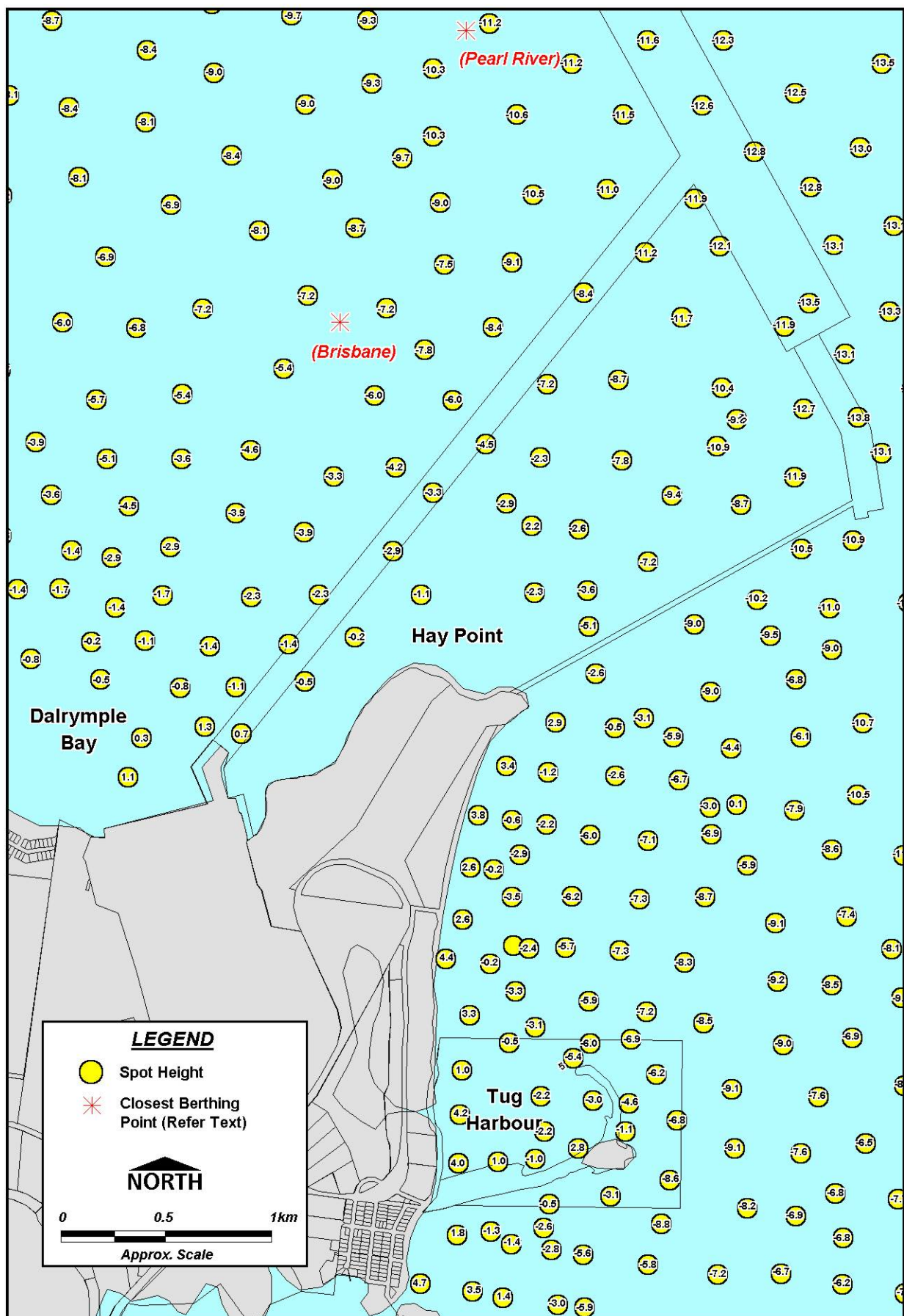
The terrain to the immediate west of the DBCT stockpiles is strongly undulating to steep and is unsuitable for any spoil disposal activities.

Figure 4-7 indicates the bathymetry of areas off-shore from Hay Point. The intertidal flats within Dalrymple Bay extend some 1 to 1.5 km off-shore. Tidal range at Hay Point is significant, with an approximate 7 m range during Spring tides.



Slope Map - Hay Point

Figure 4-6



Source : Aus 250 Hay Point 1:15000 Bathymetry Map

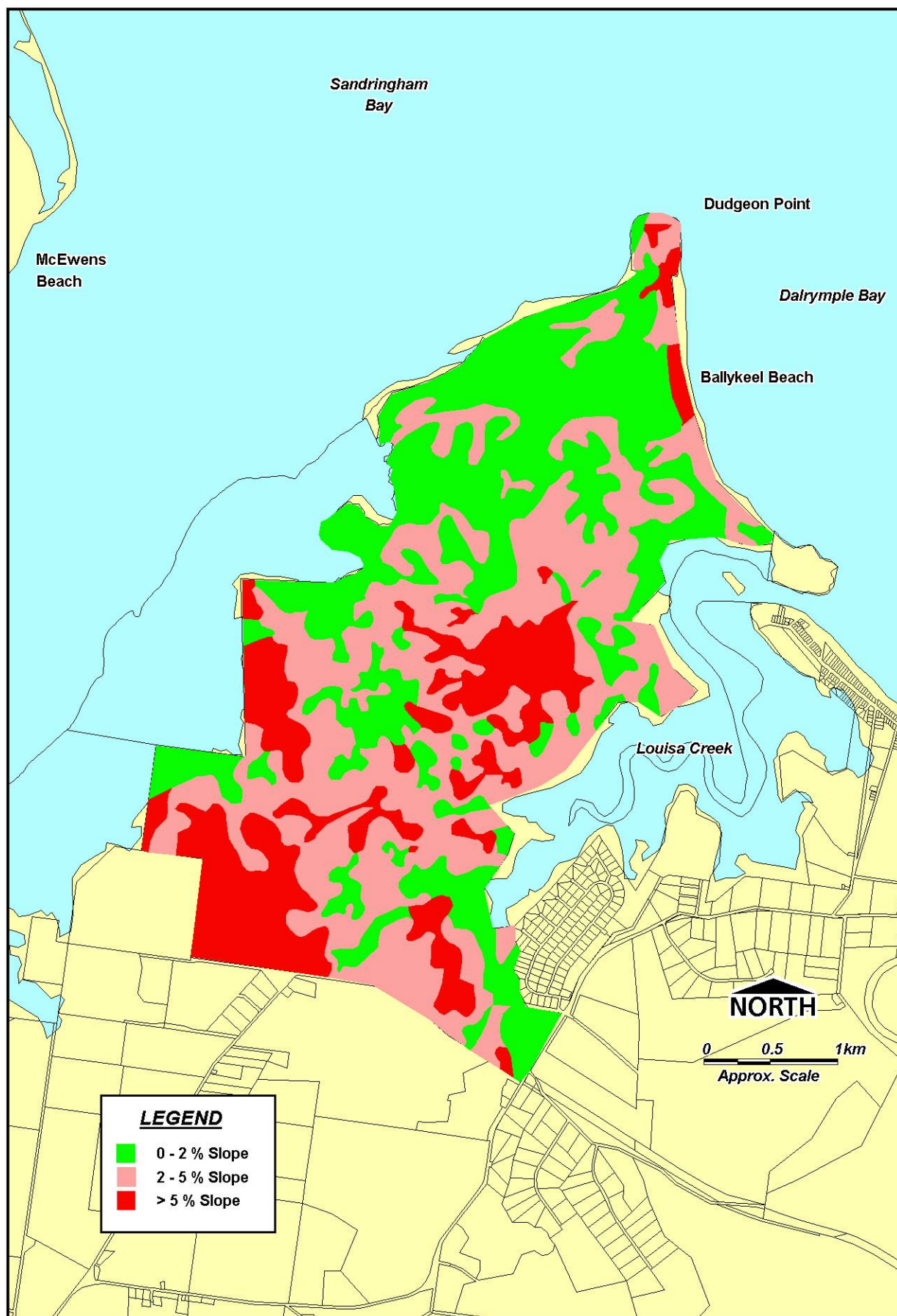
Bathymetry - Hay Point

Figure 4-7

Dudgeon Point

Detailed topographical data are not available for all PCQ holdings at Dudgeon Point. Figure 4-8 indicates the general terrain of the Dudgeon Point holdings broken into categories of 0-2%, 2 to 5% and over 5% slope. Significant areas of the low sloping land comprises intertidal wetlands of high conservation value.

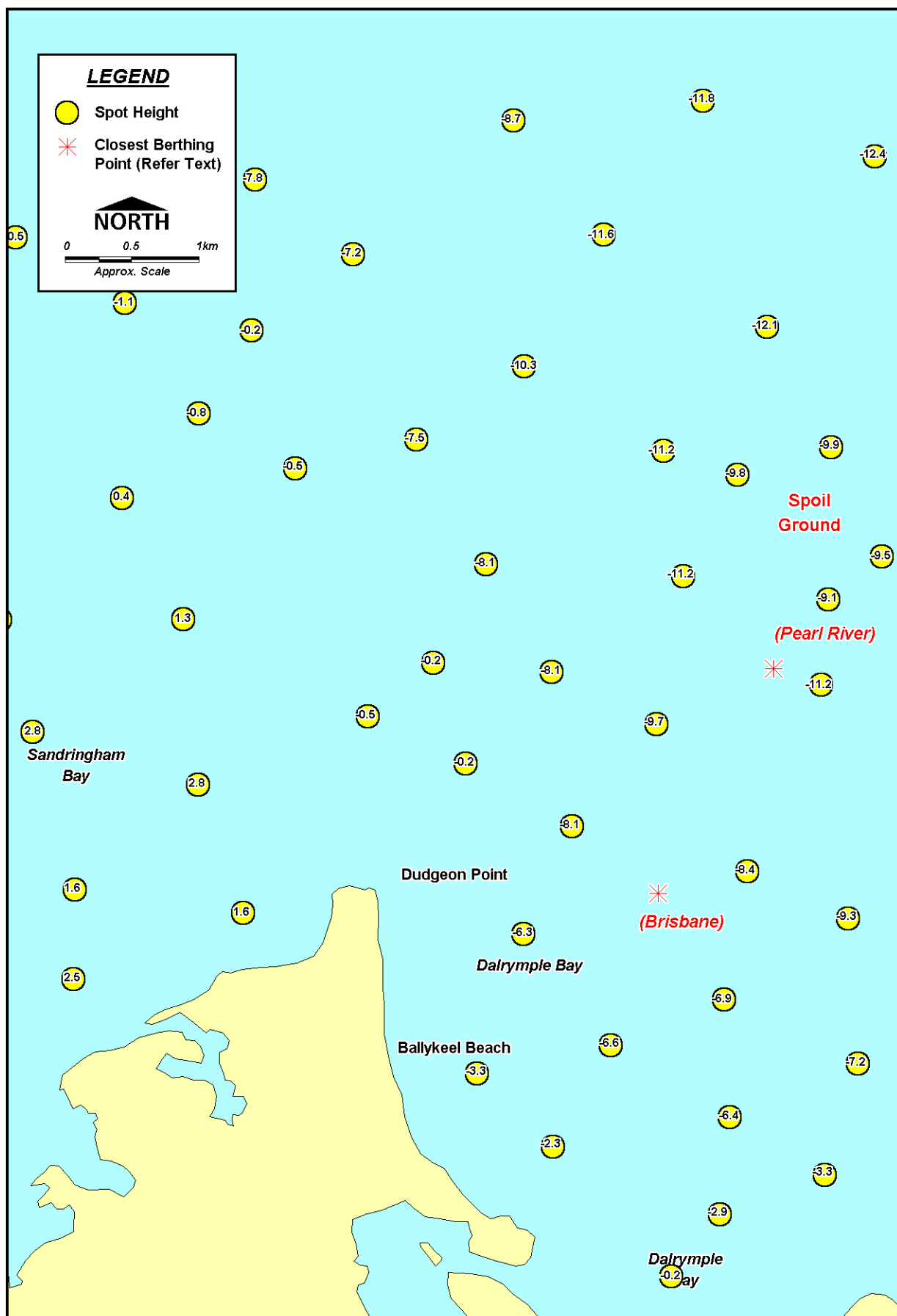
The bathymetry of off-shore waters is shown on Figure 4-9. This indicates that the tidal flats off Ballykeel Beach extend some 2 to 2.5 km off-shore. The existing spoil ground also provides a navigational barrier to entering waters immediately off-shore from Lowest Astronomical Tide (LAT) to the north east of Dudgeon Point. This figure also indicates the closest berthing point to shore for both the 'Brisbane' and 'Pearl River' based on the draft of each vessel when laden (see Table 1-2).



* Interpreted from GHD (2003)

**Slope Map - PCQ
Holdings at Dudgeon Point**

Figure 4-8



Source : Aus 251 Dudgeon Point 1:15000 Bathymetry Map

Bathymetry - Dudgeon Point

Figure 4-9

4.5.2 Hydrology/Drainage/Water Quality

Hay Point

As noted in the previous section, the terrain of Hay Point has been highly modified and, consequently, the drainage network has also been changed. Almost all drainage from the operational areas (including the northern limits of the stockpile area) drains into the intertidal wetlands in the southeast of the site via a series of water storage/sedimentation ponds.

Areas to the south of the PCQ Holdings, including the rail corridors and DBCT unloading facilities, drain towards Lake Barfield. The water quality of the Hay Point area has been investigated by URS (2000) and WBM (2004 - in print) and the existing sediment control structures have been shown to be effective in controlling turbid discharges from the coal terminal areas.

Dudgeon Point

The Dudgeon Point holdings are bounded to the north/north-west and south-east by the intertidal wetlands of Sandringham Bay and Louisa Creek respectively and all runoff from the holdings flows in local gullies to these areas. A significant freshwater wetland is found behind the foredune area of Dudgeon Beach (refer Figure 1-4). The catchment area of this wetland forms a significant component of the northern portion of the PCQ holdings. There are no data on background water quality for the area.

4.5.3 Coastal Processes

Potential impacts of reclamation on coastal processes have been considered for previous reclamation options at the Dalrymple Bay Coal Terminal (WBM 1996). Key features of the existing coastal processes are outlined below.

General Features

Potential reclamation areas for dredge material disposal were identified in Dames and Moore (1996) as located on the northwestern side of Hay Point. To the northeast of the DBCT causeway, the foreshore is predominantly rocky with a small upper beach fringe of coarse sand. Finer sediments overlay and are amongst the rock in the lower and flatter intertidal zone. Construction of the DBCT causeway has created a small embayment between the causeway structure and the point to the northeast.

Immediately to the southwest of the causeway, the existing DBCT revetment extends out to about the mid-tide level. Fine sediments continue out on a flat slope seaward of the revetment to the low water mark which is beyond the end of the causeway.

A small sandy beach extends from the end of the revetment wall to a rocky outcrop further to the west. There is a small embayment and offset of the general coastal alignment to the west of the rocky outcrop where the sandy beach continues in front of the township of Hector.

Normal astronomical tides at Hay Point have a high range with an extreme variation of up to about 7m. A typical spring tide range is about 5m. The area is also subject to abnormal water level variations associated with storm surges. This influences design criteria for coastal works.

Wave Climate

Wave exposure to the on-shore DBCT facilities is strongly influenced by the local topography, in particular, the presence of Hay Point to the northeast. The coastal alignment is such that direct wave exposure is only from the northerly sectors. While the fetch from these sectors is quite large, wind speeds and percentage occurrence are generally less than for the easterly and southeasterly sectors. Off-shore waves from the east to southeasterly sectors will only reach the western coastline of Hay Point after substantial refraction and diffraction and as such will be much smaller in height.

Sediment Transport

The nature of the coastal features and prevailing wave conditions at the site are such that sediment transport rates are likely to be low. Any net sediment movement will be towards the west under the influence of the prevailing wave conditions.

Evidence of a net westerly transport of sediment is supported by the general coastal alignment and features. The coastline has evolved with a series of small embayments controlled by rocky outcrops. Sediment has built up on the eastern side of these outcrops with a general landward offset of the coastal alignment to the west. This reflects a typical groyne type influence with a net westerly transport of sediment.

5 DEVELOPMENT OF OPPORTUNITIES AND CONSTRAINTS FOR SPOIL DISPOSAL SITE

5.1 Development of Constraints Map

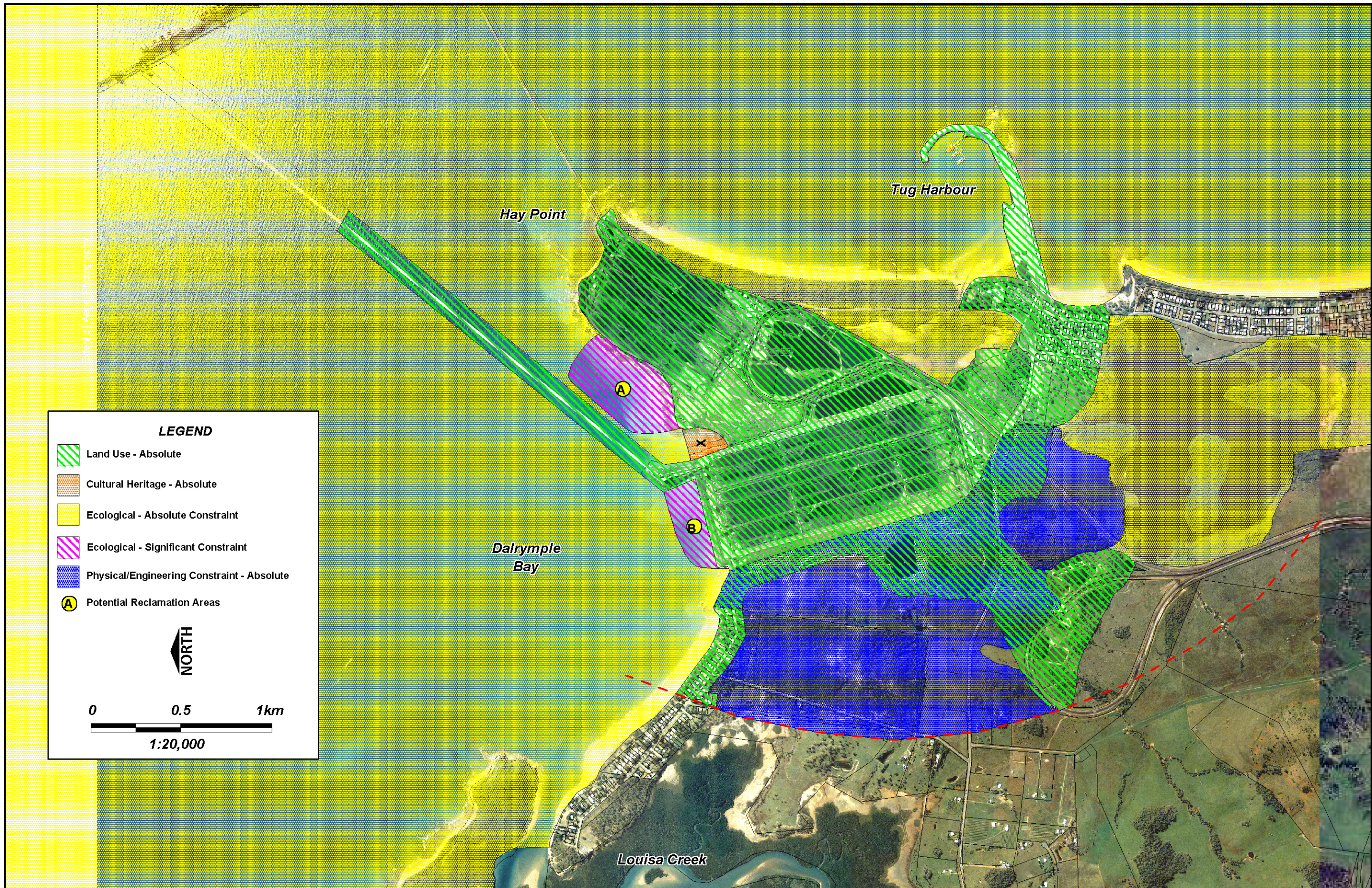
Figure 5-1 and Figure 5-2 present the constraints maps for both the Hay Point and Dudgeon Point areas based on the selection criteria presented in Table 3.1 and the existing characteristics and values presented in Section 4.

The following sections describe the rationale for determining the constraint level. Constraints have been broken into the four constraint categories as described in Table 3.1 i.e.:

- Ecological constraints (E);
- Legislative/planning/tenure constraints (L);
- Social/land use constraint (S); and
- Physical/technical/engineering constraints (P).

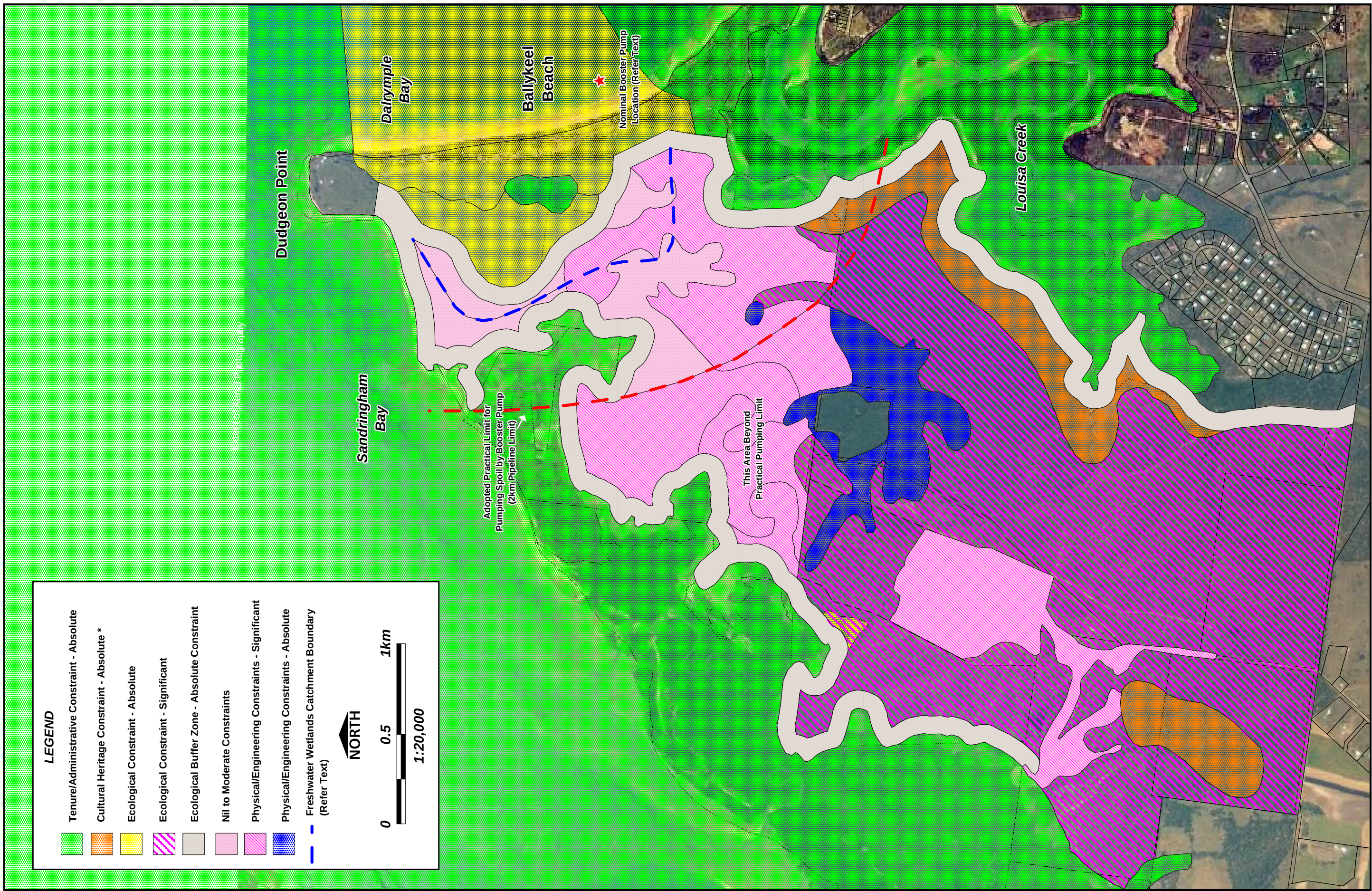
For each area mapped on Figure 5-1 and Figure 5-2, the overriding absolute or significant constraint category has been indicated.

Figure 5-1 Summary of Constraints - Hay Point



Summary of Constraints - Hay Point

Figure 5-1



* Additional to Areas of Ecological - Absolute Constraint

Summary of Constraints - Dudgeon Point

Figure 5-2

5.2 Ecological Constraints

Intertidal Flats (and adjacent sub-tidal areas)

Hay Point Area

The intertidal flats in the area to the south-east of the DBCT facilities has been identified as being of high conservation significance by McKillup and Houston (1994) and is a Category B Environmentally Sensitive Area by the EPA. This wetland had been designated as an Environmental Buffer on the PCQ Land Use Strategy.

Lake Barfield, while originally a tidal inlet, is now a freshwater system but maintains significant environmental values (and is classified as a Category B Environmentally Sensitive Area – refer Section 5.3). The unvegetated intertidal flats in Dalrymple Bay near the coal handling facilities have been considered to be of significant constraint, however there is limited ecological data for this area.

Dudgeon Point

Intertidal flats associated with the Sandringham Bay and Louisa Creek wetlands have been identified as being of major ecological value. The area is classified as a Wetland of National Importance.

Reefs/Rocky Shores

Several terrigenous rock platforms and reefs fringe the coastline, most notably being Dudgeon Point, the mouth of Louisa Creek, Hay Point, Tug Harbour and Point Victor. As indicated in WBM (2004), the EPA/DEH have stipulated a buffer width of 1 km from these areas for off-shore spoil disposal in order to meet water quality objectives based on the existing spoil ground location.

The distribution and extent of small sub-tidal patch reefs is not well known or documented in the study area. Small terrigenous patch reefs were once known to occur at the existing spoil ground, and it is possible that reefs would occur in adjacent areas. Underwater surveys would be required prior to the finalisation of any selected spoil ground site.

However, due to the relative lack of disturbance in proximity or the likely good water quality conditions that would be likely to prevail, the reef and rocky shores along Dudgeon Point and Ballykeel Beach and the rocky points at Hay Point and Half Tide have been given an absolute constraint. The rocky shores in Dalrymple Bay near the western limits of the Hay Point Services facilities have been given a significant constraint, reflecting the likely more turbid water quality. Field investigations would however be required to confirm this assessment.

Terrestrial Vegetation

Areas of Endangered and Of Concern Regional Ecosystem (whether so classified under the Vegetation Management Act or the EPA Biodiversity assessment process) have been classified as an absolute constraint. This includes areas adjacent to Lake Barfield and the foredune areas along Hay Point Beach. Other areas of remnant vegetation, both within the Hay Point and Dudgeon Point holdings have been considered as a significant constraint reflecting the condition and integrity of the communities present. The bulk of the southern area of PCQ land at Dudgeon Point falls into this category.

Terrestrial Habitat/Fauna Values

Areas frequented by significant faunal species have been identified in Section 4.4.2 and relate mainly to the intertidal wetlands (including the previously tidal Lake Barfield). Turtle nesting areas are the other absolute constraint in this regard, with frequented nesting sites identified for all beaches within the study area except Half Tide Beach. The NRA (2002) report has also identified areas of high conservation value in regard to habitat characteristics and these have been given an absolute constraint ranking.

Receiving Environmental Significance

All water bodies adjacent to catchment areas within the PCQ holdings have been allocated an absolute constraint, reflecting other ecological characteristics.

Buffer requirement

A buffer zone of 100 m width has been indicated in Figure 5-1 and Figure 5-2 around areas of high ecological value. This buffer is an absolute constraint within the Dudgeon Point holdings.

The requirement for a suitable buffer zone around areas of high ecological value at Hay Point is less clear as, in most cases, existing development lies immediately adjacent to such areas. Land use buffers of significant constraint have already been designated for the Hay Point area in the Strategic Plan.

5.3 Legislative /Planning/Tenure Constraints

Conservation/National Parks

As indicated in Section 4.3.2, a significant buffer would be required to minimise potential impacts on Mount Hector Conservation Park (to the east of the Dudgeon point holdings).

Ecological values on lands immediately to the west of the park boundary would, be likely to provide a suitable buffer width.

Fish Habitat Areas/DPI Tenure

All areas of marine vegetation have been given an absolute constraint due to ecological values.

Dugong Protection Areas

There are no Dugong Protection Areas in proximity to the study area.

Great Barrier Reef Marine Park

The boundary of the Park is approximately 5 km from the shore of the study area at the closest point and, accordingly, there is no administrative constraint in this regard.

Queensland Heritage Site

There are no listed heritage sites within or in proximity to the study area.

Places on the Register of the National Estate

Mount Hector Conservation Park and the Great Barrier Reef World Heritage Area are located within the study area, the latter extending from low tide level. This is considered to be a significant constraint to gaining the requisite approvals for reclamation in the intertidal zone.

Wetlands of National Importance

The Sandringham Bay – Bakers Creek Aggregation is listed as a wetland of national importance. Other constraints have conferred an absolute constraint to this area.

Outside Hay Point Port Limits and/or Ports Corporation Land

This has been identified on a significant constraint however the level will depend on a range of other factors.

Environmentally Sensitive Areas (EPA rating)

All ESAs have been given an absolute constraint due to factors described above.

In regard to potential impacts from contaminants within the spoil, Section 2.1.3 has indicated that no significant levels of contaminants are present within the spoil, although further testing of samples from the berth areas may be required to confirm this. At this stage, no special constraints regarding contaminants are foreseen with spoil disposal to land, however salinity levels are a major consideration for placement in terrestrial areas isolated from tidal zones.

5.4 Land Use, Social and Cultural Heritage Constraints

5.4.1 Hay Point Land

Existing land uses and proposed developments present major constraints to spoil disposal on any lands at the Hay Point coal terminal. As indicated in Figure 5-1 there are no areas in excess of 1ha with slopes of less than 5% that are not otherwise used for existing infrastructure, buffer zones or for associated water supply or water quality control. Similarly, there are no areas in proximity to the PCQ holdings at Hay Point that would potentially be available for spoil disposal due to land use, terrain and environmental factors as discussed in earlier sections.

The cultural heritage values of the area have been already affected by the developments, however the fish trap located in the cove at Point X on Figure 5-1 presents an absolute constraint to development in that area. Any foreshore reclamation within Dalrymple Bay adjacent to the existing stock yards may have recreational and visual impacts and invoke significant opposition from residents at Louisa Creek (refer Section 4.4).

5.4.2 Dudgeon Point Land

There are no significant existing land use constraints within the Dudgeon Point holdings otherwise not constrained by other issues described previously. However, as noted in Section 4.5, the area is relatively isolated in terms of accessibility and maintenance of any spoil disposal area would pose constraints in this regard. Spoil disposal may also have significant implications for any further development activity that may be planned for the area.

The cultural heritage protection zone proposed by ARCHAEO (2004) presents an absolute constraint to any form of spoil disposal within that zone. This included some items of European heritage significance near the southern limits of the cleared lands at Dudgeon Point.

5.5 Physical/Technical/Engineering Constraints

5.5.1 Dredge Operational Issues and Constraints

As is described Section 1.4, the capital dredging program for the 9.45 Mm³ of spoil material is expected to be carried out by the 'Pearl River' or equivalent size dredger. Smaller dredgers would not be economically practical for the volume of material requiring dredging within the proposed time

frame. A dredger such as the 'Brisbane' is only suitable for maintenance type or small capital programs at the Port.

Use of a dredger the size of the 'Pearl River' imposes certain constraints as follows:

- the vessel's draft imposes a minimum access depth of 12.5 m at maximum load. While the dredger may be able to be partially laden to reduce the draft, this has implications for timing of the operation. Furthermore, while access to near-shore areas may be able to be undertaken during periods outside of times approaching low tide levels, this would also affect the timing and operating efficiency of the dredging operation. Accordingly, for the purposes of this investigation, a minimum depth of 11.0 m at LAT has been allowed for as the shallowest depth within which the dredger can approach to shore. Figure 4-7 shows the closest point that may be able to be approached to on-shore areas at Hay Point, equivalent to a distance of 3.5km. A distance of 3.5km from a disposal point also represents the maximum distance that spoil material can be pumped by the dredger without the use of a booster pump placed on the discharge pipeline. This distance estimate assumes the spoil material is able to be easily pumped ie. stiff clays or muds are absent. It should be noted, however, that there may be significant quantities of clay material in the spoil, although this has yet to be determined through testwork. Should the latter be present in the material to be dredged at Hay Point, then there would be an increased need for a booster pump and the time taken for spoil pumping/discharge would increase accordingly.
- The time required for pumping to on-shore areas versus disposal at sea presents timing constraints on the dredging operation. Table 5-1 compares the typical time required for specific actions within a typical dredging cycle for on-shore disposal versus off-shore dumping. The times noted have been derived from discussions with dredger operators. This table indicates that there are significant timing implications for on-shore disposal which would be reflected in significantly increased operational costs. This aspect is address in Section 5.7.

Table 5-1 Typical Dredge Cycle Times (minutes)

	Off-shore disposal	On-shore disposal
Dredging/loading	120	120
Travel (laden)*	20	25
Turning/manoeuvring	10	10
Hook-up-discharge pipe	-	15
Discharge	10	90
Unhook discharge	-	10
Travel (unladen)	15	20
TOTAL	175	290

* based on discharge point near existing off-shore spoil ground and behind wharf area for on-shore disposal

For use of a dredger such as the 'Brisbane', operational constraints are similar to use of the 'Pearl River', however, there would be a minimum depth of 7 m for near-shore access. For this dredger, the closest the 'Brisbane' could approach to on-shore areas at Hay Point would be approximately 2.5 km from shore. The maximum pumping distance without the use of a booster pump is 2.0 to 2.5 km depending on the nature of the dredged material. Due to capacity and pumping constraints, the

timing implications for on-shore disposal versus off-shore disposal are greater for this dredger compared to the 'Pearl River' or equivalent vessel. The 'Brisbane' would also be more susceptible to significant swells affecting the pumping setup and operation.

For possible spoil disposal onto lands at Dudgeon Point, proximity of on-shore areas to the dredger is also a significant issue. Figure 4-9 indicates the closest that the 'Pearl River' and 'Brisbane' could approach the shoreline of Ballykeel Beach based on the maximum vessel drafts described earlier. In the case of the 'Pearl River', the closest point to shore based on bathymetry charts is approximately 4 km and, for the 'Brisbane', approximately 2.5 km. In both cases, a booster pump would likely be necessary. Such a pump would possibly need to be located on a pontoon or barge adjacent to the shoreline near mean low tide level. However, access to such a pump for operational and maintenance purposes would be difficult either from land or sea and the pipeline from the pump to possible on-shore disposal areas at Dudgeon Point would need to pass through areas of significant environmental value (refer Section 5.2).

5.5.2 Material Placement in Disposal Areas

Discharge of the spoil material to on-shore areas or reclamation areas adjacent to shore presents issues in regard to the following:

- the suitability of material for disposal and subsequent settlement;
- the need for surcharge of water from the settled material, both during the initial placement and on-going compaction;
- the quality of waters surcharged. While Section 2 has indicated that there is likely to be an absence of contaminating material within the spoil, there will nevertheless be typical seawater concentrations of salinity – this has implications for disposal in areas some distance from tidal zones; and
- the suitability of the deposition areas for subsequent land uses, based on the final deposited landform and stability/settlement characteristics.

An evaluation of geotechnical/spoil disposal issues in relation to the Hay Point dredging operations has been undertaken for this study by Coffey Geosciences Pty Ltd. Their report is attached in Appendix C. The implications of their findings in relation to potential spoil disposal areas are addressed in Section 5.6.1.

5.5.3 Terrain Constraints

Hay Point

As noted in Section 5.4.1, most lands at Hay Point that are currently undeveloped are too steep for any form of spoil disposal.

Dudgeon Point

115.3 ha of land at Dudgeon Point that is not otherwise classified with an absolute constraint is of a sufficiently low gradient (i.e. <5% slope) to enable some form of spoil disposal to be undertaken. Slopes in excess of 2% do however present a significant constraint in regard to establishing an effective, stable and readily managed spoil deposition area.

5.5.4 Navigation / Accessibility Constraint

Existing port infrastructure presents access constraints to potential spoil grounds at Hay Point although the pipeline can be located to prevent any significant impact on existing port operations.

5.5.5 Hydrology / Hydrodynamics and Coastal Processes

The deposition of saline spoil within an otherwise freshwater catchment presents a significant constraint in terms of management of the surcharge from the spoil disposal area. The freshwater wetlands to the immediate west of the foredune areas of Ballykeel Beach within the Dudgeon Point holdings could be significantly adversely affected by spoil disposal in the immediate catchment area.

In regard to potential reclamation at Hay Point, the off-shore area immediately to the west of Hay Point has been identified as prospective (e.g. Dames and Moore 1996). Two areas have been identified (areas A and B) and the implications of their development on coastal processes is discussed below.

Area A

Reclamation Area A would be effectively an extension to the west of the existing rocky headland of Hay Point. As discussed previously, there is a small upper beach fringe of coarse sand in this area with finer sediments overlaying and amongst the rocks with lower zones. Sediment transport is likely to be low and towards the west.

Reclamation in this area would cover this sand and interrupt any (small) transport of sand to the west. It would also alter the wave exposure immediately to the west. While these factors would have the potential to impact on the sandy beach immediately to the west, this beach is also stabilised by the existing DBCT causeway. As such, any impacts are likely to be small.

The area to the west of the existing DBCT causeway is unlikely to be affected by reclamation in Area A. This causeway extends out across the inter-tidal zone and forms an existing control to nearshore sand transport. Furthermore, wave exposure to the west of the causeway will not be affected by reclamation Area A.

While the existing foreshore in Area A will be alienated by any reclamation, public access to this area is already either difficult or restricted.

Area B

Reclamation area B would extend seaward of the existing revetment to the southwest of the DBCT causeway. Options would exist with respect to the shape of the reclamation as well as the extent seaward and along the coast towards the rocky outcrop further to the west. These options have the potential to impact to varying degrees.

Provided the reclamation does not extend further seaward than the existing causeway, sediment transport further to the west will not be influenced. The existing causeway controls sediment supply to the west.

The extent of reclamation to the west and the alignment of such reclamation has the potential to change the exposure of the adjacent beach to waves approaching from east of north. This change in wave exposure could result in an alteration to the alignment of the beach at the eastern end of the townships. This impact could be minimised by not extending the reclamation all the way to the existing rocky outcrop and incorporating a transition from the outer edge.

Reclamation options also have the potential for full or partial loss of a sandy beach. Design options can be considered to minimise the impacts.

5.5.6 Impacts of Removing Sediment from Coastal System

Land disposal of dredge material effectively removes the material from the marine environment. If this material is part of the active beach system, this can have adverse impacts on the beaches.

The proposed dredging at Hay Point is located in deep water (>10m), some 2km or more off-shore. While bed sediments in this area may be mobilised during extreme storm events, they are not part of the active beach system. As such, the removal of material from the marine environment will not have any adverse impacts on the nearshore active beach system.

5.6 Summary – Potential Area of Spoil Disposal

5.6.1 Hay Point

Establishment of Reclamation Areas

Figure 5-1 indicates that all existing land areas within the PCQ holdings at Hay Point have an absolute constraint to spoil disposal. Two areas of significant constraint have been identified, these being two potential areas for reclamation i.e. immediately adjacent to the Hay Point Services coal stock yards – Area A and adjacent to the DBCT stock yards – Area B on Figure 5-1. It needs to be recognised however that there is some degree of uncertainty in regard to the ecological values of the rocky foreshore area adjacent to Hay Point proper. Waters in this area are likely to be more turbid than the northern and eastern areas of the point. It is also possible that previous impacts from the stock yard development have reduced the values of the western foreshore area. Field investigations would be necessary to confirm the above. Area B would be an extension to the existing reclamation area of the DBCT stockyards. Given that any reclamation in these areas would desirably need to produce a final landform suitable for subsequent use by either coal terminal operator, the final height of the reclamation should reflect the existing finished level of the stock yards. Currently the north-western perimeter of each of the stock yards is bounded by a large bund so that drainage flows are all directed towards the south east to the water storage/sedimentation ponds. This approach would need to continue for any new reclamation area. Table 5-2 presents details of potential reclamation for both Areas A and B.

Table 5-2 Potential Reclamation Areas – Hay Point

	Area A	Area B
Area (m ²)	184 000	80 000
Storage depth (m) - settled	6.5	6.5
Volume (m ³)	1 200 000	520 000
Perimeter Embankment (m ³)	320 000	260 000
Time to fill ⁶ (days)	20	8.7

The total time within the overall dredging program required for filling would have implications for the overall cost and duration of the capital dredging campaign. This aspect is addressed below.

Also, filling of the reclamation areas to the required final levels could not be undertaken during the capital dredging program due to settlement of the material and requirement for surcharge. The investigation by Coffey Geosciences presented in Appendix C indicates that the final settled level of the spoil may be 1 to 3 m below the original level of the pumped slurry. Accordingly, further placement of fill would be required to bring the reclamation area to the required final level.

Coffey Geosciences have also estimated that a surcharge height in the order of 10 m would be required to reduce the in-service settlement sufficiently to allow for development to occur. It needs to be recognised that the stock yard areas need to be level to enable the stackers/reclaimers to operate efficiently. It is possible that, given the uncertain physical properties and mix of the dredged spoil due to the different origins within the proposed dredged zones, a high settlement quality suitable for coal yard development may not be able to be achieved. Other land uses may be suitable for establishment within these reclamation areas, but options in this regard have not been explored in the scope of this study.

Implications and Impacts of Reclamation Development at Hay Point

The main implications and impacts associated with the development of reclamation Areas A and B would be as follows:

- Impacts of placement of the perimeter bunds on the foreshore. The volume of rock required and placement procedures would involve a significant level of disturbance to the foreshore.
- Water quality impacts associated with surcharges from the spoil.
- Visual impacts of the reclamation, particularly Area B when viewed from Louisa Creek residential area.

⁶ Based on a deposition rate of 15,000m³/hr from pumping from the Pearl River; cycle times described in Table 5.1 and an operating day of 20hrs.

- Effects on coastal processes and the beaches of Dalrymple Bay adjacent to the Louisa Creek residential area. However, Section 5.5.5 indicates that these are not likely to be significant.
- The sourcing of quarry rock of a suitable quality for the establishment of the perimeter bunds and the impacts of cartage of the rock to the site by truck. The estimated 580,000m³ of material required to establish the bunds would require significant truck movements from the nearest quarry with a suitable rock quality for off-shore works (possibly Mt. Chelona Quarry near Sarina).
- Risks associated with management of the pumping and discharge operation. Pipeline or bund failure could have significant implications for the Dalrymple Bay environment.
- Geotechnical/settlement issues and implications for further development as noted above.
- Cost implications and effects on the overall capital dredging program. Cost issues associated with on-shore/reclamation disposal are addressed in Section 5.7.

5.6.2 Dudgeon Point

Potential Disposal Areas

Figure 5-3 indicates that there is approximately 47.7 ha of land available for spoil disposal with nil to moderate constraint (Areas C to E) and some 67.6 ha available with significant constraints (Area F). The potential volume of spoil that could be contained within Areas C to E based on a 5 m average storage depth is approximately 2.4Mm³. Coffey Geosciences have calculated overall volumes but have not taken into account some of the land use constraints subsequently identified in this report, most notably the possible need to create a final landform suitable for land development. This would be likely to significantly reduce the final storage depth requirement.

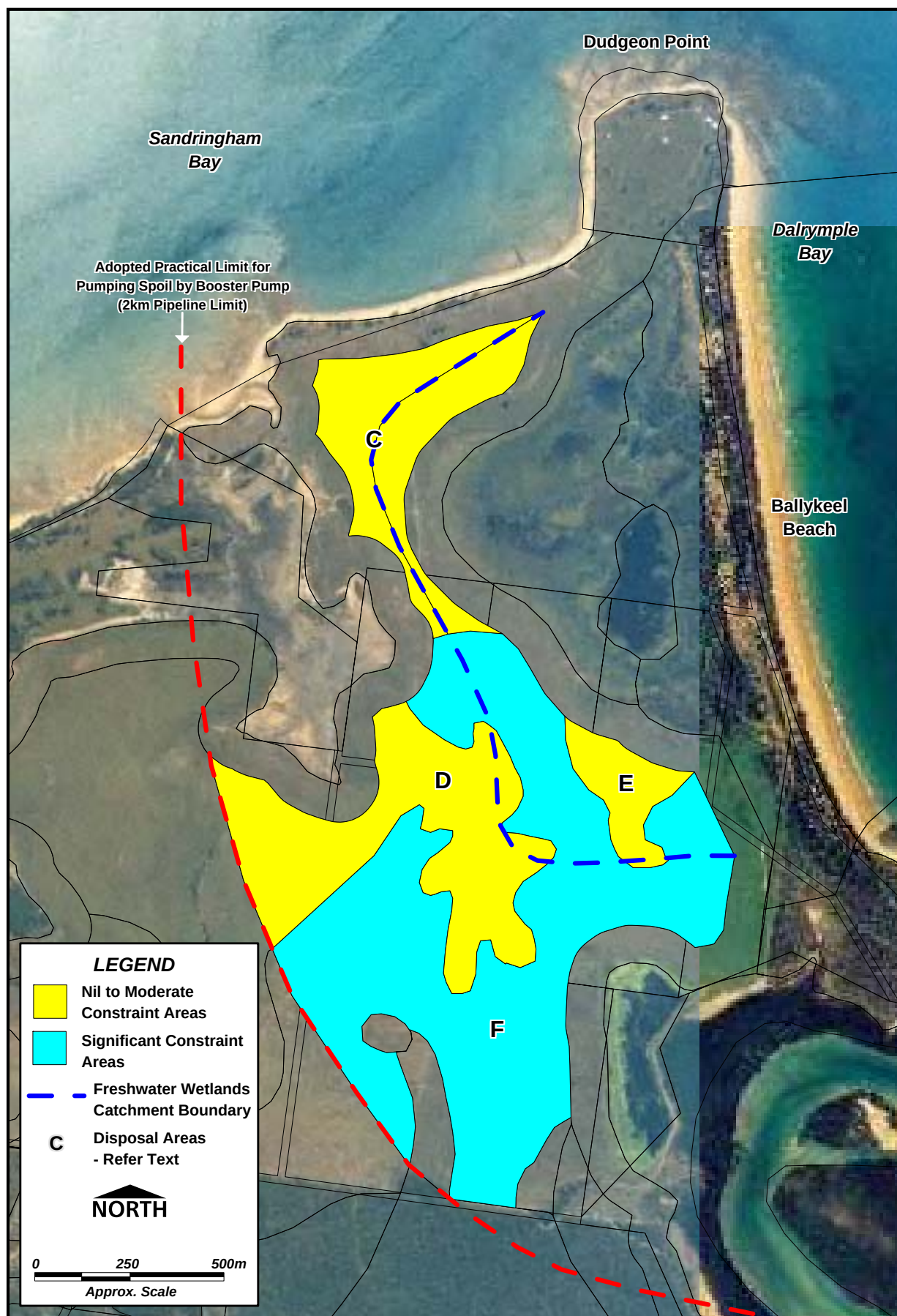
Slopes less than 2% have been identified as being of nil to moderate constraint, while slopes between 2 and 5% have been identified as a significant constraint. The drainage of saline surcharge waters from the spoil area to freshwater wetlands in the north eastern area of the Dudgeon Point land has been identified as a significant constraint that, depending on the landform and feasibility of establishing suitable containment bunds, could in fact be an absolute constraint.

Implications and Impacts of Spoil Disposal at Dudgeon Point

Based on the use of Areas C to F for spoil disposal, the following are the main implications and impacts:

- Disposal of spoil to these areas is likely to require the establishment of a booster pump near Ballykeel Beach. The additional pumping distance afforded by this pump has been based on a maximum distance of 2 km i.e. a maximum pumping distance from the 'Pearl River' of 6 km. As noted in Section 5.2, there are significant implications with establishment and operation of a booster pump in this area, particularly given the ecological significance of the beach, including its periodic use for turtle nesting, as well as the need to find a suitable pipeline route through the environmentally sensitive foredune area.
- The pumping of spoil over such a distance brings a significant level of risk particularly should pipeline failure occur.

- The establishment of spoil disposal areas on the Dudgeon Point land would have implications for any subsequent land uses that may be proposed for the area. Spoil settlement to a suitable level of compaction/stability may take a number of years depending on the physical properties of the spoil material. It is possible that significant areas of land may be alienated from further development, or require extensive earthworks subsequent to spoil disposal to create a suitable landform.
- Due to the remote location of the area, management and monitoring of the spoil disposal would be more difficult than locations closer to settled areas.
- The volume of material necessary for establishment of perimeter bunds would be significant. As for establishment at Hay Point, quarry rock may need to be sourced from a significant distance away which may cause significant local impacts on the road network.
- Time and cost on the overall dredging program require consideration and are addressed below.



**Potential Spoil Disposal Areas
Dudgeon Point**

Figure 5-3

5.7 Cost Implications of Spoil Disposal

Disposal of spoil to Areas A to F identified as potentially suitable for disposal (albeit with significant constraints as previously identified) brings with it additional costs over and above those that would apply for off-shore disposal. The additional time required for piped discharge to a shore-based disposal site (including set-up and unhooking) would increase the dredge cycle time by approximately 60% (see Section 5.5). Information received from dredging contractors have indicated that the cost of handling spoil and off-shore dumping is generally around \$2/ m³. Due to the additional time requirements for on-shore disposal, the cost would increase to \$3.25/m³.

Hay Point Costs for Spoil Ground Development

Based on 1.72Mm³ of spoil being able to be disposed of to both reclamation areas, the pumping cost rates described above are equivalent to a total of \$2.15M over and above the costs for disposal of the same volume off-shore. In addition to these costs, costs associated with construction of perimeter bunds, establishment of geofabrics and surcharge controls and management requirements (including operation of any booster pumps) would apply. It is estimated that these additional costs to establish Area A and B reclamation areas would be approximately \$16.5M and \$13.5M respectively, with a total additional cost of \$32.15M compared to off-shore disposal.

Dudgeon Point Costs for Land Based Spoil Disposal

Four areas have been identified as potentially suitable for spoil disposal at Dudgeon point. Table 5-3 provides a summary of volumes and pumping and establishment costs.

Table 5-3 Potential Spoil Disposal Areas and Costs – Dudgeon Point

Minor to Moderate Constraint Areas				
Area No.	Surface Area (m²)	Estimated Volume (m³)	Establishment costs (\$M)	Pumping Costs* (\$M)
C	140000	700000	1.35	0.875
D	245000	1225000	1.80	1.53
E	92000	460000	1.08	0.575
TOTAL		2385000	4.23	2.98
Significant Constraint Area				
F	676000	3380000	29.6	4.225

*Additional costs to disposal to off-shore areas for equivalent material volume

Estimation of the costs to establish the perimeter bunds and associated facilities for the setting up for spoil deposition presented in Table 5-3 should be considered to be a very broad estimate only due mainly to the absence of adequate existing topographic data.

As with the estimate for pumping to reclamation areas at Hay Point, utilisation of all Areas C, D and E (i.e. 2.385Mm³ of material) would involve an additional dredge spoil handling cost of approximately \$3M. Total additional costs for disposal in these three areas would then be

approximately \$7.23M over and above the costs for off-shore disposal of a similar volume of material.

For Area F (which has significant constraints), the total additional cost would be approximately \$33.8M compared with off-shore disposal. These costs would make the use of Area F not economically practical.

6 ENVIRONMENTAL APPROVALS

The following section outlines the approvals required for placement of spoil through reclamation or land disposal options outlined in Section 5.⁷

6.1 Applicable Commonwealth Legislation

6.1.1 Environmental Protection and Biodiversity Conservation Act

A referral under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* is required when it is considered the land disposal or reclamation will have, or is likely to have, a significant impact on a matter of national environmental significance (NES). Under the *EPBC Act*, matters of NES are:

- World Heritage property
- National Heritage places
- wetlands of international importance
- listed threatened species and communities
- migratory species protected under international agreements
- nuclear actions, and
- the Commonwealth marine environment.

The reclamation is within the Great Barrier Reef World Heritage area, and as such would require referral to the Commonwealth Department of Environment and Heritage (DEH). Sandringham Bay, a wetland of international significance immediately to the north of Dudgeon Point may be impacted by the land disposal. Either option would be likely to impact on listed threatened species and communities (listed marine mammal and turtle species may occur in the area), and migratory species.

Therefore, a referral would be required under the *EPBC Act*. If the project is determined to be a 'controlled action' under s67 of the Act, preliminary information would be requested by DEH. On the basis of the information provided in the preliminary information document, one of the following processes would be used to assess the reclamation:

- An accredited assessment⁸;
- An assessment on preliminary documentation;
- A public environment report;
- An environmental impact statement; or
- A public inquiry.

⁷ This advice, while designed to be comprehensive, should not take the place of legal advice. Legal advice should be sought before any actions are commenced.

⁸ For example, a bilateral agreement (in Chapter 3). A bilateral agreement between Commonwealth and the Queensland Government has recently been signed.

6.1.2 Great Barrier Reef Marine Park Act 1975

The Great Barrier Reef Marine Park (GBRMP) extends to the low water mark for much of the Queensland coastline however the Port of Hay Point lies within an exclusion zone. The Marine Park lies approximately 5km off-shore from the Hay Point Terminal. The reclamation zone is clearly not within the Marine Park, and due to the distance of the reclamation from the Marine Park, is unlikely to have either direct or indirect impacts on the Marine Park. Thus a Marine Parks permit is not required for reclamation or land disposal.

6.1.3 Indigenous and European Cultural Heritage Legislation

Commonwealth legislation that may be relevant to the preservation of cultural heritage of both indigenous people and Europeans include:

- *Australian Heritage Council Act 2003/Australian Heritage Commission Act 1975.*
- *Historic Shipwrecks Act 1976.*
- *Aboriginal and Torres Strait Islanders Heritage Protection Act 1983.*

6.2 State Legislation

6.2.1 Integrated Planning Act 1997

The *Integrated Planning Act 1997 (IPA)* outlines the assessment and approval system (IDAS) that is used for issuance of licences and permits required under, *inter alia*:

- *Coastal Protection and Management Act 1995 (Coastal Act);*
- *Environmental Protection Act 1994 (EP Act);*and
- *Transport Infrastructure Act 1994.*

A development permit must be applied for under *IPA* where the action requires approval under one or more of the above statutes.

Temporary structures needed for the pumping of spoil ashore for the land disposal option at Dudgeon Point may require assessment under the *IPA*. It is unlikely to be impact assessable under Schedule 8, however, it may need approval through code assessment. *The Standard Building Regulation 1993* (a code under the *IPA*), which regulates the construction of temporary structures. Requirements for approvals for such temporary facilities, would need to be discussed with the EPA. The *Fisheries Act 1994* will soon be incorporated in to *IPA*. When this occurs, approvals required under the *Fisheries Act* will be processed through the IDAS process. Until this time, *Fisheries Act* approvals will be processed separately.

6.2.2 Coastal Protection and Management Act 1995

6.2.2.1 Operational Works

The reclamation is likely to require approval for operational works in coastal waters for:

- o Reclaiming land under tidal water;
- o Tidal works (e.g. construction of the bund walls around the reclamation site);
- o Disposing of dredge spoil or other solid waste material in tidal water. This includes moving material under the mean high water mark to another location under tidal water;

For land disposal, approvals may be required for operational works including:

- On freehold/leasehold land above high water mark, interfering with coastal dunes on land, other than State coastal land, that is in an erosion prone area and above the high water mark; and
- State coastal land in a coastal management district above high water mark, draining or allowing drainage or flow of water or other matter across State coastal land above high water mark.

6.2.2.2 Material Change of Use

Approval is required for material change of use (MCU) (for the commencement of a new ERA on the site) completely or partly within a coastal management district, if the change of use is assessable under a planning scheme. However, should the reclamation be proposed to be within Port land (and thus covered by the Strategic Plan as amended, then this requirement may not apply - see below. Should the area for land disposal not be on Strategic Port Land, but within a coastal management district, and ERA 75 applies (see below), the MCU is assessable under the *IPA*.

Any vegetation on State coastal land must not be damaged without written approval of the entity responsible for the management and control of the land (s69(1) *Coastal Act*).

6.2.2.3 State and Regional Coastal Management Plans

The *State Coastal Management Plan*, (the State Plan) has been developed under the *Coastal Act*, and has the effect of a State Planning Policy. It describes how the coastal zone and its resources are to be managed, and uses principles and policies within the State Plan to do this. Policies which will need to be considered include, but are not limited to:

- Water Quality Policy – including acid sulfate soils and groundwater quality;
- Coastal Use and Development Policy (including dredging and associated processes);
- Conserving Nature Policy (including coastal wetlands and rehabilitation of coastal resources).

Regional Coastal Management Plans (Regional Plans) are also required as part of the Coordinated Management objective of the State Plan. Currently there is no plan, in either final or draft form, for the Whitsunday Coast Region, which includes the Mackay/ Hay Point area.

6.2.3 Environmental Protection Act 1994

An environmental authority for ERA 19 is required for either land disposal or reclamation. In consideration of the action of dredging, consideration is required of disposal of the spoil. Consideration would also be required of the *Environmental Protection Regulation 1998*, *Environmental Protection (Water) Policy 1997* (which refers to the *Australian New Zealand Guidelines for Fresh and Marine Water Quality 2000*) and the *Environmental Protection (Waste Management) Policy 2000*.

For disposal of spoil on land at Dudgeon Point, ERA 75 (Disposal of Waste) applies. Spoil to be disposed of on land comes within the broad definition under s13(1) of the *EP Act*. It may also be classed as a resource for beneficial use under the *Environment Protection (Waste Management) Regulation 2000*.

6.2.4 Transport Infrastructure Act 1994

Pursuant to the *Transport Infrastructure Act 1994 (TI Act)*, the land use Plan prepared by the Port Authority specifies details of the Strategic Port Land (SPL), any land proposed as SPL, and current and proposed uses for the land. If land is not currently included in the Plan, it may be included if it is needed for the operation of the Port, or for other specified reasons. It is likely in this case that a 'need' could be easily justified and land may be included.

Requirements under the *TI Act* include:

- approval for development below the high water mark within the limits of a port;
- for development that is inconsistent with the approved land use plan, the project must be referred to the Minister for Transport.

6.2.5 Fisheries Act 1994

Both reclamation and land disposal may require approvals under the *Fisheries Act* for placement of spoil involving the removal or disturbance of marine plants (including seagrass, mangroves, saltcouch and algae) within State waters.

Under the current legislative situation, an application to DPIF under s51 of the Act may be required. It is possible, however, that by the time an application is to be made, certain approval processes within the *Fisheries Act* will have been rolled into the *IPA*.

6.2.6 Tenure

During the process of seeking advice for other approvals, the views of the Department of Natural Resources and Mines (DNRM) would need to be sought regarding the tenure of the subject land, especially with respect to the creation of new land through reclamation. Prior to reclamation, advice from DNRM that appropriate tenure had been established, or would be granted in the form of a 'permit below high water mark' or as some other form of tenure under the *Land Act 1994*, would be required for subsequent approvals to be granted.

Consideration of land tenure by DNRM would also involve consideration of native title issues.

6.2.7 Other Considerations

Other considerations for land disposal may include:

- Application of the *Vegetation Management Act 1999*, however, it is not likely that the land disposal will disturb any remnant vegetation at Dudgeon Point as mapped by the Queensland Herbarium. The possible route for a pipeline may require consideration however.
- The *Nature Conservation Act 1992* aims to conserve nature (protected areas and protected wildlife) through integrated management and conservation. Under the Act, areas requiring protection include National Parks, Conservation Parks, World Heritage Management Areas and International Agreement Areas. The associated Regulation categorises species of conservation significance i.e. Endangered wildlife, Vulnerable wildlife, etc., and for each category there is a management intent. There are various offences under the Act for interfering with protected plants or animals located within areas of major interest. There are a number of species of conservation significance that may occur in the general area.
- For conservation of biodiversity through the use of regional ecosystems by the EPA.

Land disposal and reclamation may both require consideration of:

- The *Aboriginal Cultural Heritage Act 2003*, which seeks to protect and manage Aboriginal cultural heritage through the use of cultural heritage management plans that may be prepared voluntarily or required for certain high impact activities. The implications for the proposed new spoil site are unlikely to be significant at this stage, however it may be an expectation that at some time in the future, an overall cultural heritage plan be prepared that addresses all of the Port's activities.
- The *Queensland Heritage Act 1992*, which applies to protection of areas, relics etc. listed on the State's Heritage Register. There are no European heritage sites as listed on the EPA Heritage Register in proximity to the Hay Point area. Accordingly, this criterion was not further considered. There is no publicly available register regarding items or places of Aboriginal cultural heritage significance, but it is considered unlikely that there would be any items within the study area that could potentially be affected by spoil disposal operations. The Environmental Policy for Queensland Ports will apply to the spoil disposal and would be implemented under the framework of the land use plan. For either land disposal or reclamation, the land use plan will need to be revised.

For tidal works and reclaiming land under tidal water, the Regional Harbour Master must be consulted for navigational and maritime management purposes.

6.2.8 Assessment Manager and Referral Agencies

The Port Authority is the assessment manager (AM) for all development on SPL, regardless of the development's consistency with the land use plan. The local government should be consulted in any amendments to the land use plan.

Because the PCQ Dudgeon Point land is not Strategic Port Land, the Sarina Shire Council would be the Assessment Manager.

With respect to developments within port limits in tidal waters, the EPA will be the AM. Ports Corporation of Queensland will be the concurrence agency. PCQ will be an advice agency for all other assessable development within port limits and below the high water mark.

6.2.9 State Development and Public Works Organisation Act 1971

It should be noted that if the reclamation/land disposal, in conjunction with the capital dredging, is declared a “significant project” under the State Development and Public Works Organisation Act 1971 (*SDPWO Act*) (s29), then provisions within the *SDPWO Act* are enabled, which coordinate a whole-of-government approach to assessment of environmental impacts. This approach is nevertheless underway with the EIS process currently being undertaken.

7 SUMMARY – SPOIL DISPOSAL OPPORTUNITIES AND CONSTRAINTS AND RECOMMENDATIONS

The preceding section has indicated that the following potential spoil deposition areas may be suitable to varying degrees in the study area.

7.1 Hay Point Spoil Disposal

Two potential areas for spoil disposal (Areas A and B) have been identified to the north-west of the HPCT and DBCT stock yards. All other areas within the Hay Point Study Area have major constraints to the establishment of a spoil disposal ground.

Area A is located adjacent to the HPCT stock yards and, based on the deposition of spoil to create a useable landform for future stock yard development, a volume of 1,200,000m³ of spoil could be contained within the area. Area B is located adjacent to the previously reclaimed area of the DBCT stockyards. As above, to create a useable land surface, approximately 520,000m³ of spoil could be contained in this area.

Based on the existing bathymetry charts, a dredger such as the 'Pearl River' would need to anchor at least 3.5 km off-shore from the discharge point and pump without a booster pump to either Area A or B via a pipeline placed on the seabed, passing below the DBCT off-shore conveyor. The costs to establish the perimeter bunds, berms and associated geofabrics and surcharging facilities has been estimated to cost some \$16.5M for Area A and \$13.5M for Area B. Additional costs associated with pumping of the material to either area have been estimated to be around 60% greater than off-shore dumping. While actual pumping rates would need to be determined by the operators of the dredger, initial advice has indicated that off-shore dumping costs are generally around \$2/m³, while shore based disposal is generally around \$3.25/m³. Based on the volumes able to potentially be deposited in Areas A and B, this represents an additional cost compared to off-shore dumping of \$1.5M and \$650,000 respectively.

Total additional costs for disposal in the reclamation areas thus represent a total of \$18M for Area A and \$14.15M for Area B.

In addition to these major cost requirements, the following describes and reiterates various issues and potential constraints to development of either of the reclamation areas identified previously in this report:

- **Ecological Issues**

There is some uncertainty over the environmental values of the footprint area of Area A, particularly the condition of the impacted rocky shoreline. Development of this area would essentially remove approximately 18 ha of unvegetated, but possibly productive intertidal flats. Detailed surveys would be required to assess the ecological values of this footprint area and adjacent area that may be indirectly impacted by the reclamation. The environmental values of Area B are likely to be less significant, however the proximity to Louisa Creek Beach and possible turtle nesting areas raises significant environmental concerns. It should be noted that the investigation by QPWS (2003) recorded the presence of two green turtles foraging adjacent to this area.

- **Social/Land Use Issues**

Area B in particular is close to the residential area of Louisa Creek. Given the significant community opposition to previous reclamation proposals in Area B, it is considered likely that further reclamation proposals in this area will also face significant opposition. Also, the requirement to obtain some 580,000m³ of quarry rock from local sources and trucking to the site may cause significant local amenity issues as well as depleting viable sources of hard rock in the region.

- **Engineering/Technical Issues**

There are a number of issues that require further consideration in the assessment of the overall feasibility of establishing the reclamation areas i.e.:

- i. The geotechnical assessment has indicated that settlement of the deposited spoil may be significant and additional placement of a capping layer would be required some time later to achieve a suitable ground surface. Also, pre-loading material up to 10 m high would be required some time later to achieve a suitable surface condition for an extension to the stock yards.
- ii. The probable significant variability in the physical quality of the dredged spoil has implications for both the efficiency and costs of pumping and settlement of the material.
- iii. There are risks (e.g. pipeline failure) associated with pumping of spoil over such a distance.
- iv. The dewatering process may have significant implications for water quality management.

Based on the above assessment, these are considered to be major constraints to the establishment of reclamation Areas A and B.

7.2 Dudgeon Point Spoil disposal

An area of approximately 477 ha has been identified in the PCQ land holdings at Dudgeon Point as being without significant constraints to spoil disposal, primarily based on on-site factors. A further 67.6 ha has been identified as having significant constraints, mainly in regard to slopes being greater than 2%, but less than 5%.

The costs of disposal of spoil in Areas C to E at Dudgeon Point (i.e. the areas that have minor to moderate constraints to spoil disposal - a total of 2.385Mm³ of material) have been estimated to be approximately \$3M over and above the costs of disposal off-shore. The additional establishment costs of development of the spoil disposal sites in these areas would add an additional \$4.23M. For Area F (i.e. the area at Dudgeon Point that has significant constraints to spoil disposal mainly due to the steepness of the terrain), the total additional cost would be approximately \$33.8M.

Similar to the Hay Point assessment previously presented, there are various issues and potential constraints to the development of these reclamation areas, which have been identified previously in this report:

- **Ecological Issues**

Areas C to F have negligible environmental values. However, placement of spoil in the eastern catchment of Area C may have significant implications for nearby freshwater wetlands. Site investigations would need to be conducted to ascertain whether saline flows from the spoil could be diverted from these wetlands. The location of the spoil pipeline over Ballykeel Beach may

have significant implications for turtle nesting and access, particularly if a booster pump is required (as is likely) to be located on the tidal foreshore areas of this beach. Access and on-going maintenance of the pipeline may also impact on an area of major ecological value that is otherwise rarely visited by the general public.

- **Social/Land Use Issues**

The assessment of potential volumes of deposition for Area C to F has been based on a final settled depth of 5 m. While this is practically achievable, this has significant implications for any further development that may be proposed for the Dudgeon Point area, particularly if material quality is highly variable and, consequently, the settlement characteristics and final landform is not suitable for certain types of development.

- **Engineering/Technical Issues**

The disposal of spoil in Areas C or D would require a pipeline up to a 5.5 km long from the dredger, and thus a booster pump would be necessary. There are significant risks of operational failure in a pipeline of this length and any uncontrolled release of the spoil may have significant consequences for the intertidal ecosystems.

Based on the above, while pumping of spoil to the on-shore area of Dudgeon Point is technically achievable, there are major costs, and technical and environmental constraints and risks associated with this approach.

For all potential spoil disposal areas described in this report (i.e. Areas A to F), the costs and potential environmental issues and impacts associated with this approach will need to be carefully compared to the costs and impacts associated with off-shore disposal. The major costs associated with spoil disposal in Area F would remove this area from further consideration.

7.3 Conclusion

This report has indicated that there are significant environmental, engineering and cost constraints to spoil disposal in any of the designated Areas A to E. Even if all Areas A to E could be utilised for spoil disposal, the bulk of the dredged material would still need to be disposed off-shore. While the environmental assessment of the impacts of off-shore disposal has yet to be completed, it is clear that there are no clear environmental benefits in undertaking on-shore disposal nor are there any suitable options for reuse of the spoil material. Indeed, the impacts of on-shore disposal are likely to be significant, particularly on areas adjacent to the disposal areas. Such disposal would also have a major cost and timing implications for the dredging program.

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APPENDIX A: KEY DATA SOURCES USED TO ASSESS CRITERIA

Constraint	DATA SOURCE
Ecological	
1) Intertidal Flats	PCQ map/QDPI
2) Intertidal flats- fauna habitat / values	PCQ, Dames and Moore 1996, URS 2000, NRA 2002, McKillup and Houston 1994, Coles 1993, WBM (various), Turtle Watch
3) Reefs/rocky shores	PCQ map, QDPI CHRIS, Dames and Moore 1996
4/5) Terrestrial vegetation/ habitats	PCQ map and QDPI CHRIS, Coles 1993, 2001
6/7) receiving environment significance/ buffer requirement	NRA 2002, GHD 2003, EPA (ESA)
Legislative/Planning/Tenure	
1) Conservation/National Parks	QPWS, EPA,GBRMPA
2) Fish Habitat Areas	QDPI
3) Dugong Protection Areas	EPA
4)Great Barrier Reef Marine Park	GBRMPA
5) Queensland Heritage (incl cultural heritage) site	EPA
6) Ramsar wetland	PCQ map/DEH/EPA
7) Places on Register of National Estate/GBRWHA	GBRMPA/DEH
8) Wetlands of National Importance	DEH
9/10) Outside Hay point Limits/ Strategic Port Land	PCQ
11) Environmentally Sensitive Area	EPA
Social/ Land Use	
1) Proximity to residences	PCQ liaison, Existing reports
2) Existing use effects	EIS's, existing reports
3) Recreational areas/ fishing	QDPI
4) Noise/ dust	Existing EIS reports
5)Visual / landscape	Dames and Moore 1996
6)Cultural heritage	ARCHAEO 2004/ URS 2000
7)Future land use opportunities	GHD 2003; PCQ liaison
Physical/Technical/Engineering	
1) Slope/ stability of spoil site	PCQ reports, NRM data, GHD 2003
2) Area/volume/ consolidation available	Topo data
3) Drainage	EPA/ topo data
4) Erosion prone areas	EPA, WBM reports (various)
5) Dredge manoeuvrability -discharge	Dredger operators
6) Pumping distance/ material handling	Dredger operators
7) Establishment	Dredger operators
8)Risks/ equipment failure	Various
9)Opportunities for material reuse	Coffeys
10) Navigation areas	Regional Harbourmaster
11) Currents and waves	WBM reports

APPENDIX B: REGIONAL ECOSYSTEMS – HAY POINT AREA

8.1.1:NOC/NCAP*: Open-shrubland to closed forest of mangrove species forming a variety of associations, depending on their position in relation to tidal channels and the amount of freshwater input they receive. The seaward edge and fringe of waterways is often dominated by *Rhizophora* spp. Landward of the *Rhizophora* zone a variety of species occur together or in a mosaic and include *Avicennia marina*, *Bruguiera* spp., *Rhizophora* spp., *Excoecaria agallocha*, *Xylocarpus moluccana*, *Lumnitzera racemosa*, *Ceriops* spp. and *Osbornia octodonta* (pure stands of *Avicennia marina* often occur within this). Higher tide and spring tide areas adjacent to saltpans often support pure stands of *Ceriops* spp. The mistletoe *Lysiana maritima* is common throughout the mangrove associations, and occasional epiphytes include *Dendrobium discolor*, *Drynaria rigidula*, and *Platyserium bifurcatum*. The ground layer includes *Sporobolus virginicus*, *Acrostichum speciosum*, and *Crinum pedunculatum*. Occurs on edge of coast and waterways within the tidal zone.

8.1.2:OC/OC: Salt pans and mudflats with clumps of saltbush including one or several of the following species; *Sesuvium portulacastrum*, *Halosarcia indica* subsp. *julacea*, *H. indica* subsp. *leiostachya*, *H. halocnemoides* subsp. *tenuis*, *H. pergranulata* subsp. *queenslandica*, *Sarcocornia quinqueflora* subsp. *quinqueflora*, *Suaeda australis*, *S. arbusculoides*, *Tecticornia australasica* and *Sporobolus virginicus* and sedges including *Cyperus polystachyos* var. *polystachyos*, *C. scariosus*, *Fimbristylis ferruginea*, *F. polytrichoides*. Occurs on plains adjacent to mangroves with soils consisting of marine sediments. There is salt accumulation at the soil surface from evaporation of sea water which inundates these areas during the higher tides.

8.12.22: NOC/NCAP: Woodland usually dominated by *Eucalyptus drepanophylla*, and usually one to several of the following species; *E. platyphylla*, *Corymbia clarksoniana*, *E. exserta*, *C. trachyphloia* and *C. dallachiana*. Includes small areas of *E. portuensis* and *C. intermedia*, and occasional low open stands of *E. melanophloia*. *Lophostemon confertus* is often present as a secondary tree layer. There is usually a tall shrub layer with typical species including *Planchonia careya*, *Acacia flavescens*, *Glochidion lobocarpum*, *Timonius timon* and *A. leptocarpa*. A low shrub layer of *Xanthorrhoea* (Indet. taxa) is usually present (and sometimes *Cycas media*). The ground layer is dominated by *Heteropogon triticeus*, *Themeda triandra* and *Mnesithea rottboellioides*, *Sorghum nitidum* forma *aristatum*, *H. contortus*, *Flemingia parviflora*, *Chrysopogon fallax* and *Imperata cylindrica*. Occurs on hills and ranges on Mesozoic to Proterozoic igneous rocks at low to moderate altitudes, in drier areas. Contains minor areas of Tertiary acid volcanics (land zone 8).

8.2.13: Endangered/Endangered: *Corymbia tessellaris*, *Melaleuca* spp. *Livistona decipiens* and/or *Acacia* spp. and/or *Lophostemon suaveolens* open to closed forest on sand dunes. Occurs on dune sands mixed with alluvial material ± marine sediments. Major vegetation communities include:

8.2.13a: *Corymbia tessellaris*, *Melaleuca* spp., *Livistona decipiens*, *Corymbia intermedia*, *E. tereticornis* open forest. Some areas of *Acacia* spp. closed forest with

C. tessellaris. Occurs in near coastal situations on dune sands mixed with alluvial material and marine sediments (subregion 2).

8.2.13b: *Melaleuca quinquenervia* and/or *Lophostemon suaveolens* ± *Livistona decipiens* on interface of dunes with adjoining land zones. Occurs on interface of dunes with adjoining land zones (subregions 4 and 5).

8.2.6: OC/OC:*Corymbia tessellaris* open-forest (usually the sole canopy species, although *Melaleuca dealbata* is common in some areas, and *Acacia leptocarpa* may sometimes reach canopy level). There are a few areas (e.g. Cape Palmerston) with a dense overstorey of *Allocasuarina littoralis*. The mid-layer is variable depending on the depth of sand, exposure to wind/salt spray, and protection from disturbance such as fire. Some areas have a well developed beach scrub (microphyll rainforest) secondary layer including species such as *Jagera pseudorhus*, *Chionanthus ramiflora*, *Exocarpos cupressiformis*, *Pleiogynium timorense* and *Alphitonia excelsa*, whilst other areas are more open with *Acacia leptocarpa* and *Banksia integrifolia*. The ground layer is usually sparse, with common species including *Imperata cylindrica*, *Heteropogon triticeus*, *Themeda triandra*, *Lomandra longifolia*, and *Dianella caerulea*. *Xanthorrhoea johnsonii* is sometimes present. Occurs on coastal parallel dunes, excluding the strand and exposed front of foredune.

Major vegetation communities include:

8.2.6a: *Corymbia tessellaris* ± *Acacia leptocarpa* ± beach scrub species open forest. Occurs on parallel dunes (subregions 1, 2 and 6).

8.2.6b: *Corymbia tessellaris* ± *Livistona decipiens* ± beach scrub spp. open forest. Occurs on parallel dunes (subregions 4 and 5).

*Status: Vegetation Management Act/ Regulations: NOC- Not of Concern; OC- Of Concern; E- Endangered
EPA Biodiversity Assessment: NCAP: No Concern at Present; OC- Of Concern; E- Endangered

8.2.7: Of Concern/ Endangered: Complex of dune swales and low lying sandy/swampy wetlands which include pure stands of *Melaleuca leucadendra* in swamps adjacent to parabolic dunes, parabolic dune swales with *M. leucadendra* and other *Melaleuca* spp., broad swampy areas on sand with *M. leucadendra*, *Corymbia tessellaris*, *C. intermedia*, *Eucalyptus tereticornis* and *Livistona decipiens*, and buried swales with *Melaleuca leucadendra*. Also includes areas dominated by *Lophostemon suaveolens*. Also includes small perched wetlands. Occurs on parabolic dunes, low lying undulating areas with sandy soil consisting of mixtures of beach sand and alluvial material.

Major vegetation communities include:

8.2.7a: *Melaleuca leucadendra* open forest in near-coastal wetlands. Occurs on parabolic dunes (subregions 1 and 2).

8.2.7b: *Eucalyptus robusta*, *Melaleuca quinquenervia* swamp with dense understorey of wet heath, or wet heathland/sedgeland. Occurs on parabolic dunes (subregions 4 and 5).

8.2.7c: *Lophostemon suaveolens* ± *Corymbia intermedia* ± *Corymbia tessellaris* ± rainforest spp. open woodland to open forest. Occurs on sand associated with parabolic dunes (subregions 4 and 5).

8.2.7e: *Melaleuca leucadendra* and/or *M. quinquenervia* and/or *M. dealbata* and/or *M. sp.aff. viridiflora* open forest. Occurs in near -coastal wetlands and swales associated with parabolic dunes (all coastal subregions).

8.2.1:OC/OC: *Casuarina equisetifolia* forest to woodland, to isolated clumps of trees, with a secondary tree layer of *Thespesia populnea*, *Sophora tomentosa*, *Pandanus tectorius*, *Hibiscus tiliaceus*, *Terminalia muelleri*, *Alphitonia excelsa*, and *Caesalpinia bonduc*, and shrub layer of *Vitex trifolia*, *Clerodendron inerme*, *Cupaniopsis anacardioides* and *Argusia argentea*. The ground layer usually includes *Thuarea involuta*, *Ipomoea pes-caprae*, *Spinifex sericeus*, *Canavalia rosea* and *Cyperus pedunculatus*. Includes the upper beach zone which consists of a low hermland of *Ipomoea pes-caprae*, *Spinifex sericeus*, and *Canavalia rosea*. In subregions 4 and 5 this unit includes small areas of wind-sheared heathland (*Casuarina equisetifolia*, *Pandanus tectorius*, *Petalostigma pubescens*, *Phebalium nottii* - *P. woombye* (F.M. Bailey) Domin) and shrublands dominated by *Acacia aulacocarpa*. Occurs on Quaternary coastal foredunes and beaches.

8.2.2:OC/Endangered: Microphyll vine forest (beach scrub). Characteristic species include *Mimusops elengi*, *Ganophyllum falcatum*, *Diospyros geminata*, *D. compacta*, *Pouteria sericea*, *Pleiogynium timorense*, *Drypetes deplanchei*, *Eugenia reinwardtiana*, *Cupaniopsis anacardioides*. Occurs on coastal dunes.

8.3.13:OC/Endangered: Open-woodlands with *Melaleuca viridiflora* and/or *M. leucadendra* usually adjacent to estuarine communities. Ranges from open-woodland to closed forest to wetlands. Includes *Imperata cylindrica*, *Ischaemum* spp. and *Leersia hexandra*. Also includes woodlands of *Corymbia tessellaris* and/or *Eucalyptus tereticornis* (and frequently *E. tereticornis* × *platyphylla* hybrids) often with *Melaleuca dealbata* (sometimes pure stands of *M. dealbata*), over a dense grassy layer of *Sorghum nitidum* forma *aristatum*, *Ischaemum* spp, *Chrysopogon filipes* and *Leersia hexandra*. Occurs on marine and alluvial plains adjacent to estuarine areas.

Major vegetation communities include:

8.3.13a: Mixed *Melaleuca* woodlands. Occurs on marine plains or alluvial plains, usually adjacent to estuarine areas

8.3.13b: *Melaleuca dealbata* woodland with grassy understorey. Occurs on swampy marine or alluvial plain adjacent to mangroves.

8.3.13c: *Eucalyptus tereticornis* and/or *Corymbia tessellaris* woodland with a secondary tree layer of *Melaleuca* spp.. Occurs on marine and alluvial plains adjacent to estuarine areas.

8.3.13d: *Eucalyptus tereticornis* and or *C. tessellaris* woodland. Occurs on marine and alluvial plains adjacent to estuarine areas.

8.3.2: Endangered/Endangered: *Melaleuca viridiflora* woodland,with *Corymbia clarksoniana* or *C. intermedia* as an emergent or subdominant. Other overstorey species may include *Acacia leptocarpa*, *Eucalyptus platyphylla*, *E. exserta* and *Pandanus* (Indet taxa). A secondary tree layer is sometimes present and usually consists of juvenile *Melaleuca viridiflora*, and scattered *Acacia leptocarpa*. A sparse shrub layer is sometimes present, usually consisting of *M. viridiflora* juveniles, *Planchonia careya*, *Acacia leptocarpa*, and *Petalostigma pubescens*. The ground layer is dense and very diverse. Common dominants include *Ischaemum* spp., *Imperata cylindrica*, *Eremochloa bimaculata*, and *Themeda triandra*. Other common herb species include *Fimbristylis dichotoma*, *Fimbristylis cinnamometorum*, *Chrysopogon fallax*, *Paspalum scrobiculatum*, *Flemingia parviflora*, *Heteropogon triticeus*, *Scleria brownii*, *Abildgaardia ovata*, *Dianella longifolia*, and *Murdannia gigantea*. Occurs on seasonally inundated alluvial plains.

8.3.5: OC/Endangered: *Corymbia clarksoniana* woodland to open-forest, often with *Lophostemon suaveolens* and/or *Eucalyptus platyphylla* and/or *C. dallachiana*, and sometimes with *E. drepanophylla*. Includes areas with almost pure stands of *Eucalyptus platyphylla*, and a few areas which are pure stands of *L. suaveolens*. Occasionally *Livistona decipiens* is prominent. A sparse to mid-dense secondary tree layer of *Melaleuca viridiflora* is sometimes present. There is usually a sparse shrub layer of *Planchonia careya*, *Alphitonia excelsa*, *Glochidion lobocarpum* and *Acacia leptocarpa*. The ground layer is commonly dominated by *Heteropogon triticeus*, *Sorghum nitidum* forma *aristatum*, *Lomandra longifolia*, *Heteropogon contortus* and *Themeda triandra*.

APPENDIX C: GEOTECHNICAL EVALUATION OF SPOIL DISPOSAL – COFFEY GEOSCIENCES