AQUIS RESORT AT THE GREAT BARRIER REEF PTY LTD

ENVIRONMENTAL IMPACT STATEMENT

VOLUME 3

CHAPTER 22

MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

22. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

22.1 BACKGROUND INFORMATION

22.1.1 Scope

The ToR require that this chapter, in addition to forming part of the overall EIS, should be a stand-alone document. Accordingly, relevant information extracted from other chapters is included in the Project Background discussion (**Section 22.1.6**) below, namely:

- study area and project area
- the site
- the proposed project
- consideration of prudent and feasible alternatives.

In addition, material on environmental management (**Chapter 23** – Environmental Management Plan) is included, along with all relevant references from **Chapter 27** (References) relating to matters of national environmental significance (matters of NES).

22.1.2 Ministerial Decision

The final (corrected) decision notice dated 8 May 2014 advised that a delegate of the Commonwealth Minister decided that:

- the Aquis Resort project constitutes a controlled action under Section 75 and 87 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act)
- the assessment would be undertaken under this EIS as an accredited assessment under the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act).

Section 75 of the EPBC Act deals with the decision regarding a controlled action and associated administrative mattes (e.g. public consultation) and Section 87 deals with the subsequent assessment process.

Relevant controlling provisions are described in **Section 22.1.5**. These are the subject of the assessment described in this chapter.

22.1.3 Controlling Provisions of the EPBC Act

Matters of NES are defined under Part 3 of the EPBC Act, namely:

- World Heritage properties (sections 12 and 15A)*.
- National Heritage places (sections 15B and 15C)*.
- Wetlands of international importance (sections 16 and 17B).
- Listed threatened species and communities (sections 18 and 18A)*.
- Listed migratory species (sections 20 and 20A)*.
- Protection of the environment from nuclear actions (sections 21 and 22A).
- Commonwealth marine environment (sections 23 and 24A) – includes listed marine species.
- Great Barrier Reef Marine Park (sections 24B and 24C)*.
- A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E).

- The environment, if the action involves Commonwealth land (sections 26 and 27A), including:
  - actions that are likely to have a significant impact on the environment of Commonwealth land (even if taken outside Commonwealth land)
  - actions taken on Commonwealth land that may have a significant impact on the environment generally.
- The environment, if the action is taken by the Commonwealth (section 28).
- Commonwealth Heritage places outside the Australian jurisdiction (sections 27B and 27C).

Controlling provisions determined by a delegate of the Commonwealth Minister are marked with an asterisk (*) and are described in **Section 22.1.5**. These are the subject of this chapter.

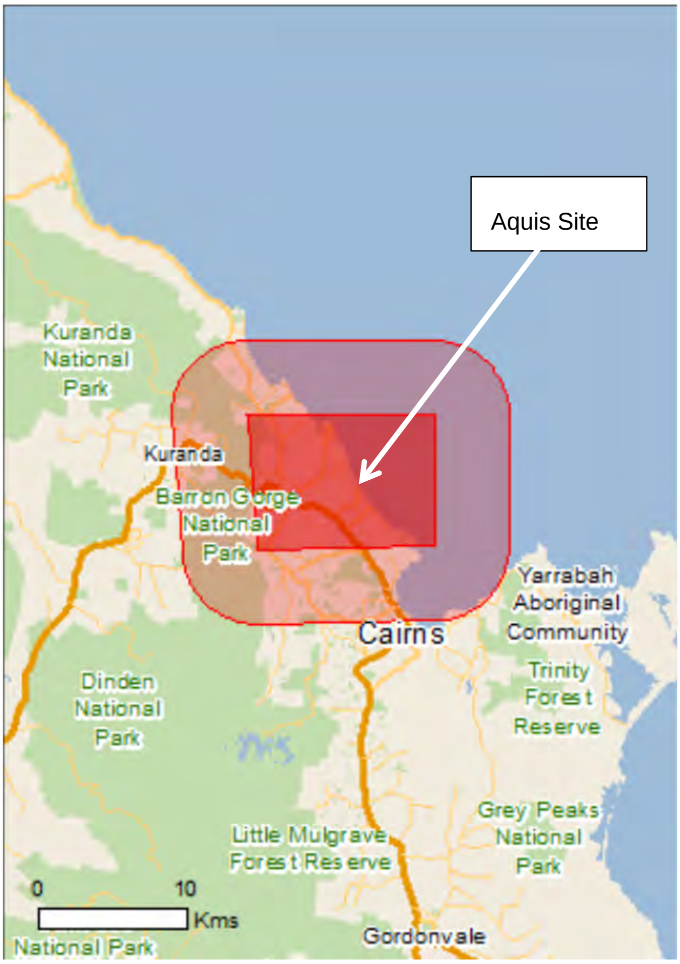
22.1.4 Protected Matters Search

a) Search Area

A protected matters search using the EPBC Act online search tool was undertaken on 26 May 2014 for the following latitude and longitude coordinates (with a 5 km buffer):

- -16.797125, 145.671748.
- -16.797125, 145.785388.
- -16.872376, 145.785045.
- -16.874348, 145.678271.

This search area is shown on **Figure 22-1** which is extracted from the protected matters search report (**Appendix I**).



Search area (+ 5 km buffer):

-16.797125, 145.671748

-16.797125, 145.785388

-16.872376, 145.785045

-16.874348, 145.678271

Figure 22-1 EPBC Act protected matters search area 26 May 2014.

b) Findings

The protected matters search (**Appendix I**) reveals the following matters of NES on or near the Aquis Resort site (i.e. within a 5 km buffer). Results are shown in **Table 22-1**.

TABLE 22-1 PROTECTED MATTERS SEARCH OUTPUT SUMMARY

Matters of NES		Other matters protected by the EPBC Act	
World Heritage Properties:	2	Commonwealth Land:	2
National Heritage Places:	3	Commonwealth Heritage Places:	1
Wetlands of International Importance:	None	Listed Marine Species:	114
Great Barrier Reef Marine Park:	2	Whales and Other Cetaceans:	12
Commonwealth Marine Areas:	1	Critical Habitats:	None
Listed Threatened Ecological Communities:	2	Commonwealth Reserves Terrestrial:	None
Listed Threatened Species:	48	Commonwealth Reserves Marine	None
Listed Migratory Species:	55		

Source: EPBC Act protected matters search undertaken 26 May 2014. See **Appendix I**.

Those matters of NES that are mappable are shown on **Figure 22-2**. Note that not all of these have been designated as relevant controlling provisions (see **Section 22.1.5**).

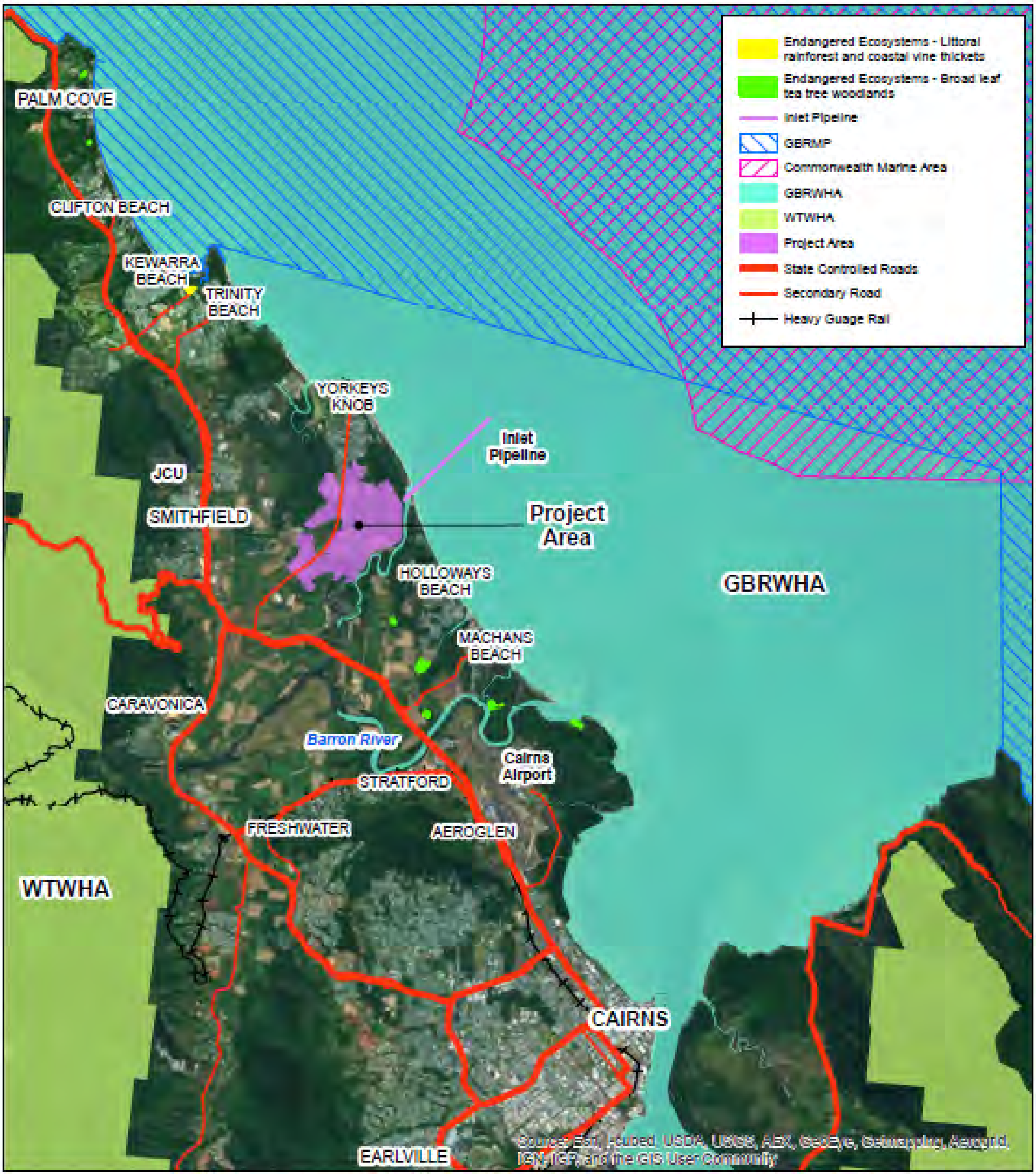


Figure 22-2 Location of mappable matters of NES. Note that not all of these matters of NES have been designated as relevant controlling provisions (see **Section 22.1.5)**.

c) *Spatial Assessment*

A GIS analysis of the data upon which this figure is based shows that the Aquis Resort site:

- is not within any area that is a matter of NES (although maps show that a small creek running into Richters Creek from the Aquis Resort site may actually include the 'low water' line)
- is adjacent to the GBRWHA (at its nearest point – Richters Creek – the site is basically adjacent to the boundary)
- is 3.5 km from the GBRMP
- is 6.3 km from the Commonwealth marine area
- is 2.5 km (line-of-sight) from the WTWHA (approximately 8.4 km via the Richters Creek / Thomatis Creek and Barron River corridor)
- is 1.1 km from the nearest listed ecological community.

It also shows that the lake inlet pipeline:

- lies almost entirely within the GBRWHA
- at its nearest is 1.9 km from the GBRMP
- at its nearest is 4.1 km from the Commonwealth marine area.

Figure 22-3 – extracted from the draft *Great Barrier Reef Region Strategic Assessment Report* produced by the Great Barrier Reef Marine Park Authority in August 2013 (GBRMPA 2013a) – shows diagrammatically the spatial extent of matters of NES near a typical coastal site such as the Aquis Resort with the exception of the WTWHA. Adjacent to Yorkeys Knob this WHA commences at the foothills that would lie well to the left of the area covered by this schematic.

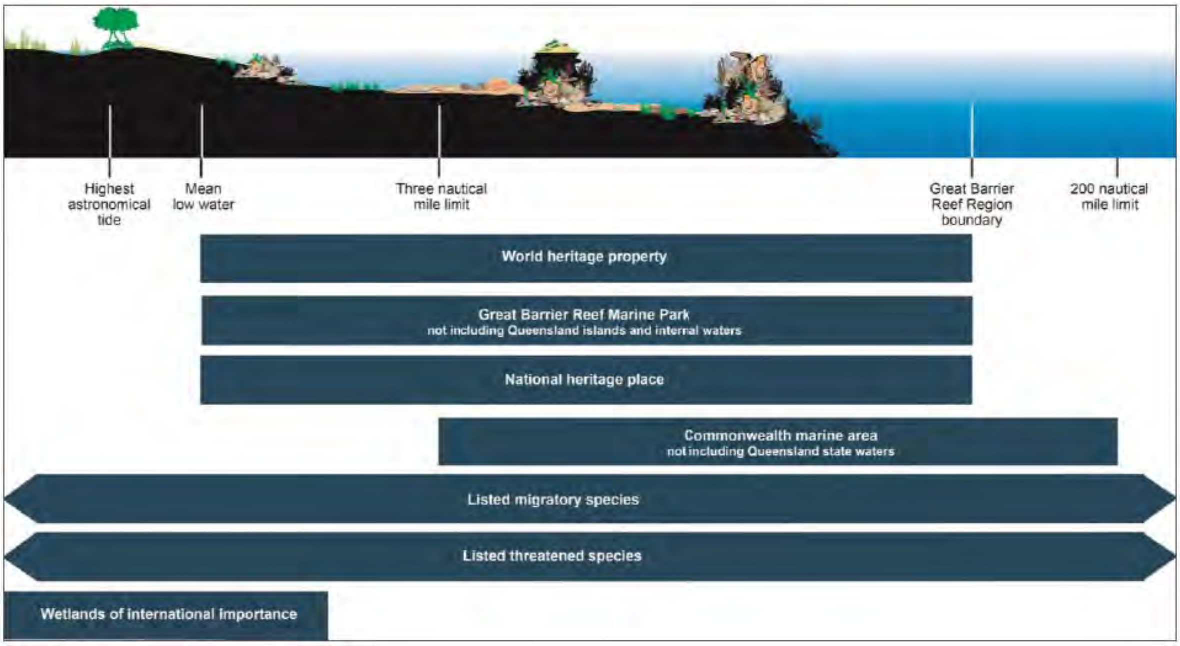


Figure 22-3 Spatial extent of the matters of NES for the Great Barrier Reef Region.

Source: GBRMPA (2013a) (Figure 4.3). The WTWHA commences at the foothills that would lie well to the left of the area covered by this schematic.

In the vicinity of the Aquis Resort site, the GBRWHA lies seaward of 'low water' – approximately 0.5 km east (downstream) of the site via Richters Creek at its closest – although the WHA includes all internal waters of the state (i.e. follows low water up Yorkeys, Richters, and Thomatis Creeks in the vicinity of the site and, at its closest, is just inside the Aquis Resort boundary). The following figure (**Figure 22-4**) and table (**Table 22-2**) – extracted from GBRMPA (2013a) – is useful in interpreting local boundaries of the GBR Region, the GBRWHA, and the GBRMP.

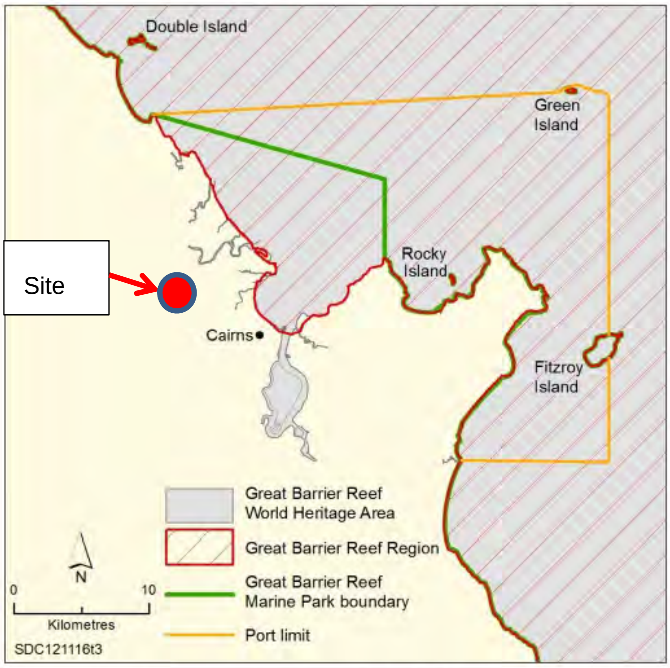


Figure 1.4 An example of the different coastal boundaries for the Great Barrier Reef World Heritage Area, Region and Marine Park

As illustrated in this map of the area around Cairns, the Great Barrier Reef World Heritage Area includes all internal waters and islands of Queensland, for example enclosed bays and estuaries, and Green and Fitzroy islands. The Great Barrier Reef Region includes all waters seaward of low water, but not the internal waters and islands of Queensland (such as Green and Fitzroy islands). The Region includes Commonwealth islands. The Great Barrier Reef Marine Park has the same boundary as the Region, except that defined areas around most trading ports are excluded. The Marine Park boundary around ports is different from the port limit which is defined in relation to operation of the port itself.

Figure 22-4 Local boundaries of the GBR region, the GBRWHA, and the GBRMP.

Source: GBRMPA (2013a) (Figure 1.4).

The Aquis Resort site is hydrologically linked to the GBRWHA via Richters Creek, Yorkeys Creek, and Half Moon Creek, all of which flow into the GBRWHA and further off-shore, the GBRMP. These creeks and other aspects of local hydrology are described in **Chapter 10** (Water Resources). This discussion concludes that, despite clearing and fragmentation of habitat in the project site, biological processes are still largely intact. This area is fringed by a band of natural vegetation and this abuts protected areas of high integrity (FHAs and QMP) to the north-east and north-west. Together these remnants maintain a high degree of biological function. Upstream of the site, connectivity is less effective and the area is characterised by waterway barriers (tide gates and undersized culverts) and degraded riparian areas. Connectivity upstream to the WTWHA is tenuous and relies on the Barron River / Thomatis Creek / Richters Creek corridor and other watercourses.

TABLE 22-2 DIFFERENCES BETWEEN THE GBR WORLD HERITAGE AREA, GBR REGION AND GBR MARINE PARK

Great Barrier Reef World Heritage Area	Great Barrier Reef Region	Great Barrier Reef Marine Park
348,000 km^2	346,000 km^2	344,400 km^2
Inscribed 1981	Established 1975	Declared in sections between 1979 and 2001; amalgamated into one section in 2003
Includes: • all islands within outer boundary (about 1050) • all waters seaward of low water mark (including internal waters of Queensland and port waters) • all 12 trading ports	Includes: • approximately 70 Commonwealth islands • all waters seaward of low water mark (excluding Queensland internal waters) Does NOT include: • internal waters of Queensland • Queensland islands (about 980)	Includes: • approximately 70 Commonwealth islands • all waters seaward of low water mark (excluding Queensland internal waters) Does NOT include: • internal waters of Queensland • Queensland islands (about 980) • 13 coastal exclusion areas

Source: GBRMPA (2013a) (Table 1.2).

22.1.5 Relevant Controlling Provisions

The ToR require that the following controlling provisions be addressed by this EIS.

TABLE 22-3 RELEVANT CONTROLLING PROVISIONS

CONTROLLING PROVISION	DETAILS
World Heritage properties (sections 12 and 15A)	Great Barrier Reef World Heritage Area Wet Tropics of Queensland World Heritage Area
National Heritage places (sections 15B and 15C)	Great Barrier Reef National Heritage Place Wet Tropics of Queensland National Heritage Place Wet Tropics World Heritage Area (Indigenous Values)
Listed threatened species and communities (sections 18 and 18A).	Not specified
Listed migratory species (sections 20 and 20A).	Not specified
Great Barrier Reef Marine Park (sections 24B and 24C).	Great Barrier Reef Marine Park

Source: Study team compilation based on decision notice dated 8 May by the Minister for the Environment and revised EIS ToR issued on 23 May 2014.

The above relevant controlling provisions are discussed below in terms of:

- presence of matter (based on the protected matters search and/or other relevant research) and a discussion of the underlying values of the matter

- potential impact on the values
- proposed mitigation and effectiveness
- significance of mitigated impact on the values
- consistency with international obligations, agreements, management plans etc. (where relevant).

22.1.6 Relevant Legislation and Policy Statements

a) Objects of the EPBC Act

The objects of the EPBC Act are:

(a) to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance; and

(b) to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and

(c) to promote the conservation of biodiversity; and

(ca) to provide for the protection and conservation of heritage; and

(d) to promote a co-operative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples; and

(e) to assist in the co-operative implementation of Australia's international environmental responsibilities; and

(f) to recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity; and

(g) to promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.

An assessment of the Aquis Resort against these objects is provided in **Table 22-51**.

b) EPBC Act Regulations

As required by the ToR, this EIS addresses all matters required by Division 5.2 of the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cwlth) and Schedule 1 of the *State Development and Public Works Organisation Regulation 2010* (Qld) – refer to **Appendix A** for a detailed checklist of where issues are addressed. Additional matters are:

- environmental record of the proponent – refer to **Section 22.1.7**
- reliability of information – see **Section 22.2**Error! Reference source not found. and **Section 22.20**
- cost of mitigation measures – refer to **Section 22.18.4**
- dealing with uncertainty – see **Section 22.20**.

c) Matters of NES Significance Guidelines

The *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* produced by the Department of The Environment (DoTE 2013c) have been prepared to assist in the referral of actions under the EPBC Act. They outline a 'self-assessment' process, including detailed criteria, to assist persons in deciding whether or not referral may be required.

The guidelines document what are called 'significant impact criteria' to be applied to each matter of NES as part of the referral process. proponents are required to assess impacts against the criteria and advise the outcome in the referral. The referral process for the Aquis Resort was completed in April 2014 and resulted the following:

- undertaking extensive investigations into the likely impacts on all matters of NES listed in the protected matters search undertaken at the time preparation of a major report (i.e. an early version of the report described in **Section 22.1.4**) – all possibly present or nearby EPBC Act matters were investigated, not just those since found by the Minister to be controlling provisions
- documenting the findings in a comprehensive report on EPBC Act issues (Environment North 2014) – this was published on 2 April 2014 on the EPBC Act website in accordance with the Act and is still available at http://www.environment.gov.au/cgi-bin/epbc/epbc_ap.pl?name=current_referral_detail&proposal_id=7169.
- completion of a referral (this involved completing the form provided by DoTE under the EPBC Act) – this was published on 2 April 2014 on the EPBC Act website in accordance with the Act and is still available at the above address.

The referral process requires (s5.1) proponents to advice as whether or not they think that the proposed action is a controlled action. Aquis responded that it did not think so, and provided details as to why not, citing the conclusions of the supporting document with respect to:

- Outstanding Universal Value
- species
- impacts.

In providing this advice, the significance guidelines were used for all matters of NES as required and their application was detailed in the supporting report. The guidelines were also used in the post-referral assessment of impacts as discussed in Section **22.2.4b)**.

d) EPBC Act Offsets Policy

The EPBC Act Offsets Policy (SEWPaC 2012a) aims to:

- improve environmental outcomes through the consistent application of best practice offset principles
- provide more certainty and transparency
- encourage advanced planning of offsets.

According to the policy, offsets are defined as 'measures that compensate for the residual impacts of an action on the environment, after avoidance and mitigation measures are taken'. Where appropriate, offsets are considered during the assessment phase of an environmental impact assessment under the EPBC Act. This policy relates to all matters protected under the EPBC Act andprovides transparency around how suitable offsets are determined. The suitability of a proposed offset is considered as part of the decision to approve or not approve a proposed action under the EPBC Act.

As noted above, environmental offsets are measures that compensate for the residual adverse impacts of an action on the environment. That is, offsets are designed to provide environmental benefits to counterbalance the impacts that remain after avoidance and mitigation measures. These remaining, unavoidable impacts are termed 'residual impacts'. For assessments under the EPBC Act, offsets are only required if residual impacts are significant (as determined by the significance guidelines described above).

Best-practice environmental management is documented in the Great Barrier Reef Region Strategic Assessment (Appendix 2 of GBRMPA 2013a), namely *avoid, mitigate, offset, and adaptively manage* impacts. This approach has been undertaken for the Aquis Resort as explained in the sections describing each controlling provision. See also the discussion on impact avoidance and minimisation in **Section 22.4.2**.

The need for offsets is discussed below for each controlling provision.

e) Environmentally Sustainable Development

According to Australia's 1992 *National Strategy for Ecologically Sustainable Development* (Department of the Environment 2013g) ecologically sustainable development (ESD) is ‘using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased’.

The Strategy includes a goal, core objectives, and guiding principles as noted below.

- **Goal**: Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.
- **Core Objectives:**
- *to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations*
- *to provide for equity within and between generations*
- *to protect biological diversity and maintain essential ecological processes and life-support systems.*
- **Guiding Principles:**
- *Decision making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations.*
- *Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.*
- *The global dimension of environmental impacts of actions and policies should be recognised and considered.*
- *The need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised.*
- *The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised.*
- *Cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms.*
- *Decisions and actions should provide for broad community involvement on issues which affect them.*

The 1992 strategy was given effect in a slightly modified form in the EPBC Act (Section 3A) as follows:

- *Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations (the ‘integration principle’).*
- *If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation (the ‘precautionary principle’).*
- *The principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations (the ‘intergenerational principle’).*
- *The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making (the ‘biodiversity principle’).*
- *Improved valuation, pricing and incentive mechanisms should be promoted (the ‘valuation principle’).*

Under the EPBC Act, the ESD strategy applies to Commonwealth agencies (i.e. not private developers) that need to report against two core criteria:

- how agencies accord with and contribute to ESD
- to report the environmental performance of agencies, that is the impact their activities have on the natural environment, how these are mitigated and how they will be further mitigated.

The EPBC Act defines the ‘environment’ to mean:

- ecosystems and their constituent parts, including people and communities
- natural and physical resources
- the qualities and characteristics of locations, places and areas
- heritage values of places (including places on the Register of the National Estate kept under the *Australian Heritage Council Act 2003*), and
- the social, economic and cultural aspects of the things mentioned above.

An assessment of the Aquis Resort against the ESD policy is provided in **Table 22-51** and the ensuing discussion.

f) National Heritage Places

In 1997, the Council of Australian Governments agreed that heritage listing and protection should be the responsibility of the level of government best placed to deliver agreed outcomes. It was agreed that the Commonwealth's involvement in environmental matters should focus on matters of national environmental significance, including World Heritage properties and places of national significance. Each state, territory and local government has a similar responsibility for its own heritage.

This led to the creation of two new heritage lists in 2003:

- under the EPBC Act, the **National Heritage List** includes places of outstanding heritage value to the nation
- the **Commonwealth Heritage List** includes heritage places owned or controlled by the Commonwealth.

The protection of heritage places for which the Commonwealth Government is responsible continues under the EPBC Act. The act not only protects heritage from actions by the Commonwealth, but also protects places on the National Heritage List, on the Commonwealth Heritage List, and on Commonwealth land. All proponents, not just the Commonwealth, are required to seek approval for actions that could have a significant impact on the heritage values of these places.

Of relevance to this chapter is the fact that both the Great Barrier Reef and the Wet Tropics of Queensland are also listed as National Heritage places.

g) Objects of the GBRMP Act and Regulations

The *Great Barrier Reef Marine Park Act 1975* (Cwlth) requires the Great Barrier Reef Marine Park Authority to have regard to, and seek to act in a way that is consistent with, the objects of the Act, the protection of the world heritage values of the Great Barrier Reef World Heritage Area, and the principles of ecologically sustainable use.

This is discussed in detail in **Section 22.16.6b)**.

22.1.7 Environmental Record of proponent

The proponent (Mr Fung) has operated his pastoral and agricultural businesses in Queensland with an unblemished record of environmental performance. Notwithstanding that these businesses have not involved any assessments or approvals under the EPBC Act, Mr Fung is fully aware of his responsibilities under the EPBC Act and recognises and appreciates the world renowned and unique environmental values of Far North Queensland in which his businesses operate. Mr Fung is committed to ensuring that these values are respected and if possible enhanced through his business operations.

22.2 SURVEY DETAILS

22.2.1 Introduction

The EIS (including this chapter on matters of NES) has been informed by a suite of technical studies that are generally included as appendices to the EIS. In particular, much of this chapter is based on detailed aquatic and terrestrial ecology and water quality fieldwork and analysis undertaken in the dry season (July – October 2013) and wet season (February – March 2014) by the Aquis study team. Additional fieldwork and reporting has been undertaken on the topics of terrestrial and aquatic ecology with specific reference to EPBC Act issues (i.e. matters of NES and Outstanding Universal Value) as described below. This summary of survey methodology is organised as follows:

- terrestrial ecology – detailed assessment
- aquatic ecology – detailed assessment
- matters of NES (presence and impact assessments) – relevant to terrestrial and aquatic work.

22.2.2 Terrestrial Ecology

The following is a detailed description of methodology employed in the production of **Appendix G** (Terrestrial Ecology) and a companion report on matters of NES (Biotropica Australia 2014c). It provides a summary of the background, techniques and timing that were utilised and the limitations imposed by the site. The narrow, linear nature of residual vegetation and the very flood prone and tidal nature of the project area restricted the size and replication of study sites.

Consultation was undertaken with a number of government agencies, most notably Mike Trenerry, Senior Conservation Officer with EHP, and Louise Johns, Fisheries Biologist with the DAFF. The outcome of these discussions is provided as Appendix 3 of **Appendix G**.

a) Overview

A desktop review of the preliminary development envelope was conducted in May 2013, prior to undertaking the field component of the terrestrial survey. This involved review of a number of database and literature surveys. Of particular relevance was the EPBC Act protected matters report for the search area (a 5 km area around the Project footprint with a 5 km buffer). The search area was based on the project description in the IAS (Aquis Resort at The Great Barrier Reef 2013), which was refined in the final stages of the baseline studies. The EPBC Act protected matters report was originally generated on 30 July 2013, with subsequent revisions generated on 19 February 2014 and 26 May 2014. All work in this chapter has been updated to reflect the latest version.

The initial verification of desktop data was undertaken during a two week period in July 2013 (dry season). During this period, two ecologists spent a total of seven days and four nights surveying natural and anthropogenic habitats present on and adjacent to the site. Intensive meander surveys were conducted to sample vegetation, birds, flying and non-flying mammals, and reptiles. Amphibians were not specifically targeted at this time due to the very dry weather preceding the July 2013 survey. Based on these surveys, five permanent 30 m x 30 m study plots were established at sites representative of the broad vegetation communities present in the project area, and in areas where extensive wet season flooding would not compromise sampling effort and safety These five study plots were re-sampled in March 2014 when the same range of biological attributes were measured during a wet season survey, which included amphibian sampling.

A meander technique was employed to sample the property to ensure maximum coverage but also to avoid routine habits that may be recognised by *Crocodylus porosus* (Estuarine crocodiles) known to be present on the property. Where routine re-visits were essential and in areas where *C. porosus* were more likely, two persons were required at all times, with one person acting in a safety observation role.

An additional (time intermediate) study was undertaken in October 2013, specifically to:

- further characterise the vertebrate and invertebrate fauna and the floristics of the intertidal zone (i.e., mangrove) habitats within the project area
- better understand the relationship between forest cover and water relations by examining ground-water dependent ecosystems (GDEs)
- continue refining ecosystem boundaries.

The intermediate October 2013 study also included detailed observations of fauna including amphibians that were not targeted during the July 2013 survey.

For the October 2013 studies, twenty-three 10 m x 10 m plots were established across the site. Site locations were chosen to reflect zonation, and were sited across the project area, but with a bias to sites that would be closer to the proposed water body at the centre of the development. Of the 23 plots, 20 were in sites surrounding the proposed resort development as it was then defined, and three were located on the western side of the project area. Sites were located on and directly adjacent to the actual project area boundary. Their location was informed by the July 2013 dry season surveys which provided a degree of site familiarity, and allowed selection of an appropriately varied range of plot locations for the mangrove study.

Of the 23 study plots established for the October 2013 study, five locations were also used to undertake detailed mangrove fauna studies. At each of these five sites, a 40 m x 20 m plot was established within the mangrove forest. Within each plot, trapping, active searches, observational site assessments (within and surrounding the plot), site photos, and differential GPS locations were recorded. Sampling plots were located to coincide with intertidal vegetation surveys. Incidental fauna observations were also recorded from across the mangrove communities in the project area.

Further mangrove mapping was completed in February 2014. The purpose of this work was to map the various mangrove associations occurring in the project area, and establish permanent mangrove monitoring sites that would allow regular survey to detect any changes to the health and integrity of mangrove ecosystems that may be affected by the development. To adequately gauge whether negative effects are attributable to the project, or are symptomatic of a more widespread effect, analogue sites were established in matched associations in the Yorkeys Knob, Machans Beach and Holloways Beach areas. For this study, eighteen 10 m x 10 m plots were established encompassing the majority of the Aquis associations, and within matched analogues located on mostly state lands.

Additional mangrove mapping was been completed in April 2014 but the results have not been included in this EIS.

In summary, the survey sites reflect the diversity of habitats in the project area as well as their size, orientation, and susceptibility to long periods of inundation during the wet season.

b) Fauna

Fauna surveys were undertaken following the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al. 2012) (‘the Guidelines’). The application of the Guidelines is detailed below, along with any divergences.

Define Objectives S2.1

The objectives of the study were clearly defined before the survey commenced. Objectives were:

- To assess the value of the project area in terms of the ecological relationship of these lands to the surrounding landscape, canvas the terrestrial biodiversity constraints potentially arising from the development, and examine the potential opportunities arising from the development to maintain and enhance environmental values.
- To allow EHP to evaluate the project by describing the existing ecological values that may be affected by a project, including biological diversity, existing integrity of ecological process, habitats or threatened or near threatened species.

Skill and Experience level S2.2

A team of four ecologists has been formed to undertake specific aspects of the survey such as small mammals, macro-invertebrate studies, bird surveys and identification of bat echolocation calls. All team members have relevant tertiary qualifications and acknowledged significant skills in their area of expertise. The senior investigator is Nigel Tucker (ADApp Sci, M.Sc), an experienced tropical forest ecologist with almost 30 years' experience in tropical ecosystem studies in North Queensland and elsewhere.

Stage 1 – Scoping S3

The environmental and landscape attributes of the study area were subject to a desktop review in May 2013 which contributed to the project Initial Advice Statement (IAS). A variety of ecological and planning attributes of the study area were identified, and discrete ecological units developed using proximal ecosystem / remnant vegetation extents based largely on hydrological patterns and processes. These are shown on **Figure 22-29**.

Prior to the initial ground survey in July 2013, a database review was undertaken that indicated that there were species potentially present that are protected under Commonwealth and state legislation.

Permits and Ethics Approval S3.1.4

All team members hold a current Scientific Purposes Permit, are registered Scientific Users, and are approved by the Animal Ethics Committee.

Scoping Document S3.1.5

The IAS provided the background and descriptive information for Stage 2 of the survey. The IAS provided the information required in this section of the Guidelines.

Sampling: The Assessment Unit and Site Selection S4.1

The study area was clearly defined and stated within the IAS before sampling commenced.

Delineation of Assessment Units within the Survey Area S4.2

Assessment units were defined as part of the scoping study. Discrete ecological units were developed using proximal ecosystem / remnant vegetation extents based largely on hydrological patterns and processes. This stratification enabled the determination of location and number of sites for survey.

The July 2013 and March 2014 surveys consisted of walkover studies of the entire project area as well as five intensive survey sites in identified assessment units representative of the main forest types and the extent of variation within these types across the study area. They are spatially independent and their location was designed to capture the full range of ecological attributes of the study area.

The October 2013 study concentrated on intertidal zone habitats and species including macro invertebrates and amphibians. Twenty-three additional study sites were chosen to reflect zonation and were sited across the project area, but with a bias to sites that would be closer to the proposed water body at the centre of the development.

Replication and Location of Survey Sites S4.3

As a minimum there should be three replicate generic survey sites per assessment unit.

The extent and configuration of native vegetation on-site meant that this number was not attainable. Instead five sites were selected that are representative of the broad vegetation assemblages remaining across the project area. Moreover, sampling recommendations suggest a 100 m x 100 m grid size. The project area contains only one area of native vegetation (mangroves) that could accommodate a 100 m x 100 m grid, and this area is largely inundated for long periods. While another area of woodland could accommodate a 100 m x 100 m grid, this would place much of the grid in heavily disturbed forest. In order to standardise the sampling across the site, the smaller size that could be accommodated by every study site was chosen.

Sampling Adequacy and Power S4.4

The extent and fragmented nature of the site precluded any reliable statistical analysis.

Setting up a Generic Fauna Survey Site S4.5

Generic fauna survey sites were utilised during all surveys.

A 30 m x 30 m grid was used rather than the 100 m x 100 m survey area as per the Guidelines due to size constraints, and extensive inundation during the wet season. Grids with dimensions of 100 m x 100 m would of necessity sample areas of sugar cane fields and anthropogenic grasslands because native vegetation is not consistently 100 m wide across the project area.

When to Conduct Surveys S4.6

The Guidelines state that for the Wet Tropics bioregion, surveys should be undertaken in the Wet Season or immediately after (December – May) and in the Dry Season (August – October).

The requirement to undertake at least two surveys in different seasons was met and exceeded. Full surveys were undertaken in July 2013 (dry season) and March 2014 (wet season) as well as additional intertidal zone and mangrove studies undertaken in October 2013 and February 2014.

The dry season survey is referred to in **Appendix G** as being undertaken in July 2013. However the dates of the survey are 27 July through to 2 August 2013. In addition, **Figure 22-5** shows that the two months preceding the survey had low rainfall, enabling a dry season survey to be undertaken with confidence.

During the July 2013 and October 2013 surveys, conditions were fine with only occasionally overcast conditions during the survey periods and no rainfall. During the March 2014 survey conditions, were significantly different with rainfall on four of the five survey days, including a two day period when the property recorded 110 mm of precipitation.

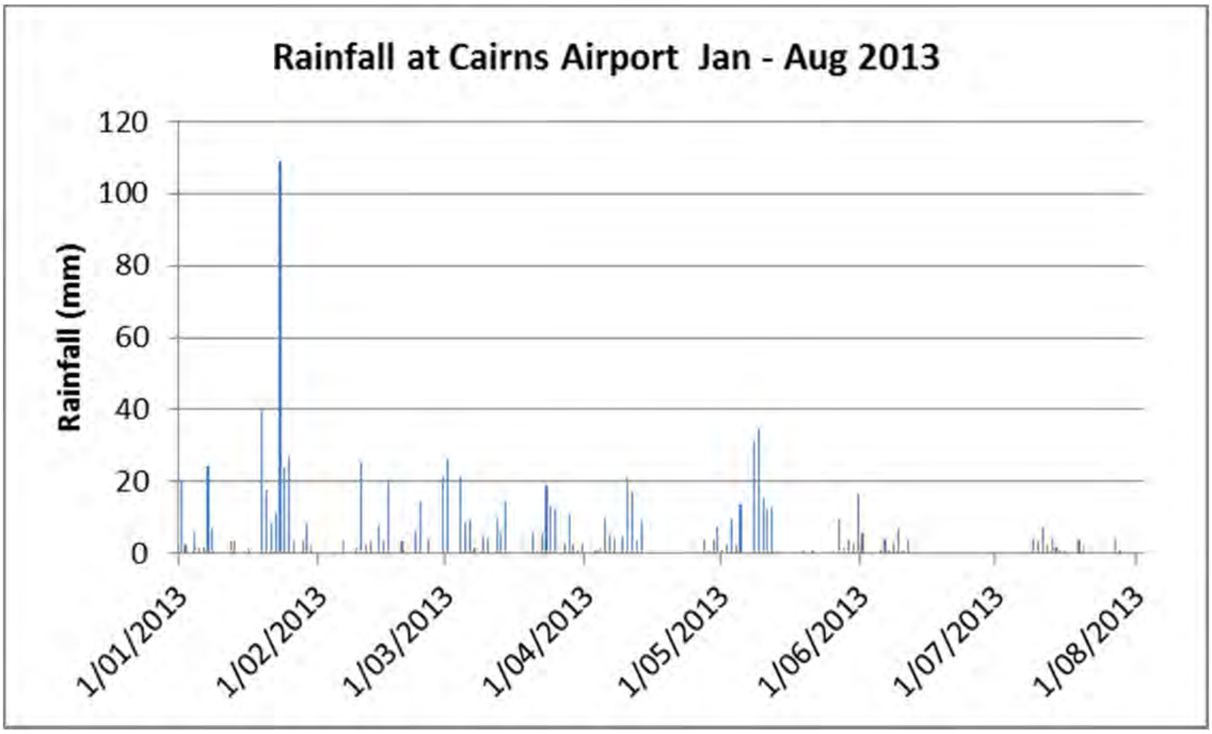


Figure 22-5 Rainfall at Cairns Airport Jan – August 2013.

Repeated wet and dry season surveys are planned to be undertaken in the upcoming years, with committed studies being planned for July 2014 and February 2015. This is deemed highly desirable under the Guidelines. Re-sampling of mangrove habitats has commenced (April 2014) and committed studies are planned for July and October 2014 and January 2015.

Sources of Variation during Surveys S5.2

The methods of minimising sources of spatial and temporal variation outlined in the Guidelines were met, namely:

- surveys were not taken during inclement weather
- multiple survey visits to a site were undertaken
- surveys were undertaken during at least two survey periods in the different seasons
- recording conditions at the time of each survey to allow incorporation of this data as covariates during data analysis.

Note: there was some rainfall during the wet season survey. Appropriate adjustment was made to search effort to ensure consistency of time effort, in addition to ensuring that cages and traps were suitably protected.

Data Management S6

All required information was collected and appropriately recorded and stored.

Handling Animals S7

All animals were handled using the standard operating procedures as set out in Animal Ethics Approval. No voucher specimens were required or taken.

Generic Survey Methods for a Site

- Pitfall trapping: Four buckets at 7.5 m intervals on T-design; 45 m fence for four nights. Within a 100 m x 100 m grid this is a suitable approach, however the size and orientation of native vegetation on the property precluded this, and 30 m x 30 m plots were selected on the basis that this size could accommodate all the site types while minimising edge related effects. (Sampling results showed that even 30 m x 30 m plots were invaded by typical edge-dwelling species e.g. *Melomys burtoni*). A single pit trap was installed at each 30 m x 30 m site and operated over a four night period, again reflecting the size of the plot and effort commensurate with that size. Pits utilised deep 20 litre buckets from which medium to larger-bodied reptiles and amphibians would be unable to escape, and 10 m of drift fence leading into the pit.
- Funnel trapping: Six funnels 3 m in on distal ends of T-design, 4 5 m fence for four nights. Funnel trapping was not undertaken as it was considered that active searches, cage traps and pitfall traps would adequately sample the range of species that were likely to be found on-site, considering its isolated and fragmented vegetation. Deep pitfall traps and cage traps would be expected to capture the same range of fauna that may be captured within funnel traps, with the exception of land snakes, which were sampled through active searches and opportunistic observations. Species records at all sites generally peaked after three days, suggesting that species detection was comprehensive and reliable.
- Diurnal active search: Two x 30 person-minute searches within two different 50 x 50 m quadrants of the survey site. Diurnal active searches were completed daily by two ecologists for at least 30 minutes within and adjacent to each 30 m x 30 m site, in addition to extensive active searches in sites across the entire project area.
- Nocturnal active search: Two x 30 person-minute searches within the 100 x 100 survey site. This was completed nightly within and adjacent to the five 30 m x 30 m sites before and after spot-lighting, and opportunistically at locations where diurnal searches suggested species were most likely to be present.
- Elliot trapping: 20 traps at 5-10 m intervals along 100 m transect; open for four nights. Layout was adjusted to account for the size and orientation of sampling sites as noted above, however total trap numbers were the same.
- Cage trapping: One trap per site open for four nights. Four traps were set at each 30 m x 30 m site to sample *Uromys* / *Hydromys*/*Dasyurus.*
- Diurnal bird survey: Six 5-10 minute area searches within 100 m x 100 m survey site. Point count surveys were conducted for one hour twice daily at each 30 m x 30 m site, and opportunistically across the property throughout daylight hours.
- Camera trapping: One camera per site for minimum of four nights. Remote cameras were installed at each of the five sites, with four nights at each site.
- Call playback: Two sessions of call playback of relevant species at midpoint of survey site. Call playback was not undertaken in the dry season. It was considered that active dedicated searches would be sufficient during the dry season, based on the species that were likely to be encountered. Call playback was completed for selected species during the wet season survey, and in habitats considered most likely to support those species.
- Spotlight: Two 30 person-minute spotlight search within 100 x100 m survey site. It was considered that nocturnal vehicle transects provided more opportunities to conduct vehicle based spotlighting and herpetofauna transects. As discussed in Section 9.15 of the Guidelines, vehicle based transects allow for more extensive areas to be surveyed efficiently while also adding a greater element of surprise to the animals, given the speed of approach (Wayne *et al.* 2005). These vehicle transects are useful to detect a wide range of nocturnal fauna, particularly those occurring at relatively low densities. Two hours was spent on four nights by three ecologists, working independently during the dry and wet season surveys, and sampling the maximum area possible.
- Echolocation call detection: One bat detector for three nights. Anabat devices were used at each of the five study sites, for four nights at each site, in wet and dry seasons.

- Scat and sign search: Can coincide with systemic diurnal active searches, within 50 x 50 m quadrats of the survey site. Otherwise incidental. Searches were conducted for scats, tracks and other forms of sign during all diurnal surveys, at all locations.
- Incidental: Incidental detection of any species. Incidental fauna records were generated during diurnal surveys.

Table 22-4 below shows the survey methodologies utilised and the fauna species targeted by each method. This shows that each fauna species has been appropriately surveyed.

TABLE 22-4 SURVEY METHODOLOGIES UTILISED AND THE FAUNA SPECIES TARGETED

METHOD	AMPHIBIANS	REPTILES	DIURNAL BIRDS	NOCTURNAL BIRDS	SMALL MAMMALS	MED – LARGE MAMMALS	ARBOREAL MAMMALS	MICROBATS
Pitfall trapping	✓	✓			✓			
Diurnal active search	✓	✓			✓			
Nocturnal active search	✓	✓			✓			
Elliot trapping					✓			
Cage trapping						✓		
Diurnal bird survey			✓					
Camera trapping		✓				✓		
Spotlighting				✓		✓	✓	
Echolocation call detection								✓
Scat and sign search		✓		✓		✓	✓	
Incidental	✓	✓	✓	✓	✓	✓	✓	✓

Source: N Tucker pers. comm. 30 May 2014.

The design and procedure and ethical considerations as set out in Section 8.1 to 8.12 of the Guidelines, were observed except for the departures discussed above.

Targeted Survey Methods S.9

Targeted survey methods were utilised at non-standard sites e.g. mangroves and wetland habitats. Targeted survey methods as set out in the Guidelines that were used included:

- additional and targeted diurnal bird surveys for wetland species
- intertidal benthic surveys at 23 sites including pitfall trapping, burrow searches and sweep netting.

Habitat and Condition Assessment S.10

Each generic survey and targeted fauna survey site was also a survey site for the flora study. Therefore the minimum requirement of a standardised description of the habitat that is being survey for fauna was exceeded.

The Final Report S.11

The preparation and content of the final report meets the objectives of the ToR and includes the sections set out in the Guidelines.

c) Flora

Flora surveys were undertaken following the Guidelines for Flora Survey and Assessment in Northern Queensland (Wannan 2013). The application of these guidelines to the project is detailed below:

1.1 Review existing information

Existing information was obtained and reviewed from the sources set out in the Guidelines including:

- aerial photography
- Wildlife Online Database
- Queensland Herbarium
- regional ecosystem mapping
- wetland mapping
- detailed RE descriptions
- Biodiversity Planning Assessments
- geology, soils and topographic mapping
- EPBC protected matter search.

In regards to the searches for threatened species, the Guidelines recommend a buffer of 10 km from the edge of the proposed study area for sites in the Wet Tropics. The actual study area is approximately 2 km x 2 km, the polygon used for the study area in the threatened species searches is approximately 12 km x 7 km and an additional buffer of 5 km was searched around this polygon.

1.2 Field Survey

Two full site surveys were undertaken in July / August 2013 (dry season) and March 2014 (wet season). In addition, specialist surveys were undertaken in October and February in the intertidal habitats. This exceeds the requirements set out in the Guidelines.

The surveys were undertaken by Nigel Tucker who is a botanist with almost 30 years of experience of tropical forest ecology in Cairns and the surrounding areas. This level of experience and familiarity with the local flora meets the requirements set out in the Guidelines.

Accurately map and describe the occurrence of vegetation

During the field survey, the occurrence of vegetation types was accurately mapped using a (differential) GPS system as set out in the Guidelines. There were no unmapped habitat areas on the site, and two plants were collected for lodgement with the Queensland Herbarium to document the extended known range of those species. A large number of sampling plots were established, using a combination of 100 m transects and 10 m x 10 m plots, in addition to the five 30 m x 30 m permanent plots.

Accurately determine the likelihood for plant species of conservation significance

Effective and targeted searches were undertaken for plants of conservation significance. There were no unmapped habitat areas on the site.

Accurately determine the ecological function

The following aspects were considered in relation to the surrounding landscape ecology as set out in the Guidelines:

- integrity of habitats
- identify key connective habitats
- identify refugia
- identify critical habitat
- identify disjunct species or communities
- identify key habitat areas
- identify hydrologically important areas.

1.3 Reporting

The reporting of vegetation includes:

- descriptions of geology, landform, and soils for each community
- description of vegetation in all structural layers including understorey and groundcover
- a representative photograph for each site.

Discussion included the conservation status of vegetation and species of conservation concern and the likelihood of occurrence on-sites, including spatial identification of suitable habitats / landforms / REs for plants of conservation significance including essential habitat or critical habitat.

Appendix G also includes discussion on the ecological function of the habitats, connectivity, refugia, critical habitat, disjunct species, and key habitat areas as identified during the field survey.

A series of maps include in **Appendix G** show the vegetation and wetland communities on-site, the occurrence of individuals of conservation significance, and areas of important ecological function. Copies of field work sheets are not included as an appendix to the report as all data was logged electronically on-site.

The overall outcome of the assessment is text and a series of maps describing areas of biodiversity and ecological value relating to flora. This EIS incudes summaries of important aspects of this work – judgement has had to be used to find the balance between detail and brevity in the interests of overall readability. **Appendix G** is supplied as part of the EIS package for readers with a need for full details.

2. Identification of Impacts

Appendix G (and the EIS itself) includes spatial delineation of all areas proposed for clearing, disturbance or impacts and a description, diagrams and artists impressions of the proposed development. Maps and numerical details of the areas affected segregated by habitat type are included. The potential impacts on the site's values including on vegetation and wetland communities, plants of conservation significance and ecological function including integrity and connectivity are discussed as required in the Guidelines.

3. Identification of mitigative or ameliorative measures

Measures to reduce or avoid environmental impacts on the flora values identified including vegetation and wetland communities, plants of conservation significance and ecological function are discussed, with any residual impacts discussed. These mitigation measures have be mapped and described.

22.2.3 Aquatic Ecology

The following is a detailed description of methodology employed in the production of **Appendix H** (Aquatic Ecology) and a companion report on matters of NES (frc environmental 2014a). It provides a summary of the background, techniques, and timing that were utilised and the limitations imposed by the site.

The assessment of listed threatened and migratory species was based on a suite of technical and baseline studies with respect to aquatic ecology. The studies were undertaken in several stages.

a) Stage 1 – Literature Review

Listed aquatic species that may be present in the project area, and in areas that may be impacted by the Aquis Resort, were identified by generating an EPBC Act protected matters report for the search area (a 5 km area around the Project footprint with a 5 km buffer) as described in **Section 22.2.2a)**. All work in this chapter has been updated to reflect the latest version.

The literature review considered the proposed development site, the Barron River catchment and the delta, including:

- the Cattana Wetlands
- Half Moon Bay
- the waters seaward of Thomatis / Richters Creek in the east
- the Great Barrier Reef World Heritage Area
- nearby waters such as Trinity Inlet and the Russell-Mulgrave River Catchment
- other estuaries in the Wet Tropics of Queensland as relevant.

The literature review focused on the following aspects of aquatic ecology relevant to the study area:

- aquatic habitats
- water quality (consolidated into **Chapter 11** – Water Quality)
- sediment quality (consolidated into **Chapter 11** – Water Quality)
- macroinvertebrates, including subtidal benthic infauna and aquatic macroinvertebrates associated with mangrove habitats
- fish and fisheries, including freshwater fish, estuarine and marine fin fish, crustaceans, molluscs, sharks and rays, and pest species
- marine mammals
- marine reptiles.

Five databases (**Table 22-5**) and over 150 source documents were considered. In addition, contact was made with a number of people from the local community and from government agencies (**Table 22-6**).

The results of the literature review showed that the site, the surrounding creeks, and near-shore areas were not likely to contain important populations of, nor provide important breeding areas for, any listed threatened and migratory aquatic species. The beaches of Trinity Bay were also not recognised as major nesting areas for any marine turtle species (Worley Parsons 2010). At the time of the baseline EIS studies, technical staff from the Queensland Government were not aware of the results of any surveys of marine turtles nesting in the vicinity of the proposed development.

TABLE 22-5 DATABASES SEARCHED AND COORDINATES USED DURING LITERATURE REVIEW

DEPARTMENT	DATABASE	DATE SEARCHED	COORDINATES
Queensland Department of Environment and Heritage Protection	Wetland Summary	2013-07-30	-16.797125, 145.671748 -16.797125, 145.785388 -16.872376, 145.785045 -16.874348, 145.678271 -16.797782, 145.672778 -16.797125, 145.671748
Commonwealth Department of Sustainability, Environment, Water, Population and Communities	EPBC Act Protected Matters Search	2013-07-30 2014-02-19, and 2014-05-26	-16.797125, 145.671748 -16.797125, 145.785388 -16.872376, 145.785045 -16.874348, 145.678271 -16.797782, 145.672778 -16.797125, 145.671748
Commonwealth Department of Sustainability, Environment, Water, Population and Communities	Ramsar wetlands of Australia	2013-08-05	Australia
Queensland Government	Wildlife Online Extract	2013-07-30	-16.797125, 145.671748 -16.797125, 145.785388 -16.872376, 145.785045 -16.874348, 145.678271 -16.797782, 145.672778 -16.797125, 145.671748
Commonwealth Department of Sustainability, Environment, Water, Population and Communities	Australian places on the World Heritage List	2013-07-30	Australia

TABLE 22-6 AGENCY AND COMMUNITY ENGAGEMENT

AGENCY CONTACTED	CONTACT OFFICER	DATE	ISSUE DISCUSSED
NA	Paul Aubin (local fisherman)	2013-08-13 2013-10-22	Water quality and fisheries of Thomatis / Richters Creek
CRC	Lynn Powell	2013-08-26	Water quality of the Barron catchment
Centre for Tropical Water and Aquatic Ecosystem Research James Cook University	Rob Coles Team Leader Seagrass habitats	2013-08-06	Water quality and seagrass
Holloways Beach Environmental Education Centre	Louise Carver	2013-08-14	Water quality in Thomatis / Richters Creek
Department of Agriculture, Fisheries and Forestry	Louise Johns Senior Fisheries Biologist Impact assessment and Management	November 2013	Nomenclature of oysters. Fish species lists
Department of Environment and Heritage Protection	Andrew Moss Principal Scientist	2013-08-21	Water quality of the Barron catchment
Department of Environment and Heritage Protection	Justin Meager	2013-08-09	Marine turtles
Department of Environment and Heritage Protection	Ashley Bunce Director Wildlife Management	November 2013	Marine turtles
Department of Environment and Heritage Protection	Mike Trenerry Team Leader Environmental Services and Regulation	November 2013	Fish species lists, marine turtles, fish and mangrove invertebrate assessment programs
Department of Science, Information Technology Innovation and the Arts	Neil Tripodi Principal Scientist	November 2013	Water quality trigger values, guidelines and reference sites
Queensland Parks and Wildlife	Kurt Derbyshire Principal Fisheries Resource Officer	November 2013	Nomenclature of *Thenus* and *Ibacus* spp.

b) Stage 2 – Preliminary Field Survey

A brief field survey was undertaken of the site, the surrounding creeks, and near-shore areas in the dry season, between 30 July and 2 August 2013. The preliminary field survey was intended to provide input into the design of the proposed development, rather than providing a baseline survey for a known development, and was led by frc environmental's Principal Ecologist, Dr John Thorogood.

Twenty-five sites (including 13 sites within the site) were surveyed in detail:

- 3 sites in Yorkeys Creek
- 6 sites in Thomatis / Richters Creek and their tributaries
- 7 sites in Half Moon Creek and its tributaries
- 2 freshwater pool sites, south of Yorkeys Creek
- 2 cane drains
- an unnamed creek on the site
- 4 man-made dams.

The field survey included an assessment of:

- the distribution and condition of aquatic habitat
- water quality
- sediment quality
- freshwater and estuarine macroinvertebrates
- aquatic plants (excluding mangroves).

In addition, incidental observations of any listed threatened and migratory aquatic species were made, along with observations of any aquatic habitats likely to be critical to the survival of these species (including key nesting or breeding habitats).

No listed threatened and migratory aquatic species were observed during the preliminary field survey. The shallow, often tidally isolated waters adjacent to the site were deemed unlikely to provide significant habitat for listed threatened and migratory aquatic species, although some species, including Australian snubfin dolphin, Indo-Pacific dolphin and green turtle, may forage in these creeks on occasion. In was also deemed likely that some sparse turtle nesting occurs on the beaches in the vicinity of the proposed development (in consultation with Bunce pers. comm. 2013, Trenerry 2013 pers. comm.). Future turtle nesting surveys will be conducted in these areas.

The results of Stages 1 and 2 were used to refine the design of the field survey for Stage 3.

c) Stage 3 – Intensive Field Surveys

Additional aquatic ecological studies were undertaken in the wet season (February – March 2014) to further describe the aquatic ecosystems that may be affected by the proposed development, and the aquatic ecosystems of nearby reference sites. In addition to supporting a more detailed understanding of the aquatic biota of the project area and surrounds (including observations of listed species and their habitats), the survey was designed to support ongoing monitoring programs to assess potential impacts of the proposed development during and after construction.

The survey design, aquatic ecological indicators focused on and methods used in the Stage 3 field surveys were based on widely accepted ecological assessment methods (e.g. *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC & ARMCANZ 2000) and the Queensland *Monitoring and Sampling Manual 2009* (DERM 2010e))[8].

[8] Note that the Queensland Government fauna survey guidelines relate to terrestrial fauna surveys and do not address surveys for freshwater, estuarine and marine fauna.

Twenty-two sites were surveyed within the site and the surrounding creeks between 26 February and 6 March 2014:

- 10 sites along Thomatis and Richters Creeks
- 5 sites along Half Moon Creek
- 4 sites along Yorkeys Creek
- 2 sites along the Barron River
- 1 site in the dune lake system adjacent to Yorkeys Creek.

The sites reflected the diversity of habitats in the study area and where practical were co-located with dry season-sites (frc environmental), water quality monitoring sites (WBM BMT **Appendix M**), and mangrove monitoring sites (Biotropica Australia – **Appendix G**). Assessments were made of the following aquatic ecological indicators:

- water quality
- sediment quality
- benthic macroinvertebrate (infaunal) communities of shallow subtidal channels
- macroinvertebrates of mangrove forest
- fish (using a variety of techniques including cast netting, baited box traps, opera traps and creel surveys)[9].

An additional field survey was undertaken between 21 and 23 March 2014 to describe the aquatic ecosystems that may be affected by the construction and operation of the proposed off-shore water intake pipeline (frc environmental 2014c). The survey area for this assessment included the proposed pipeline alignment and immediate surrounds, and included an assessment of:

- the subtidal habitat (including un-vegetated soft sediment, seagrass and macroalgae, epi-benthic fauna and coral or rocky reef habitat) along ten transects perpendicular to the pipeline alignment
- water quality (in situ measurements only)
- sediment quality
- benthic invertebrate (infaunal) communities.

As per the preliminary field survey, incidental observations of any listed threatened and migratory aquatic species were made in each field survey.

No listed species were recorded during any of the field surveys undertaken by frc environmental. In addition, no habitats critical to the survival of listed species (e.g. seagrass meadows, rocky reefs, coral reefs) were recorded within the potential area of impact of the Aquis development.

d) Skill and Experience of Team

The technical and baseline studies were led by Dr John Thorogood and Carol Conacher, each Principal Ecologists, and each with over 30 years of experience in aquatic ecosystem studies, including in north Queensland. John and Carol were supported by a team of six ecologists, who have relevant tertiary qualifications and significant expertise in freshwater, estuarine, and marine ecosystems.

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9 Other fishing methods, such as seine and fyke nets, were not used due to permit constraints and the potential for estuarine crocodiles in the creeks.

e) Permits

All sampling was conducted under the following permits issued to frc environmental:

- Queensland Animal Ethics (CA 2012/02/593)
- Queensland Fisheries (153223)
- Great Barrier Reef Marine Park (G14/36497.1).

f) Constraints and Limitations

Fishing was limited to methods listed in the GBRMPA sampling permit issued to frc environmental. The wet season work for the EIS was classified by GBRMPA as 'non-research', and allowed only for recreational fishing methods described in the DEEDI's *Recreational Fishing Rules for Queensland* (2012). Methods used in aquatic surveys were also constrained by the potential presence of crocodiles.

Communities of fish, sharks and rays are likely to vary with environmental factors (e.g. season and moon phase). The results are from one wet season survey only and additional surveys would be required to record other species likely to occur in the area.

Surveys of adjacent beaches for turtle nesting and hatching were not undertaken.

The off-shore field survey was completed at the end of the wet season in March 2014. The distribution and abundance of seagrass varies seasonally, with maximum distribution and abundance in late spring / early summer, when water clarity is generally good (Rasheed et al. 2013). High rainfall and associated runoff during the wet season reduces water clarity, resulting in suboptimal growth conditions for seagrass. Consequently, the survey was not at an optimal time to determine the likely maximum distribution of seagrass in the area. However, regional work (Rasheed et al. 2013) suggest that seagrass is unlikely to occur along the alignment.

Prevailing weather conditions during the off-shore field survey were moderate to poor, with high rainfall and wave action. This resulted in poor water clarity throughout the survey area, and meant that obtaining useful video footage of benthic habitats was difficult. A combination of techniques (including video footage, visual observation of exposed sediment, sediment grabs and grappling) were used to survey benthic habitats along the proposed pipeline alignment.

22.2.4 Matters of NES

a) Occurrence

A critical component of an assessment of impacts on listed threatened species is the appropriate use of the protected matters report which lists possible species based on a wide range of sources. The terrestrial and aquatic ecology specialists used the protected matters report as a checklist and then made an assessment of their likely presence on-site or in the adjacent area, based on knowledge of the project site (literature research, professional experience), and the preferred habitat of listed species. This assessment was informed by a targeted search of the site for all listed species in accordance with the survey methodology described above and the following methodology:

- Confirmed: The species has been definitively recorded using one or more of the survey techniques described.
- Likely: The species is known to occur within the project area and/or there is core habitat in the project area.

- Unlikely: The species is considered to have a low likelihood of occurring in the project area, or occurrence is infrequent and transient. There may be habitat for the species; however, it is marginal or not considered core habitat. Existing database records are considered historic, invalid or based on predictive habitat modelling. Despite a low likelihood based on the above criteria, the species is known from the wider region and could potentially occur.

Table 22-7 sets out criteria used to assess the likelihood of occurrence of species.

TABLE 22-7 CRITERIA USED TO ASSESS THE LIKELIHOOD OF OCCURRENCE OF SPECIES

LIKELIHOOD OF OCCURRENCE	DEFINITION	FURTHER ASSESSMENT REQUIRED?
Low	The species is considered to have a low likelihood of occurring in the study area, or occurrence is infrequent and transient. Existing database records are considered historic, invalid or based on predictive habitat modelling. The habitat does not exist for the species or the species is considered locally extinct. Despite a low likelihood based on the above criteria, the species cannot be totally ruled out of occurring within the study area.	No
Moderate	There is habitat for the species; however, it is either marginal or not particularly abundant. The species is known from the wider region and could potentially occur in the study area.	Yes
High	The species is known to occur within the study area and there is core habitat in the study area.	Yes

Source: frc environmental (2014a).

b) Stage 4 – Assessment of Likely Impacts

An assessment was made of the likely impacts to listed species that were moderately or highly likely to occur in areas that may be impacted by the project, or for which suitable habitat is likely to be impacted. The impact assessment was undertaken in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoTE 2013c). Whether or not an impact on a matter of NES is significant under the EPBC Act depends on four criteria:

- the matter (or value etc.) must be present in the area of the proposed action or be capable of being affected by it
- there must be the potential for impacts
- any proposed measures to avoid or reduce impacts must be considered to be ineffective in reducing the level of impact below the ‘significant impact’ threshold
- the impacts must be likely to be significant (important, notable, or of consequence, having regard to their context or intensity).

These principles and detailed impact significance criteria ((DoTE 2013c) are referred to in this chapter.

22.3 PROJECT BACKGROUND

22.3.1 Study Area and Project Site

For the purposes of this report:

- the **Project Site** (or **Aquis Site**) is the parcel of lots upon which the project is to be constructed
- the **study area** (or **Investigation Area**) is that part of the Barron River delta and near-shore area that surrounds the project site and could be influenced by it – nominally from the Barron River in the south to Trinity Beach in the north and east into near-shore parts of the Coral Sea.

22.3.2 The Site

a) Lots Comprising the Site

The site comprises 11 freehold titles as shown on **Figure 22-6**. These lots are currently under option to purchase by the proponent and have a total area of 340.63 ha (including an easement and excluding a reserve for esplanade) as detailed in **Table 22-8**.

TABLE 22-8 LOTS COMPRISING THE SITE

LOT AND PLAN	TITLE REFERENCE	AREA (ha)	TENURE	ROAD FRONTAGE
Lot 100 on NR3818	20983091	119.521	Freehold	Yorkeys Knob Road and Richters Creek Esplanade
Lot 1 on RP800898	21449027	34.245	Freehold	Yorkeys Knob Road
Lot 2 on RP800898	21449028	53.914	Freehold	Yorkeys Knob Road
Lot 2 on RP745120	21343157	26.331	Freehold	Yorkeys Knob Road and Dunne Road
Lot 60 on RP835486	21027116	43.252	Freehold	Yorkeys Knob Road and Dunne Road
Lot 4 on RP713690	20503245	3.507	Freehold	Yorkeys Knob Road
Lot 1 on RP724792	20864025	0.218	Freehold	Yorkeys Knob Road
Lot 2 on RP746114	21360116	0.251	Freehold	Yorkeys Knob Road
Lot 3 on RP746114	21360117	0.200	Freehold	Yorkeys Knob Road
Lot 4 on RP746114	21360118	28.791	Freehold	Yorkeys Knob Road
Lot 4 on RP749342	21418082	30.421	Freehold	Yorkeys Knob Road
TOTAL		**340.63**		

Source: Study team compilation based on the Queensland Government Digital Cadastral Data Base (DCDB).

Figure 22-6 Real property details.

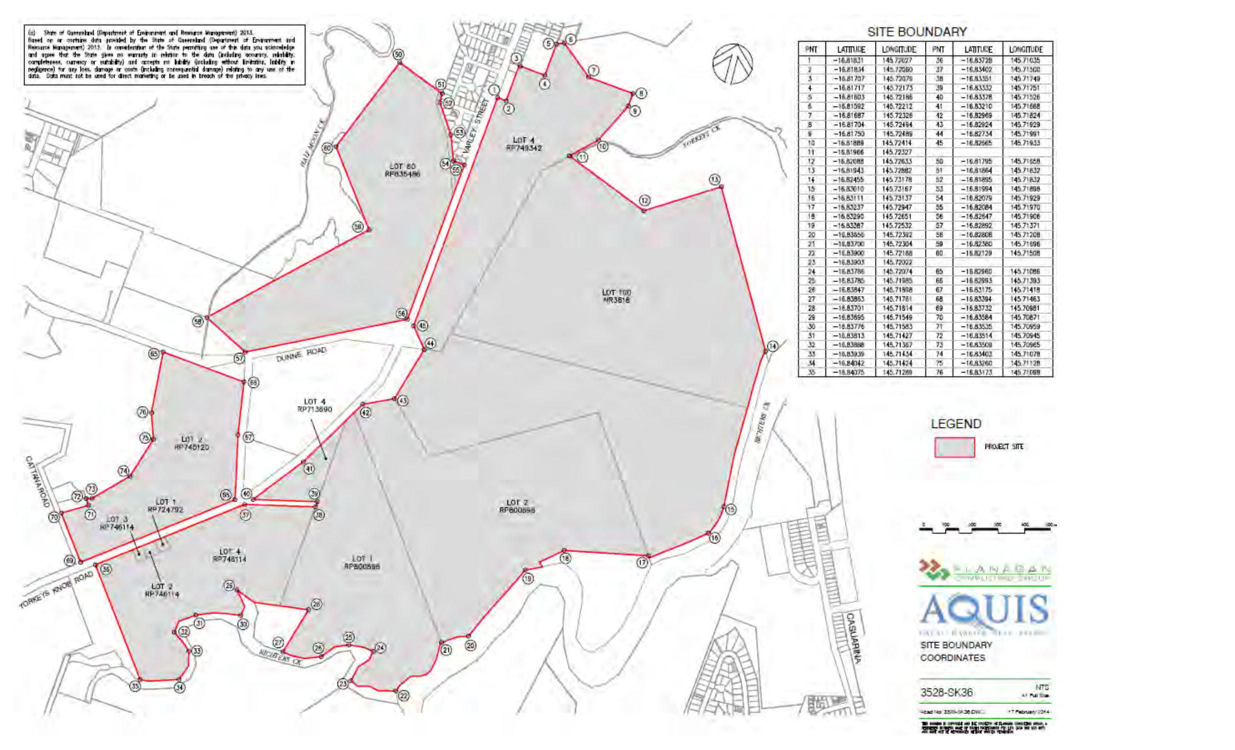


Figure 22-7 RP details and boundary coordinates.

The following is a simplified description that denotes the north / east / south / west extents shown on the above map and in the coordinates table.

TABLE 22-9 COORDINATES OF PROJECT AREA LIMITS

LIMIT	POINT ON MAP (Figure 22-7)	LATITUDE	LONGITUDE
Most northerly	6	-16.81592	145.72212
Most easterly	16	-16.83111	145.73137
Most southerly	35	-16.84075	145.71289
Most westerly	65	-16.82960	145.71086
Western end of pipeline	90	-16.82334	145.73189
Eastern end of pipeline	91	-16.80794	145.74897

As shown above, the lots are accessed by either or both of Yorkeys Knob Road or Dunne Road. The Richters Creek Esplanade on the eastern boundary of Lot 100 on NR3818 is unformed and provides no physical access to the creek or adjacent land.

b) Existing Land Use

The 340.6 ha Aquis site is currently used predominantly for sugar cane production. Of the total area, 211 ha (62%) is currently under cane while the balance consists of natural areas, cleared but unfarmed areas, farm infrastructure (roads, farm dams, and various structures), and abandoned aquaculture ponds. These features are shown on the following figure. By way of explanation:

- Land formerly cleared for sugar cane but which has been abandoned due to salinity issues is referred to as man-made or anthropogenic grassland. It contains some areas of marine plants that have recolonised the cleared areas and has some habitat values.
- The abandoned aquaculture ponds are man-made dams formerly created for fish-farming. This activity was abandoned many years ago and the (fresh water) ponds have been colonised by a range of native and exotic plants and animals. Water levels vary considerably over the year and are used during the dry season by many species of birds when other resources are scarce and when water depths are low and therefore attractive for edge feeders.

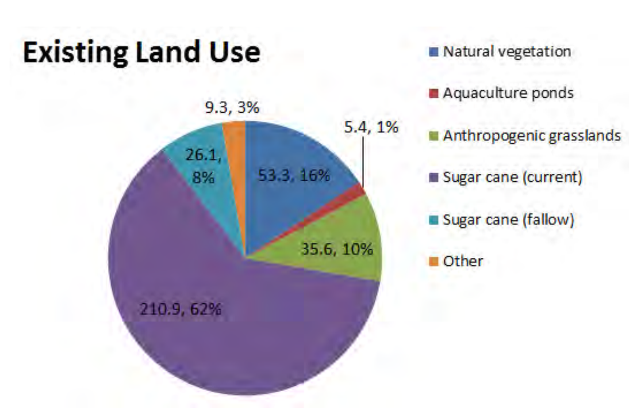
A Geographic Information System (GIS) analysis of the land use data is provided in **Table 22-10** below. The 'other category' includes:

- residences
- farm buildings including equipment sheds and a former cane barracks
- a section of cane tramway
- roads and tracks
- exotic plantings.

The land is included in the Regional Landscape and Rural Production Area in the FNQ Regional Plan 2009-2013 and in the Rural 1 Planning Area under the CairnsPlan.

TABLE 22-10 EXISTING LAND USE

LAND COVER	AREA (ha)	% of SITE
Natural vegetation	53.3	16%
Aquaculture ponds	5.4	2%
Grasslands (former cane land)	35.6	10%
Sugar cane (current)	210.9	62%
Sugar cane (fallow)	26.1	8%
Other	9.3	3%
TOTAL	**340.6**	**100%**



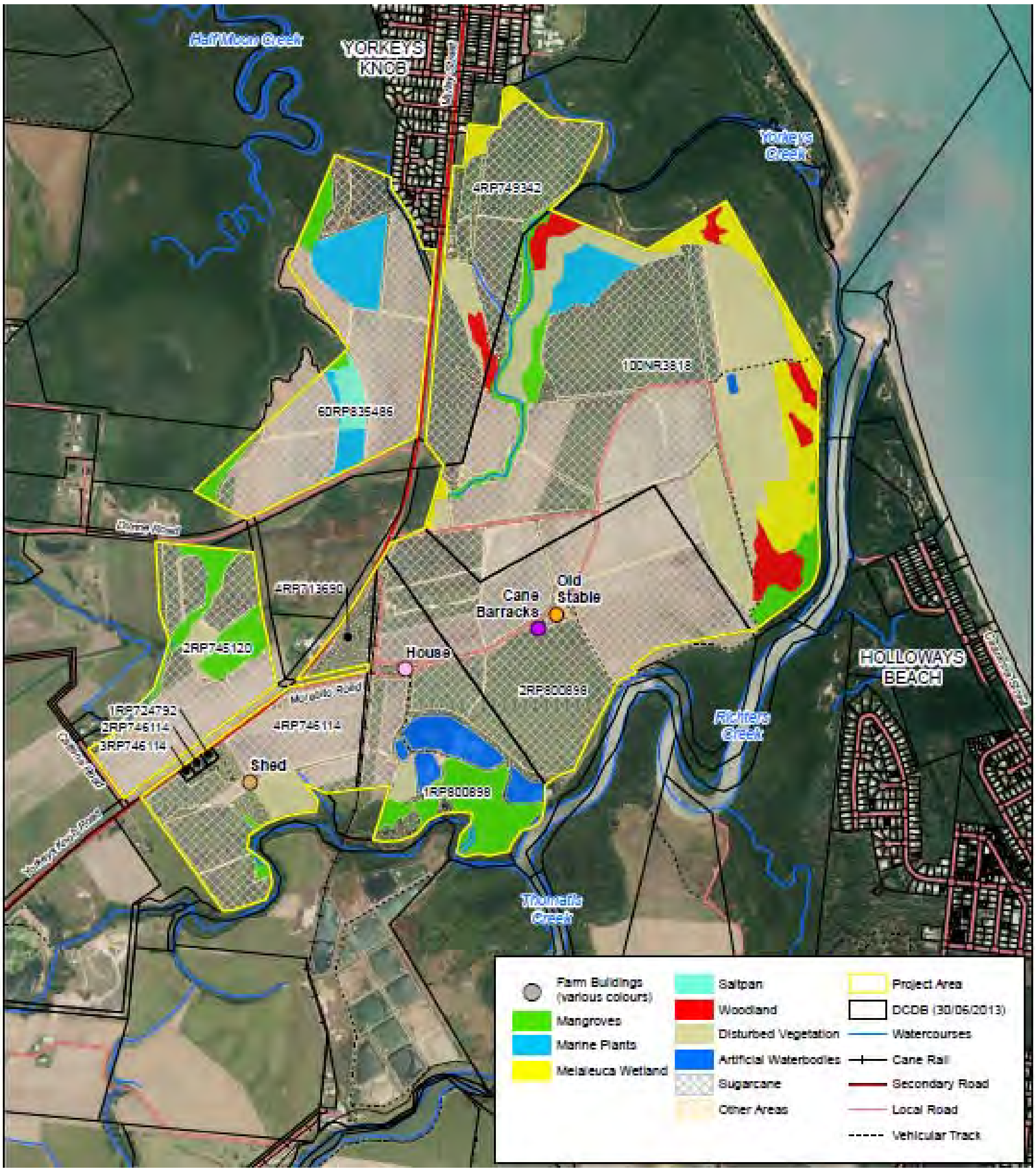


Figure 22-8 Existing land use.

c) Conservation Context (Protected Areas)

Although the site is largely cleared, it is surrounded to the north-west, north, and north-east and south-east by remnant coastal vegetation and marine areas, most of which are protected under a raft of Queensland legislation and in particular two Fish Habitat Areas and part of the Great Barrier Reef Coast Section of the Queensland Marine Park. Off-shore from low water (and up Richters Creek to its confluence with Thomatis creek and beyond) lies the GBRWHA while the GBRMP lies some 3.5 km further off-shore.

The key environmental features surrounding the Aquis site are:

- protected areas (e.g. the GBRWHA, Queensland Marine Park (Great Barrier Reef Coast Section), the Yorkeys Creek Fish Habitat Area (FHA-034) – Area B and the Half Moon Creek Fish Habitat Area (FHA-033) – Area B
- regional ecosystems (small areas of ‘Of concern’ and ‘Least concern’ regional ecosystems as listed under the *Vegetation Management Act 1999* (Qld) (VM Act) around the fringes of the site)
- wetlands (of various types and values).

Key ecological features are shown on **Figure 22-9**.

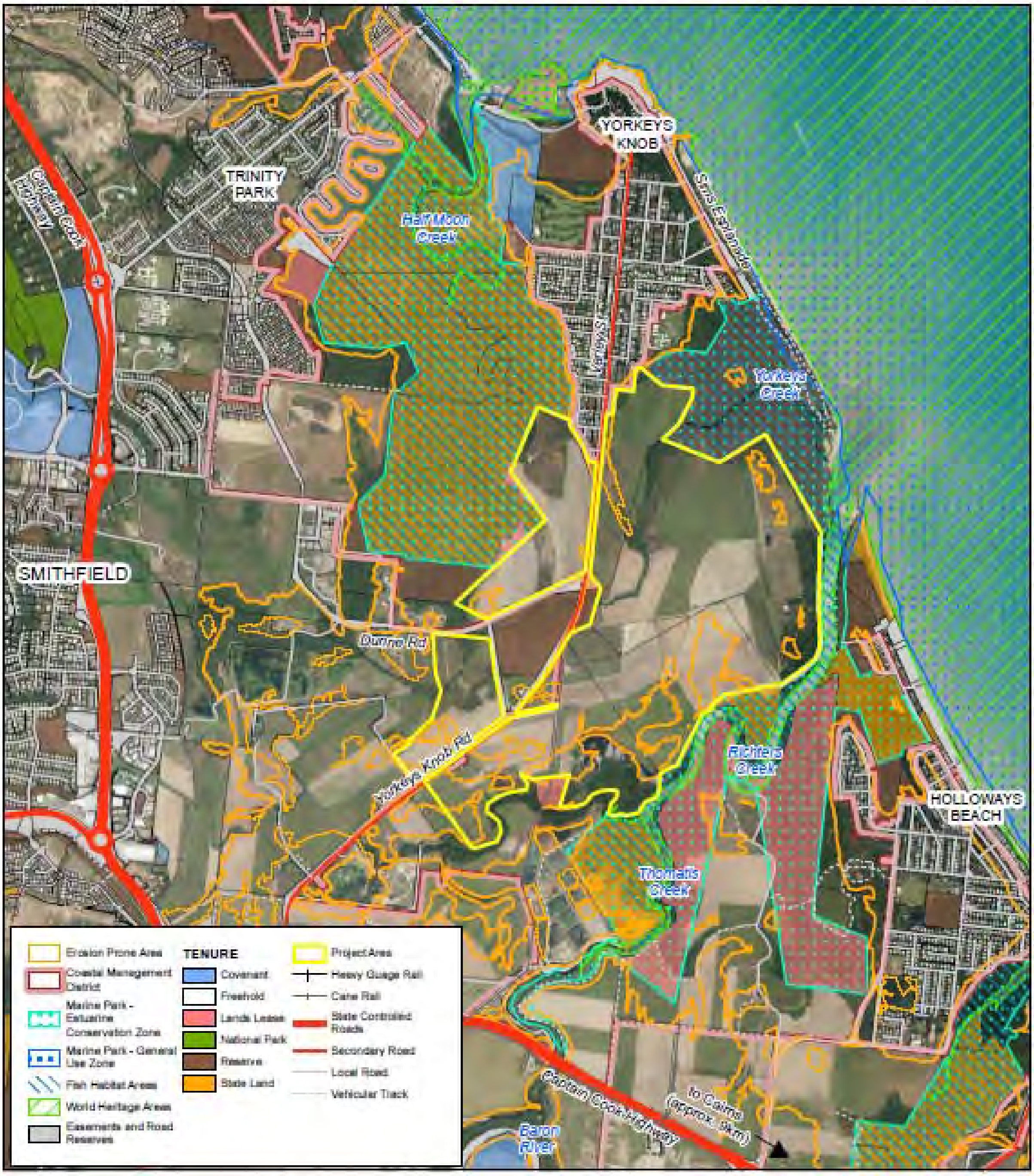


Figure 22-9 Environmental context.

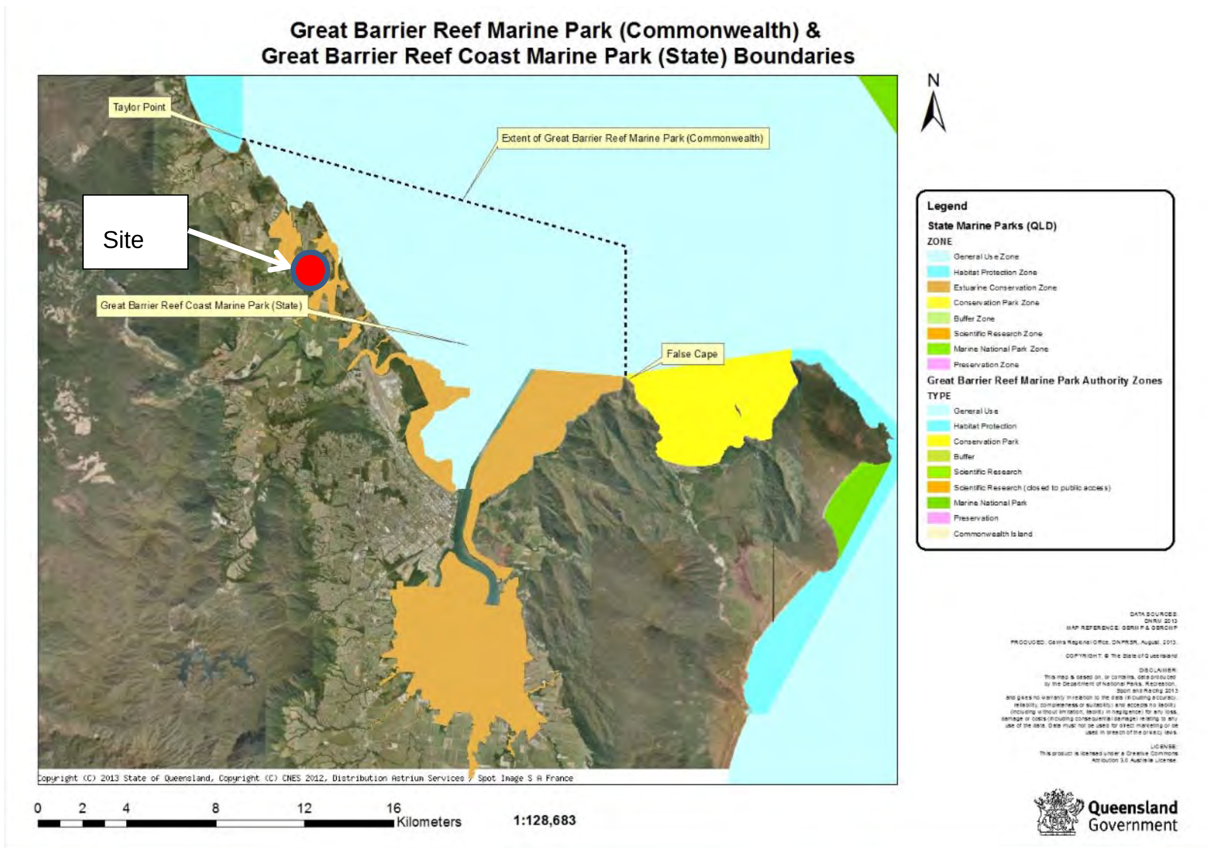


Figure 22-10 Great Barrier Reef Marine Park and Great Barrier Reef Coast Marine Park.

See also **Figure 22-4**.

The site contributes to and is part of the ecological functioning of the broader study area. Importantly, the maintenance of ecological values of the site and its surrounds depends on the continuation of key landscape-scale ecological processes/functions, namely:

- connectivity of habitats (terrestrial connectivity)
- watercourses that permit the free movement of aquatic fauna (aquatic connectivity)
- absence of pollution of surface and groundwater (water quality)
- maintenance of overland flows under natural flooding regimes.

22.3.3 The Proposed Project

a) Project Title

The project is titled **Aquis Resort at The Great Barrier Reef**. In this report it is referred to simply as the Aquis Resort.

b) Project Features, Range of Land Uses and Site Layout

The Aquis Resort includes the following key features, distributed over three precincts:

- Accommodation for up to 12 000 guests (at peak occupancy) in hotel rooms/suites, ancillary retail and food and beverage outlets, convention and exhibition spaces, entertainment facilities including casino and theatres, and an interpretative centre in a **Resort Complex** precinct.
- An 18 hole championship golf course, tennis centre, and other outdoor and sports and recreation activities in and a **Sports and Recreation** precinct.

- Protection and enhancement of the remnant environmental values on the site and improved bio-diversity and connectivity in an **Environment Conservation and Management** precinct.

The Precincts are shown on The Aquis Land Use Plan shown on **Figure 22-11**.The Concept Master Plan (**Figure 22-12**) shows more details of likely features that may occupy the various precincts.

Figure 22-11 The Aquis Precinct Plan.

Figure 22-12 Aquis Concept Master Plan.

Figure 22-13 Aerial View of Aquis Resort.

A summary of land use areas is shown below.

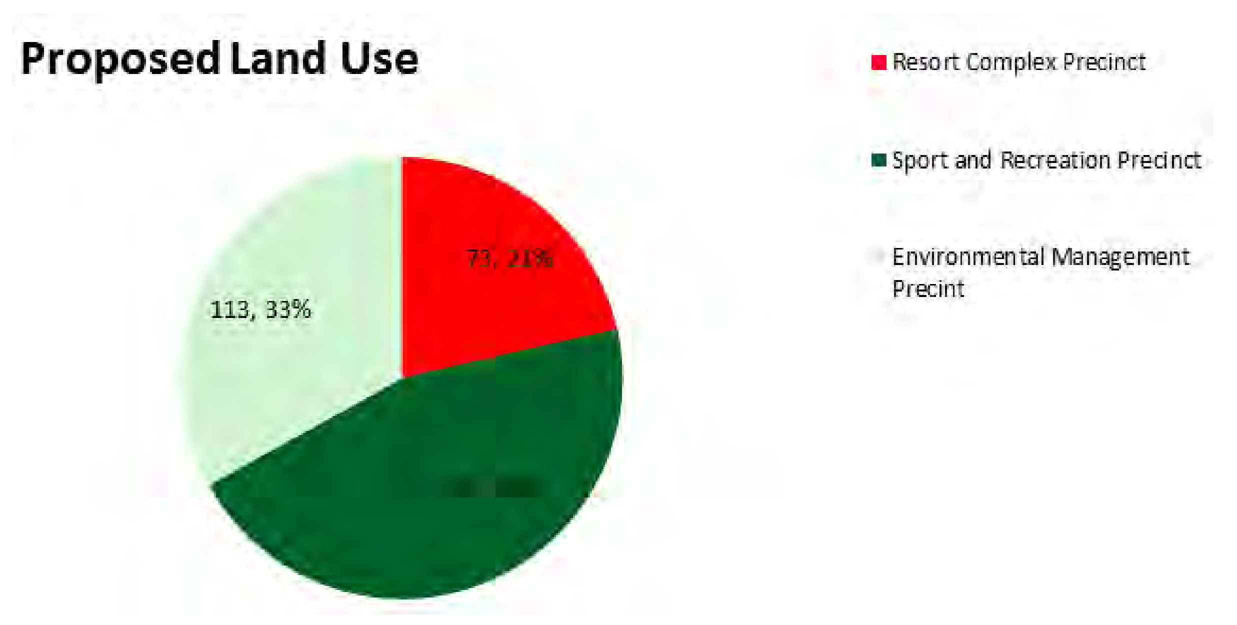


Figure 22-14 Proposed land use by precinct (ha, % of site).

c) Precinct Details

<u>Resort Complex Precinct (73 ha including Lake)</u>

The resort complex is generally located on an 'island' with an area of approximately 40 ha surrounded by an artificial lake with an area of 33 ha. This lake is a flood mitigation solution and has been designed to allow the resort to be safely built above the Probable Maximum Flood[10] (PMF) / stormtide level (see **Section 22.3.4b)**). The lake provides flood plain storage and conveyance such that floodwater can safely pass around the island without creating afflux or unacceptable changes in velocity that could affect adjacent land (see **Figure 22-18**). The design of the lake was a critical concept design task. The 'resort island' will include all features shown in **Table 22-11** below.

The aquarium is an architectural feature in the central facilities and is not a stand-alone use or public aquarium. The proposal does not include any permanent residential elements.

TABLE 22-11 RESORT COMPLEX PRECINCT ELEMENTS

ELEMENT	NO	GFA (M2)
Hotel rooms/suites configured in 8 towers	7500	625 000
Casinos	2	40 000
Convention and exposition	1	23 000
Theatres	2	5000
Retail		10 000
Aquarium	1	2250

10 Probable Maximum Flood (PMF) is a very extreme theoretical flood used for emergency management planning.

ELEMENT	NO	GFA (M2)
Rainforest		2500
Circulation/shared space/back of house/services		350 000
Guest/staff parking	1400	80 000
Landscaping/lagoons/pools/entry water feature		110 000

The following (**Figure 22-15**) is a detailed layout of the resort complex precinct.

Figure 22-15 Layout (ground floor) of Resort Complex Precinct.

When completed, the Aquis Resort will provide employment for up to 20 000 staff.

<u>Sport and Recreation Precinct (155 ha)</u>

The principal land use in the **Sports and Recreation Precinct** is an 18 hole golf course, together with:

- tennis complex
- stormwater quality improvement devices
- miscellaneous minor flood-tolerant infrastructure (e.g. carpark, maintenance workshop, sheds).

Broad uses within this precinct are as shown on **Figure 22-12**.

The golf course, tennis club and other facilities are located in the sports and recreation precinct, generally surrounding the resort complex precinct. The sports and recreation precinct also includes an area to accommodate up to 3000 staff carparks.

In recognition of the limited sports and recreation facilities currently available to the community at Yorkeys Knob, the proposal includes the development of a community sports and recreation facility on land north of Dunne Road and west of Yorkeys Knob Road. The facilities to be provided and the range of uses and sports to be accommodated will be determined through consultation and engagement with the Yorkeys Knob Community during project implementation.

The golf course is proposed to be irrigated when necessary using some of the 1400 ML/a (approximately) of treated sewage effluent imported from one or both of the two nearby sewerage treatment plants operated by CRC.

Environment Conservation and Management Precinct (113 ha)

The **Environment Conservation and Management Precinct** covers the outer fringes of the site as well as the Yorkeys Creek corridor. It includes (see also **Section 22.4.2**):

- protection of the overwhelming majority of the 58 ha of natural vegetation on the site (clearing is largely restricted to the existing aquaculture ponds)
- ecological restoration works and other plantings involving over 55 ha of natural vegetation around the perimeter of the site, along Yorkeys Creek, and along the eastern frontage of Yorkeys Knob Road
- restoration works involving buffers to existing natural vegetation
- removal of waterway barriers and the consequential improvement of connectivity of Yorkeys Creek through to the Cattana Wetlands
- stormwater quality improvement devices.

This precinct covers one third of the site and connects with natural areas adjacent. See also **Section 22.4.2**.

d) External Works

External works include:

- construction and operation of a buried seawater inlet pipe for lake exchange drawing sea water from the Coral Sea at a appoint approximately 2.2 km north-east of the site where the water is some 8.1 m deep at low water and free from near-shore turbidity (see **Figure 22-16**)
- construction and operation of a buried seawater outlet pipe for lake exchange discharging lake water (essentially seawater) via a diffuser located in Richters Creek near its mouth
- works to upgrade Yorkeys Knob Road to a suitable flood immunity, including replacement of the undersized culvert carrying Yorkeys Creek with a small bridge to enhance riparian connectivity
- a range of infrastructure upgrading works by Council and others to accommodate Aquis demands on the regional services network.

Figure 22-16 shows the proposed lake inlet and lake outlet infrastructure.

Figure 22-16 Conceptual plan of inlet and outlet structures.

The technical performance of this system is discussed in **Chapter 11** (Water Quality).

e) Environmental Policies and Commitments

The project also includes a suite of proponent polices and commitments as outlined below.

<u>proponent Policies</u>

Aquis Resort at The Great Barrier Reef Pty Ltd has developed a series of project-specific policies that demonstrate the proponent's commitments to positive environmental and community outcomes, namely:

- Environmental Policy
- Communities Policy
- Health and Safety Policy
- Commitment to Local Business Policy
- Employee Relations Policy.

A copy of these policies is included as **Appendix C**.

<u>Proponent Commitments</u>

The proponent makes the following detailed commitments in relation to the project. These fall into four main aspects of the project, namely:

- Environment
- Community (Social, Economic and Cultural)
- Infrastructure
- Financial Assurance.

The first and fourth of these are relevant to the referral as outlined below.

Environment Commitments

In terms of the Environment aspect, the proponent will:

- *Adopt best practice solutions to site drainage and water quality.*
- *Adopt best practice solutions for the environmental management of:*
  - ecosystems
  - airport operations
  - birds and bats (to avoid interfering with aircraft)
  - crocodiles and insect vectors
  - dust
  - lighting
  - noise
  - visual screening.
- *Establish environmental management system to accord with AS14001.*
- *Adopt sustainable development practices, including:*
  - green building design
  - water harvesting and re-use including of treated wastewater and rainwater
  - energy efficiency
  - waste minimisation, re-use, and recycling.
- *Develop interpretive and educational programs to protect and present natural and cultural values and engender a high level of environmental awareness for guests and staff.*

The proponent will adopt and develop an environmental management plan for both construction and operations. The management plan will include traffic management plans for construction and events which attract significant external patronage. The site based management plan will include consideration of erosion and sediment control, management of acid sulfate soils, protection of water quality, and waste minimisation, re-use, and recycling.

Financial Assurance

In terms of the Financial Assurance aspect, the proponent recognises the values of the site and the region and understands its ongoing obligation to manage the site during construction and the project operations to ensure that there is no major direct environmental disturbance. The proponent understands its responsibility to meet any reasonable requirement for environmental management, repairs and rehabilitation in the event of extreme weather events, accident, calamity or financial distress.

The proponent is able to provide an assurance to the government and community that it will put in place the necessary policies of insurance to underwrite its commitment to repair and rehabilitate the landscape in these circumstances. Where reasonably required, the proponent will negotiate with the government in good faith to settle the terms upon which additional security/financial guarantees may be provided to better secure the proponent’s commitment to meet these.

f) Environmental Management

The project includes a program of environmental management actions to be taken during the design, construction and operation phases. In particular, the project will include a detailed Environmental Management Plan (EMP) containing an EMP (Construction) and an EMP (Operation & Maintenance) to guide the construction and operation phases respectively. Further details are provided in **Section 22.18**.

22.3.4 Consideration of Prudent and Feasible Alternatives

a) Locational Factors Influencing Choice of Site

<u>Regional Alternatives</u>

The initial brief for the Aquis Resort included the following criteria:

- proximity to an international airport
- proximity or gateway to the Great Barrier Reef
- regular international and domestic links through the airport.

Cairns was found to be preferable to the four other reef gateways when these criteria were investigated. Refer to the following schematic.

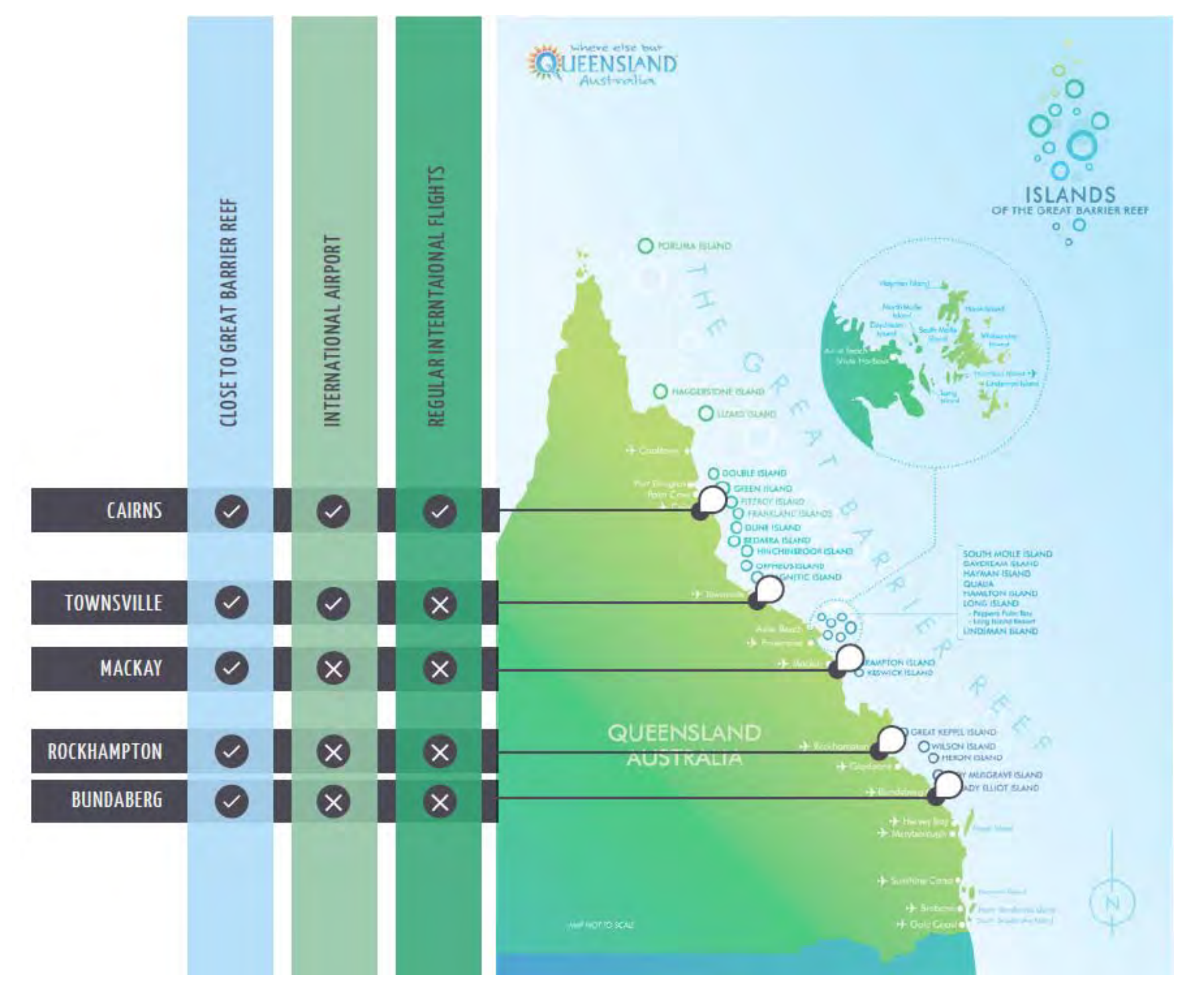


Figure 22-17 Screening analysis.

Subsequent Site Selection

In the Cairns context, comparisons were made between areas where sufficient land may be consolidated to facilitate the Aquis resort. These were the:

- southern corridor
- CBD
- Barron River delta
- Northern Beaches
- Atherton Tableland.

When standard accessibility and planning screening criteria were applied, the Barron River delta ranked highest. While all three sites within the delta that were considered (not described in order to protect commercial-in-confidence information) for were assed for strategic cropping land and flood constraints, the Yorkeys Knob site provided the best opportunity to contain impacts. In addition, an attractive feature of the site is that all the land is in freehold tenure.

b) Natural Hazards

The Aquis site is exposed to a number of natural hazards, the most important of which are tsunami, elevated water levels and high winds associated with tropical cyclones, and Barron River flooding. Of some but lesser risk are coastal erosion and river migration. These are discussed in detail in **Chapter 12** (Hazards).

Flooding

Figure 22-18 and the associated narrative briefly describe flooding behaviour (refer also to **Chapter 9** – Flooding). While this is not central to a discussion on EPBC Act issues, the solution to the flooding challenge is the lake and the lake is a major element when considering water quality issue which could affect the GBRWHA.

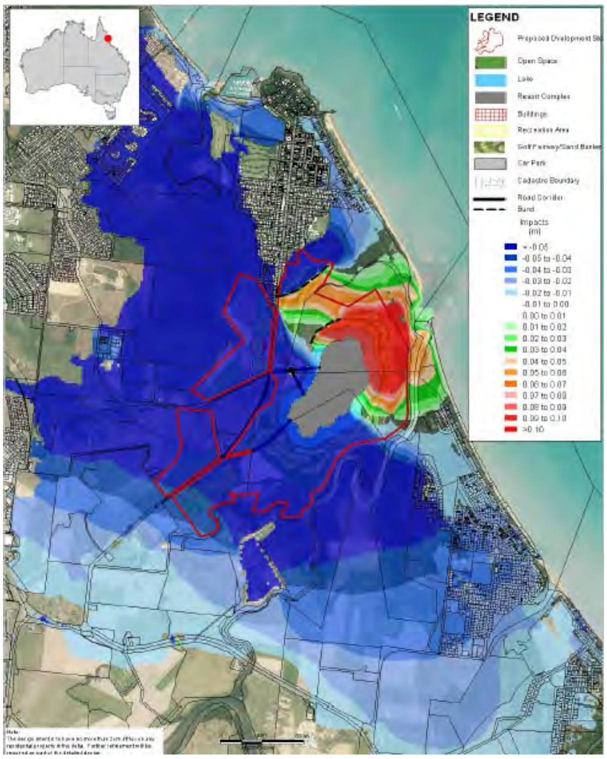


Figure 22-18 Flood modelling results of 1% AEP flood.

This figure demonstrates that the resort can feasibly be designed to achieve a no significant worsening impact on private land beyond the site, in terms of actionable damage and nuisance. In particular it shows that:

- upstream of the development, there are extensive areas of predicted flood level reduction (shades of blue) and no unacceptable flood level increases
- downstream of the development, significant impacts (red and orange) are contained to non-urbanised areas
- predicted velocities across the site are generally less than 1 m/s and therefore are non-scouring for grassed areas and are not highly hazardous to people
- flood modelling and impact assessment has also been carried out for a range of events and this reveals that acceptable flooding impacts can be achieved across the full range of flood frequencies.

Overall, the impact is beneficial due to the lowering of flood levels on many Holloways Beach properties.

Elevated Water Levels

Design water levels arising from an assessment of cyclonic effects (storm surge, waves) and tsunami have been determined and have informed the concept design.

Coastal Erosion and River Migration

Deltas such at the Barron River delta are intrinsically mobile areas over geological time. Although extreme events can possibly cause significant changes in a delta in a short time, the available studies indicate that the major changes in recent times are in the lower estuary below at the Barron River / Thomatis Creek bifurcation. These changes are or could be expected to be in future:

- river mouth changes (including the effect of this on sand supply for beach nourishment)
- longshore sand transport and beach erosion and accretion
- short-term storm erosion potential
- longer term shore erosion, including the effects of sea level rise.

In addition, the coast line itself is mobile and the best estimate of shoreline erosion adjacent to the site over a 50 year planning period is 400 metres (this is outside the Aquis boundary).

Conclusion

While recognising that this hazard exposure presents constraints to the development, it is also the reason why the various parcels that comprise the Aquis site are still undeveloped. As the technical studies undertaken in support of this EIS have shown, the Aquis site is large enough and the project sufficiently well-resourced to enable these constraints to be overcome. Specifically:

- The Resort Complex is to be built on a raised podium set at 7.5 m Australian Height Datum (AHD). This level:
  - is approximately 5 m above natural ground level
  - is above the Probable Maximum Flood (PMF) for all parts of the site
  - provides 2 m freeboard to the 0.01% AEP storm tide (allowing for 0.8 m sea level rise)
  - is also well above the 6 m AHD refuge level set by CRC for tsunami.
- The resort complex will include flood secure basements for car parking / back of house facilities under the podium level.
- Other parts of the site have generally flood-tolerant land uses.
- Provision is made for strategic armouring against river erosion.

c) Sensitive Environmental Areas

While the Aquis site is surrounded by protected areas such as Fish Habitat Areas, an area of Queensland Marine Park, and the Great Barrier Reef World Heritage Area, and contains valuable remnant vegetation with relatively intact ecological function around its perimeter, most of the land (285 ha or 83%) has been cleared of native vegetation as part of historic use for sugar cane production and this area provides a major opportunity for development. The main constraints posed by the presence of the on-site and adjacent sensitive environmental areas are:

- the need to protect and if possible enhance remnant vegetation around the perimeter and along the degraded but still functional Yorkeys Creek
- the need to protect ecological processes, and in particular maintain the water quality of adjacent areas by managing stormwater and ensuring that the lake discharge water is of an acceptable standard.

d) Summary

The subject site is suitable and probably optimal for development for the following reasons:

- The proponent has insisted that the site be adjacent to the GBR. This is a project 'must-have' fundamental to the proponent's vision. The Yorkeys Knob site is immediately adjacent to the GBRWHA and in close proximity to both the GBRMP and the WTWHA – areas which are internationally recognised attractions.
- Compared with other regional centres that are also close to the GBR, the Aquis site is serviced by a modern airport that currently handles a high volume of international and domestic traffic. The airport has adequate capacity to handle the expected flights and is only a few minutes' drive from the Aquis site. Guests will be transported to the site by high occupancy vehicle to minimise vehicle movements and traffic impacts.
- Although it is subject to natural hazards (notably storm tide and Barron River flooding), this hazard exposure is the reason why the various parcels that comprise the Aquis site are still undeveloped. The Aquis site is large enough and the project sufficiently well-resourced to enable these constraints to be overcome.

Although the site is surrounded by protected areas and contains valuable remnant vegetation with relatively intact ecological function around its perimeter, over 83% of the site is cleared and this area provides a major opportunity for development.

22.4 IMPACTS

22.4.1 Impacts – Discussion and Screening

In the following screening of impacts, reference is made to the proposed environmental framework (especially the Environmental Management Plan (Planning) (EMP (Planning)) described in **Chapter 23** (Environmental Management Plan). In the interests of making this chapter as self-contained as possible, much of **Chapter 23** has been repeated in **Section 22.17** and **Section 22.18**.

Particular construction phase management plans / strategies that are relied upon to protect matters of NES are expanded on in **Table 22-50** and include:

- Erosion and Sedimentation Control Plan (ESCP) – all aspects of construction management to manage rainfall and runoff.
- Acid Sulfate Soil Management Plan (ASSMP) – specific management of acid sulfate soil (ASS) and potential acid sulfate soil (PASS) described jointly as ASS / PASS.
- Integrated Water Management Strategy (IWMS) – all aspects of on-site use of potable water, treated effluent, water harvesting, and stormwater drainage and including Water Quality Management and Stormwater Management Strategy.
- Fauna Management Strategy – specific actions to manage native fauna during construction.
- Weed and Pest Management Strategy – control of pest species during construction.
- Lake Management Strategy – all actions required to protect lake water quality and that of the receiving environment.

a) Types of Impacts

Various types of impacts on matters of NES are relevant (SEWPaC n.d.):

- Direct impacts may include for example direct clearing of vegetation and habitat, construction of buildings and impacts to water quality through runoff.
- Indirect and/or consequential impacts may include, but are not limited to, the risk of weed invasion, pollution, noise, increased boat strike on marine fauna and increased impacts from recreational activities, such as fishing. The department may also consider road upgrades and supporting water and power infrastructure and the possibility that urban development and population growth may be encouraged in the surrounding region as a result of the proposed development. Consideration may also be given to changes to the shoreline as a result of land reclamation.
- Cumulative impacts which may be considered include coastal development (including habitat loss and degradation, and underwater noise) and changing landscape character, catchment runoff (creating greater accumulation of toxins and bacteria), climate change impacts such as extreme weather events and the combined effects of the proposed development in light of these.

The above definitions are consistent with those adopted by in the strategic assessment of the GBR (GBRMPA 2013a):

- Direct impacts — where the loss or modification of values is a direct result of an action within the strategic assessment area (for example, dredging and disturbing wildlife). Indirect impacts — can be either:
  - from actions outside the strategic assessment area with 'downstream' effects in the area (for example, modifying supporting terrestrial habitats, urban and industrial discharge)
  - as a result of another direct impact (for example, an oil spill resulting from the grounding of a ship).
- Consequential impacts — where the impact arises from an action made possible by an initial direct impact (for example, anchor damage from ships now able to visit an area after dredging).
- Cumulative impacts — the successive and combined effects of impacts on the environment, taking into account direct, indirect and consequential impacts and the incremental and compounding effects of these impacts over time.

An assessment against these categories is provided in **Table 22-49** and the subsequent text.

b) Impact Screening

Simplified Project Details

For the purposes of this assessment, the project has been simplified into a broad land cover plan that shows the three precincts (**Resort Complex**, **Sport and Recreation**, and **Environmental Management and Conservation**) and the lake which forms part of the **Resort Complex** precinct.

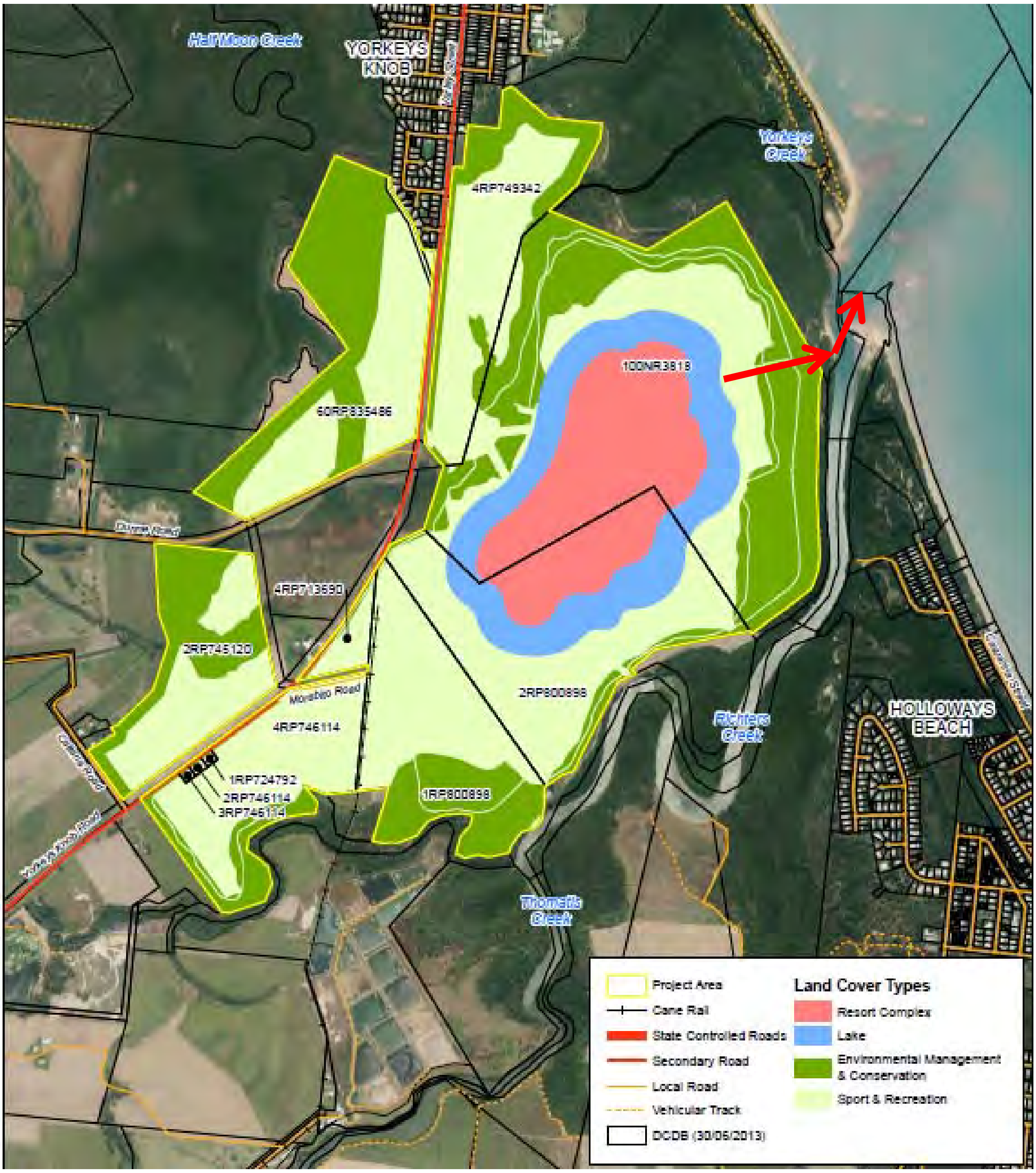


Figure 22-19 Land cover plan. Arrows represent lake discharge the mouth of Richters Creek (ebb tide only).

<u>Potential Impacts on Matters of NES</u>

In assessing potential impacts arising from the Aquis development in the context of a landscape-scale property like the GBR (taken to include the World Heritage Area, National Heritage Place, and GBRMP), consideration needs to be given of the scale over which impacts should be considered. Guidance on this issue has been obtained from GBRMPA (2013a). Table 6.1 of that report lists all likely impacts on the GBR and assigns a scale of applicability (Local, Regional, and Reef-wide).

Table 6.2 of GBRMPA (2013a) assigns this list of impacts to a range of activities. The most relevant of these activities to Aquis is considered to be 'Urban development'. In addition, 'Tourism' is also considered as it is likely that some Aquis Resort guests will choose to visit the GBR (and WTWHA).

In terms of 'urban development', **Table 22-12** below is an amalgamation of Tables 6.1 and 6.2 (i.e. expected impacts caused by urban development and the scale of these impacts) and provides a suitable screening of applicable impacts. In particular:

- the 'Urban development' impacts are listed in the first three columns of the following table
- the balance of the table covers the study team's assessment of:
  - relevance to Aquis (recognising that not all urban development issues apply)
  - project phase (construction / operation)
  - significance (major / minor) including direction (beneficial / adverse)
  - relevance to the designated controlling provisions
  - EIS chapter where more details are provided.

Colour coding is used as follows:

-	Very little or no impact		Major adverse impact
	Minor adverse impact		Major beneficial impact
	Minor beneficial impact		

This high level screening has guided the material presented in the balance of this chapter.

Likely 'tourism' impacts are discussed in **Section 22.4.1c)** along with identified 'urban development' impacts.

TABLE 22-12 POTENTIAL IMPACTS

GBRMPA ASSESSMENT GBRMPA (2013a) Tables 6.1 and 6.2			STUDY TEAM ASSESSMENT (see note below table)			CONTROLLING PROVISION						
Abbreviated Title	**Impact**	**Scale**	**Relevance**	**Construction**	**Operation**	**GBRWHA & NHP**	**Listed threatened flora**	**Listed threatened fauna**	**Listed threatened communities**	**Listed migratory species**	**GBRMP**	**EIS CHAPTER**
Acid sulphate soils	Exposure of potential acid sulphate soils	Local	Possible minor construction impacts (can be effectively mitigated by management).	■	-	✓				✓		15
Altered ocean currents	Altered ocean currents due to climate change or anomalies related to the El Niño-Southern Oscillation, and altered coastal water movement at a local scale	Reef-wide	Not likely to be significant. Lake discharge is estimated to be between 7% (spring tide) and 20% (neap tide) of the tidal prism of Richters Creek at the mouth of Richters Creek. The effect of this on the GBR is infinitesimal.	-	-							-
Artificial barriers to flow	Artificial barriers to riverine and estuarine flow including breakwalls, weirs, dams, gates, ponded pastures, and weeds causing changes to hydrology, groundwater and ecological connectivity	Regional	Minor beneficial impact likely. The concept includes the removal of five waterway barriers on or adjacent to the site (three tide gates and two undersized culverts). See **Table 22-13**.	-	■	✓					✓	7
Atmospheric pollution	Atmospheric pollution, including coal dust	Local	Not likely to be significant.	-	-							-

GBRMPA ASSESSMENT GBRMPA (2013a) Tables 6.1 and 6.2			STUDY TEAM ASSESSMENT (see note below table)			CONTROLLING PROVISION						
Abbreviated Title	**Impact**	**Scale**	**Relevance**	**Construction**	**Operation**	**GBRWHA & NHP**	**Listed threatened flora**	**Listed threatened fauna**	**Listed threatened communities**	**Listed migratory species**	**GBRMP**	**EIS CHAPTER**
Coastal reclamation	Coastal land reclamation, including for ports and groynes	Local	Not proposed.	-								-
Dredging	Dredging of the seafloor	Local	Possible minor pipeline construction impacts (can be effectively mitigated by management). See **Section** 22.4c).	■		✓				✓		7
Increased freshwater inflow	Increased freshwater inflow from prolonged or heavy rainfall including flood events, and from changes to catchment ecosystems; resulting in reduced salinity	Regional	Although the percent impermeable area east of Yorkeys Knob Road will increase relative to the cane farm, runoff will be attenuated by the lake. Further, because the lake will draw saline water from 2.2 km off-shore, the lake will recover quickly from flood effects and may have a small beneficial impact on salinity in Richters Creek.	-	■					✓	✓	11
Light impacts (artificial)	An increased amount of artificial light	Local	Likely but minor construction and operation impacts. See **Section** 22.4c).	■	■	✓		✓		✓		7

GBRMPA ASSESSMENT GBRMPA (2013a) Tables 6.1 and 6.2			STUDY TEAM ASSESSMENT (see note below table)			CONTROLLING PROVISION						
Abbreviated Title	**Impact**	**Scale**	**Relevance**	**Construction**	**Operation**	**GBRWHA & NHP**	**Listed threatened flora**	**Listed threatened fauna**	**Listed threatened communities**	**Listed migratory species**	**GBRMP**	**EIS CHAPTER**
Marine debris	Manufactured material discarded, disposed of or abandoned in the marine and coastal environment (including discarded fishing gear and plastics)	Reef-wide	Not relevant. [See 'tourism' **Section** 22.4.1c)]	-	-							-
Modifying supporting terrestrial habitats	Clearing or modifying supporting terrestrial habitats such as wetlands, saltmarshes, mangroves and sand dunes — this also includes trampling and damage from recreational vehicle use	Regional	Significant beneficial impacts are expected due to restoration of 55.7 ha of degraded land (over 100% increase in current on-site natural vegetation). See **Table 7-12**.	-		✓	✓	✓		✓	✓	7
Nutrients from catchment run-off	Nutrients entering the Region in run-off from the catchment	Reef-wide	Possible minor construction impacts (can be effectively mitigated by management). Significant beneficial impacts are expected due to WSUD and re-use of treated effluent. Approximate reductions are: • TP: 0.24 t/a (28%) • TN: 0.70 t/a (12%).			✓				✓	✓	11

GBRMPA ASSESSMENT GBRMPA (2013a) Tables 6.1 and 6.2			STUDY TEAM ASSESSMENT (see note below table)			CONTROLLING PROVISION						EIS CHAPTER
Abbreviated Title	**Impact**	**Scale**	**Relevance**	**Construction**	**Operation**	**GBRWHA & NHP**	**Listed threatened flora**	**Listed threatened fauna**	**Listed threatened communities**	**Listed migratory species**	**GBRMP**	
Outbreak of crown-of-thorns starfish	Outbreak of crown-of-thorns starfish (i.e. when the density exceeds about 30 starfish per hectare)	Regional	Increased nutrient loads are thought to lead to crown of thorns outbreaks (GBRMPA 2013a). Therefore proposed reductions in nutrient export will reduce this risk.	-		✓					✓	11
Pesticides from catchment run-off	Pesticides (including herbicides, insecticides, fungicides) entering the Region in run-off from the catchment	Regional	Possible minor construction impacts (can be effectively mitigated by management). See **Section** 22.4c). Significant beneficial impacts are expected due to the change in land use away from agricultural to urban and the use of WSUD.			✓		✓		✓	✓	15
Sediments from catchment run-off	Sediments entering the Region in run-off from the catchment	Regional	Possible construction impacts (can be effectively mitigated by management). Significant beneficial impacts are expected due to WSUD and re-use of treated effluent. Reduction in TSS is 132 t/a (46%).					✓		✓	✓	11

(Continued over)

GBRMPA ASSESSMENT GBRMPA (2013a) Tables 6.1 and 6.2			STUDY TEAM ASSESSMENT (see note below table)			CONTROLLING PROVISION						
Abbreviated Title	**Impact**	**Scale**	**Relevance**	**Construction**	**Operation**	**GBRWHA & NHP**	**Listed threatened flora**	**Listed threatened fauna**	**Listed threatened communities**	**Listed migratory species**	**GBRMP**	**EIS CHAPTER**
Spill — large chemical	Chemical spills that trigger a national or regional response or are more than 10 tonnes	Regional	Not likely from the proposed development.	-	-							-
Spill — small chemical and oil	Chemical and oil spills that do not trigger a national or regional response and are less than 10 tonnes	Local	Possible minor construction impacts (can be effectively mitigated by management). [See 'tourism' **Section** 22.4.1c)]	■	■	✓				✓	✓	15
Urban and industrial discharge	Point and diffuse-source land-based discharge of pollutants from urban and industrial land use and mining, including polluted water, sewage, wastewater and stormwater	Local	Possible minor construction impacts (can be effectively mitigated by management). See **Section** 22.4c). Operation impacts will be reduced by WSUD features.	■	■	✓				✓	✓	15
Wildlife disturbance	Disturbance to wildlife including from snorkelling, diving, fish feeding, walking on islands and beaches, and the presence of boats	Local	Not relevant. No beach access is proposed and all resort activities will take place on the site itself. [See 'tourism' **Section** 22.4.1c)]	-	-							4

(Continued over)

GBRMPA ASSESSMENT GBRMPA (2013a) Tables 6.1 and 6.2			STUDY TEAM ASSESSMENT (see note below table)			CONTROLLING PROVISION						EIS CHAPTER
Abbreviated Title	**Impact**	**Scale**	**Relevance**	**Construction**	**Operation**	**GBRWHA & NHP**	**Listed threatened flora**	**Listed threatened fauna**	**Listed threatened communities**	**Listed migratory species**	**GBRMP**	
Aesthetic considerations	Not included in GBRMPA (2013a) assessment	Local		■	■	✓						6

Source: Columns 1 to 3: GBRMPA (2013a) (Table 6.1 – 'Urban Development' impacts only and Table 6.2); balance of table: study team compilation.

Note: The designation of adverse and beneficial impacts as being significant at the regional to reef-wide level is a constraint of the table used (as Columns 1, 2 and 3 were determined by GBRMPA). A more rigorous analysis suggests that all impacts above (adverse and beneficial), while undoubtedly being significant at the site level, when considered in the context of the GBR as a whole are not likely to have significance at the regional to reef-wide level.

Discussion

Table 22-12 includes references to the EIS chapter where the relevant issue is discussed in detail. This detailed work is drawn on as appropriate. In summary, the screening shows that the construction and operation of Aquis is likely to have:

- no major adverse impacts (construction and operation)
- potential minor adverse construction impacts of local significance on nine impact categories:
  - acid sulfate soil
  - dredging (dredging will not be undertaken for the off-shore pipeline but this category has been taken to include underwater trench excavation as proposed)
  - light
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off
  - small chemical spills
  - urban discharge
  - aesthetic considerations
- potential minor adverse operation impacts of local significance on four impact categories:
  - light
  - small chemical spills
  - urban discharge
  - aesthetic considerations.
- potential minor beneficial operation impacts of local significance on three impact categories:
  - artificial barriers to flow
  - increased freshwater inflow
  - outbreak of crown-of-thorns starfish
- potential major regional beneficial impacts (although as the note following the table argues, these are really only of local scale) on four regional to reef-wide impact categories:
  - modifying supporting terrestrial habitats
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off.

c) Impact Assessment Arising from Screening

Prior to an assessment of impacts on each designated matter of NES, further discussion is provided below on the following (as they apply to more than one matter of NES):

- potential minor construction phase impacts:
  - construction of lake inlet and outlet pipework
  - disturbance of acid sulfate soil
  - disturbance of nutrients, pesticides, and sediments
  - land-based sediment export
  - small chemical spills

- potential minor adverse operation phase impacts:
    - light (and noise)
    - small chemical spills
    - urban discharge
    - tourism.

Impacts specific to design considerations have already been discussed, namely:

- **Chapter 7** (Flora and Fauna) – clearing, restoration, and connectivity
- **Chapter 11** (Water Quality) – lake discharge (salinity etc.) and WSUD
- **Chapter 10** (Water Resources) – avoidance of surface water / groundwater interaction by the quarantining of the lake from groundwater.

Findings from these assessments are highly relevant to impacts on matters of NES and are summarised in **Section 22.4.2**.

<u>Construction of Lake Inlet and Outlet Pipework</u>

Outline of Works

As detailed in **Section 11.3**, it is proposed to construct a submerged seawater inlet from a point 2.2 km north-east of Richters Creek to on-shore pumping facilities adjacent to the bank as shown on **Figure 22-20**. This pipeline is entirely within the GBRWHA and the inlet is some 1.9 km landward of the GBRMP boundary.

Figure 22-20 Route of lake inlet pipeline.

Outlet works are shown on Map B (**Figure 11-19**).

Construction of the Inlet Structure and Pipeline

The construction of the inlet pipeline will be a 'cut and cover' operation with excavation being undertaken by a long-reach excavator mounted on a spud pile barge. Silt curtains will be deployed around the excavation and work zone. If necessary, a no-fines gravel backfill will be used which could be dumped from a second barge.

Another barge will be used to all the construction team to make the pipe joints and progressively lower the pipe into the trench.

The trench is expected to be about 2 m deep and the disturbance about 4 m wide over the 2.2 km length.

Construction of the Outlet Structure

The outlet will consist of a diffuser located parallel to the bank (refer to **Figure 11-19**) with sufficient jets to adequately mix the discharge. The initial mixing zone will be designed to be within 2 m of the jet so that there will be no discernible effect on the natural tidal velocities within 5 m of the outlet. Hydraulic criteria are discussed in **Section 11.3**. This reveals that:

- the increase in tidal prism volume will not cause any notable increase in scour potential along Richters Creek
- the initial mixing zone will be designed to be within 2 m of the jet so there would be no discernible effect on the natural tidal velocities within 5 m of the outlet (assessment of these velocities and appropriate design responses will be addressed during detailed design).

In constructing the outlet works, a steel sheet pile cofferdam will be fabricated around the location of the outlet to allow works beneath the tidal levels within the creek. A cofferdam is a temporary structure that is designed to allow water to be excluded from the submerged construction area. Steel sheet piling is a manufactured construction product with interlocking mechanical connections between adjacent sheets to form a continuous wall of sheeting that will resist lateral forces from water, soil, wave action etc.

Figure 22-21 Outlet structure and shore-based works.

Source: Appendix M (Figure 8-2 part only)

The following is the general methodology for the construction and eventual removal of the cofferdam:

- A silt curtain will be installed around the site to contain sediments / materials that become suspended during construction. At this stage, any necessary temporary navigational markers are installed around the site to ensure public safety.
- Steel sheet piles will then be driven into the creek bed and banks around the perimeter of the work site (within the silt curtain). The length of the sheets will allow for the highest expected water level, allow for the sheets to be driven to the depth required to provide sufficient resistance to the forces that will be applied to the exterior of the cofferdam, and to provide resistance to the ingress of groundwater to the site (ongoing dewatering will be required). It may also be necessary to place rock around the external base of the cofferdam as a temporary measure to resist erosion from wave action and currents within Richters Creek.
- The area within the cofferdam will be gradually de-watered and bracing framework installed within the cofferdam as necessary to provide the necessary stability against the external forces on the structure.
- Following de-watering, the site will then be excavated to the necessary levels. Given the location of the site and the potential for ASS / PASS, the excavated material will be stockpiled in a contained site and if necessary, the material neutralised with lime in accordance with the ASSMP that will be in place at the time of construction.
- Following excavation to the necessary levels, concrete will be poured in the base of the cofferdam. This concrete will resist the ongoing ingress of groundwater into the cofferdam and will also form the structural base for the outlet diffuser, which will need to resist forces from the pumped delivery line from the lake. It is also noted that concrete-lined wells may be required around the inlet and outlet at a sufficient depth to allow operation under LAT conditions. Subject to detailed design, these wells will be incorporated into the concrete base as necessary. The wells will also function as dewatering sumps within the cofferdam during construction. Sections of pipe will be installed as an integral part of the well construction as necessary.
- The trenches for the inlet and outlet pipes will then be excavated and the pipes, outlet diffuser assembly etc. all installed and the area back-filled with the excavated material in accordance with standard earthworks compaction requirements.
- The cofferdam will then be gradually filled with water. As the water level increases within the cofferdam, the internal bracing structures can be sequentially removed.
- Once the cofferdam is completely full and all internal bracing structures are removed, the steel sheet piles will be removed, followed by the perimeter silt curtain and temporary navigational measures.
- Permanent navigational structures (markers / signage) are then to be installed in accordance with the requirements of Maritime Safety Queensland (MSQ).

Rehabilitation of the Site

Although the pipeline route has been selected to make use of an existing clearing, some natural vegetation will be unavoidably damaged / removed during construction. Necessary approvals for the removal of mangroves etc. will be in place prior to the commencement of works and the disturbed area will be rehabilitated with the existing species following completion of construction.

Waterway Safety / Navigational Requirements

MSQ has been contacted regarding the navigational requirements associated with construction of hazards within Richters Creek. Preliminary advice suggests that bollards adjacent to the ends of the outlet structure (with appropriate signage on the bollards) would satisfy requirements. The height and diameter of the bollards, along with the size and wording on the signage, will be designed to meet MSQ requirements.

Provision for Aquatic Organisms

Screening the inlet pipe will reduce the number of pest fish entering the lake and prevent potentially dangerous species (e.g. sharks) from entering the lake via this pathway. Screens will also be designed to prevent entrapment of aquatic fauna in the pipework etc.

Screens will also be provided on the entrance to the outlet pipe to avoid the risk of objects fouling the diffuser system and the export of undesirable aquatic organisms from the lake.

Existing Environment

A survey of the pipeline route was undertaken in March 2014. This involved:

- visual underwater inspection including video record
- benthic sampling (sediments and benthos).

The visual inspection shows that the substrate is devoid of vegetation (e.g. seagrass), coral, and any habitat features. Once seaward of the sand-dominated sediments at the mouth of Richters Creek, the sea floor was found to consist of soft un-vegetated muds typical of the turbid near-shore environment.

Potential Impact

Construction of the proposed inlet and outlet pipes at Richters Creek mouth will result in the direct loss of non-vegetated[11] soft sediments, and the associated macrobenthos. Given that the estuarine and marine areas adjacent to the areas of disturbance are typical of the region, the loss of this macrobenthic infauna is not likely to have a measurable ecological impact beyond the project footprint.

A small area of mangroves may need to be removed during construction of the on-shore component of the inlet / outlet pipes, although the pipeline route has been selected to follow an existing track where there are few plants present. Mangrove communities in the vicinity of the proposed pipelines appear to provide relatively poor habitat for fauna compared with other mangrove forests that fringe the project site, based on surveys of macroinvertebrate communities within the mangrove forests. Therefore, the fisheries habitat values of Richters Creek mouth are unlikely to be significantly affected by the loss of any of the mangroves that remain.

Photo 22-1 Location of on-shore works for inlet and outlet pipeline.

This location has been chosen as it is near the mouth where there are good dispersion conditions and is free from existing vegetation (it is the terminus of an existing cleared track that leads to the lake site).

[11] Devoid of flora; benthic microalgae are expected to be associated with the surface sediments

Excavation activities during construction of the seawater inlet and outlet pipes may also alter aspects of water quality. For example, disturbance of sediments in a reducing environment can lead to an elevation of biological and chemical oxygen demand, depleting enclosed waters of dissolved oxygen. Increases in bacterial concentration can also be associated with turbid waters surrounding dredging operations (Salvat 1987). Bacteria are known to adhere to suspended solids. Further, construction of the pipelines may also disturb ASS / PASS. Toxicants may also be released from the sediment. Depending upon the nature and extent of this release, impacts could range from morbidity and the reduction of reproductive capacity of some species, through to mortality of plants and animals.

Pipeline construction can also affect marine megafauna (e.g. turtles) through injury or mortality through accidental impact, and marine fauna are likely to show behavioural responses to increased noise during the dredging operations. These impacts are discussed further in the sections following.

Proposed Mitigation and Effectiveness

The proposed construction methodology described above is designed to reduce all impacts to a very low level of risk. In summary, risk of impacts to aquatic habitats and biota during construction of the inlet and outlet pipes will be by the following actions:

- perimeter silt curtains, bunds or similar technologies are used around the site to contain sediments / materials that become suspended during construction
- the sediments proposed to be disturbed during construction of the inlet and outlet pipelines are tested for contaminants prior to disturbance, and appropriate management measures are implemented according to the results
- an ASSMP is implemented during excavation and backfilling of the site
- coarse-grained sediments are used during backfilling to prevent siltation (where sediment testing indicates that a high proportion of fines are present in the sediments to be excavated)
- water quality monitoring is undertaken during the construction period, including the use of ‘trigger levels’ to effectively control suspended solids concentrations in adjoining waters
- areas where mangroves have been removed for construction of the pipeline route are rehabilitated
- marine fauna spotters are utilised during trench excavation operations.

<u>Disturbance of Acid Sulfate Soil</u>

Potential Impact

Disturbance of sediments during construction of the lake and inlet / outlet pipes (and lake excavation on the main site) may expose acid sulfate potential sediments to oxidising (acidifying) conditions that result in the release of acids to the ambient water. In addition, the on-site excavation activities have the potential to disturb ASS / PASS material.

A direct effect of the oxidation of pyrite is the lowering of pH. The consequences of short-term and localised acidification may be profound. As a result of exposure of acid sulfate soils, the growth rate and condition of fish and invertebrates are impaired and populations may be removed from the natural environment. A relatively sudden reduction of pH can result in fish-kills, disease and other disturbances (Sammut et al. 1993). Invertebrates (including molluscs, crustacea and worms) may also suffer mass mortality. Less visible are the more common chronic effects of reduced hatching and declined growth rates (Sammut et al. 1993). This is due to the unfavourable ionic composition of acidified water, the periodic presence of finely dispersed ferric hydroxide and mobilised aluminium, and the related reduced supply of algal feed (Brin kman & Singh 1981). Repeated flows of acid water prevent fish and invertebrate populations recovering, altering the natural food chain and nutrient cycles. An example of this is the outbreak of mosquitoes that can occur because larvae-eating fish are unable to survive the acid water (Sammut et al. 1993). Historical fluctuations in commercial finfish and prawn catches may be in part attributable to periods of enhanced acidity in estuarine waters (Leadbitter 1993).

Other environmental effects of acidification include the:

- dissolution of clay minerals and the release of soluble aluminium, which is highly toxic to gilled animals (including fish, molluscs and crustacea) and aquatic plants
- release of soluble iron, also toxic to aquatic life in high concentration
- oxidation of ferrous iron causing large decreases in dissolved oxygen.

Proposed Mitigation and Effectiveness

Chapter 15 (Geology and Soils) includes a conceptual ASSMP to the current state of design. The environmental management framework described in **Section 22.18.3** includes a commitment to develop a detailed ASSMP via the *Acid Sulfate Soil Management Strategy* which will involve the following:

- documenting further sampling required including ASS / PASS sample collection and analysis to achieve compliance with the State Planning Policy
- detailed groundwater and surface water quality monitoring to determine pre-development baseline conditions relating to ASS / PASS
- using results from sampling to avoid disturbance of soils with higher acid generating potential, where possible
- ensuring the EMP (Construction) specifies that soil stockpiling prior to treatment is limited to reduce the risk of oxidation
- impact mitigation by lime treatment (carried out in accordance with Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines (Dear et al. 2002)), or alternatively, placing PASS materials back below the water table at an approved location
- ensuring that the timeframe and extent of groundwater drawdown is limited for dry excavation works
- during construction, undertaking monitoring of groundwater levels and quality and implementation of water treatment, where required
- during construction, undertaking monitoring of surface water and any extracted groundwater / dewatering discharges and implementing water treatment where required
- avoiding filling on areas where ASS has been identified (if this is not possible, constructing lime trenches to protect surface water features and conducting additional groundwater quality monitoring).

Where these measures are implemented, the risk of impact due to disturbance of ASS / PASS is low.

<u>Disturbance of Nutrients, Pesticides, and Sediments</u>

Potential Impact

Without appropriate management, construction and operation of the proposed development may mobilise various chemicals in on-site or estuarine soils and result in an increase in nutrients to the estuaries and downstream coastal waters via a number of processes including:

- disturbance and excavation of soil and sediment
- release of treated effluent.

Nutrient enrichment of coastal waters can impact the health, composition and resilience of local floral and faunal communities. Impacts to aquatic biota that relate to nutrient enrichment include:

- aquatic plants:
  - changes to community composition and distribution of the mangrove and saltmarsh communities
  - an initial increase in biomass of mangroves followed by longer-term degeneration of mangrove communities as nutrient saturation levels are reached, and as species composition changes
  - increased uptake of other toxic chemicals as a consequence of enhanced growth due to increased nutrient supply
  - increased biomass of algae such as *Ulva* and *Enteromorpha* within the mangrove habitats, blocking drainage lines and preventing / retarding the establishment and growth of young seedlings
- benthic invertebrates:
  - a reduction in community diversity and species richness
  - trophic shifts toward deposit feeding taxa and the dominance of polychaetes in soft sediment communities
- marine vertebrates:
  - reduced habitat availability due to the deterioration of mangrove communities
  - reduction in the species diversity and production of crustaceans and molluscs can affect fish populations, that are important prey for many vertebrate species (e.g. dolphins).

Proposed Mitigation and Effectiveness

The remediation / management of contamination associated with historical cane farming activities is not a complex task. A large number of former cane farming properties in the Cairns region have been successfully remediated and redeveloped for residential and other sensitive land uses. Management of soils is an element of the proposed EMP (Construction) described in **Section 22.18.3**. The net impacts are likely to be very minor.

Risks to the receiving environment through the release of operation phase nutrient-rich water will be minimised through design of the proposed development, and in particular of the lake, stormwater, and sewage effluent management regimes.

Changes to water quality and hydrology are addressed in **Chapter 11** (Water Quality). Modelling indicates that the water quality of the lake discharge is expected to be superior to that of Richters Creek into which it will be discharged. A summary of performance is provided in **Section 22.4.2**.

The design of the project includes a commitment to the adoption of WSUD features as part of the stormwater drainage strategy. Modelling of stormwater indicates that, compared to current conditions (a functioning cane farm), the development will reduce export of the modelled pollutants by 131.6 t/a (45%). Effluent re-use (including importing of class ‘A’ treated effluent from nearby WWTP) will further reduce discharges to the estuaries and ultimately the Coral Sea (this effluent is licensed to be discharged to Half Moon Creek – by importing it to the Aquis site all remnant nutrients will be used on-site). The management of imported treated effluent will be undertaken within the IWMS. A summary of performance of the WSUD features is provided in **Section 22.4.2**.

Where these measures are implemented, the risk of impact due to nutrient enrichment or disturbance of contaminated sediment to aquatic flora and fauna is low.

Land-based Sediment Export

Potential Impact

Construction of the Aquis Resort has the potential to contribute sediment to the waters of Half Moon, Yorkeys, Thomatis and Richters Creeks and the downstream coastal environment. This risk is highest during the construction period, particularly in the wet season. Any increase in the sediment load entering the system would be expected to directly increase the levels of turbidity and suspended sediments in the water column, and may lead to enhanced sediment deposition and the smothering of benthic communities.

Excavation of sediments during construction of the seawater intake and outfall pipes will also temporarily increase turbidity and sediment suspension in estuarine areas at Richters Creek mouth, and in marine areas off-shore.

The potential impacts of increased turbidity, sediment suspension and smothering on local communities are:

- reduced growth of marine plants by limiting light for photosynthesis
- reduced respiration and feeding of benthic invertebrate communities leading to a reduction in abundance and biodiversity
- traumatization of fish gill tissues affecting growth and survival
- burying of aquatic plants (including roots and mangrove pneumatophores) and invertebrate communities (burrowing polychaetes and crustaceans)
- reduced algal and coral diversity and reductions in epifaunal densities in coral communities (however, note that the nearest coral community is >10 km from the mouth of Richters Creek).

The effect of increased suspended solid concentrations and sediment deposition on marine vertebrate communities is likely to be minimal, primarily because mobile organisms tend to avoid unfavourable environments. Further, the likely absence of seagrass in the area makes it unlikely habitat for listed threatened, migratory or marine species such as dugongs (*Dugong dugon)*, green turtles (*Chelonia mydas*) and syngnathids (seahorses and sea dragons). While some marine vertebrates will avoid areas of high turbidity, these waters may attract a range of fishes, particularly juveniles, as it confers a greater degree of protection from predators (Blaber & Blaber 1980).

The effects of increased suspended solids and sedimentation resulting from excavation and spoil handling are highly variable and will depend on both the techniques used and the season. The likelihood of increases in suspended sediments and of smothering are closely related to the characteristics of the sediment. Coarse sediments settle from the water column quickly and are less likely to move away from the excavation site. Fine sediments remain suspended longer and may be carried further before settling, and consequently are more likely to smother marine organisms.

Proposed Mitigation and Effectiveness

The risk of sediment run-off from terrestrial areas to nearby waterways will be reduced by a range of actions under an ESCP plan, namely:

- retention of all natural vegetation and buffers
- construction of sediment dams and contour banks prior to any vegetation clearing and earthworks (the lake will be used during construction as a sediment pond)
- timing of clearing and earthworks to minimise any wet season work
- staging of vegetation clearing and earthworks to limit the area exposed at any one time.

The risk of increased turbidity and sediment suspension during construction of inlet and outlet pipes will be reduced where:

- dredging activities be timed so that they do not coincide with coral spawning or known spawning periods for reef fish
- appropriate dredging and spoil handling methods are used
- the dredge / disturbance areas are effectively isolated, using silt curtains, oil spill booms, bunding, trenching and / or similar technologies
- water quality monitoring is undertaken during the construction period, including the use of 'trigger levels' to effectively control suspended solids concentrations in adjoining waters.

Operation phase sediment control is discussed above under the stormwater drainage strategy.

Where these measures are implemented, the risk of impact due to increased turbidity or sedimentation to aquatic flora and fauna is low.

<u>Small Chemical Spills</u>

Potential Impact

A moderate spill of chemicals (e.g. hydrocarbons or other contaminants) from construction plant and / or vehicle or other equipment may severely impact the local estuarine and marine ecosystems. Where the spill is a 'once-off', recovery is likely.

Hydrocarbons, heavy metals and other contaminants can have major impacts on estuarine communities, and can impact growth, morphology, reproduction and development of estuarine flora and fauna. The biological effects of toxicant discharge are usually greatest in low energy environments (such as within estuaries), where accumulation and retention in fine sediments occur (Gundlach & Hayes 1978; Jackson et al. 1989). Low energy, sheltered beaches show a much higher initial mortality, with the possible elimination of some species. Here, microbial degradation, rather than wave-action is the principle force for breakdown and removal.

Several studies have characterised the potential impacts of hydrocarbons in marine systems, however there is very little quantitative data readily available for specific communities. Mangroves have been shown to reduce growth rates and seedling survivorship due to acute and chronic hydrocarbon contamination (e.g. Proffitt et al. 1995). The potential impacts of hydrocarbons on corals range from mass mortality to loss of zooxanthellae, reduced growth and tissue degradation, with reduced growth and tissue degradation impairing settling ability (recruitment) and competition for space (e.g. Reimer 1975; White & Strychar 2010). The effect of hydrocarbons on invertebrates other than corals and coral-associated sessile invertebrates and vertebrates such as fish and reptiles is likely to be minimal, primarily because mobile organisms tend to avoid unfavourable environments. The hydrocarbon type and concentration, together with environmental factors (e.g. wave and wind action) and previous exposure influence the severity of impact.

Proposed Mitigation and Effectiveness

Best-practice vessel and vehicle management and site management will minimise the risk of contaminant spillage. Risks associated with the spillage of fuels and other contaminants will be substantially reduced, if not eliminated, by the following construction controls:

- vehicle maintenance areas, portable refuelling stations and storage of fuels, oils and batteries are undertaken within bunded areas that are designed and constructed in accordance AS1940 (2004) – *The storage and handling of flammable and combustible liquids* (as proposed for the project) and are above the Q100 flood level of nearby waterways and dams

- appropriate spill containment kits are available, and used for the clean-up of spills in the field. The kits should contain equipment for clean-up of both spill on land or in dry gullies, and spills to water (such as floating booms).

Artificial Light

Potential Impacts

GBRMPA (2013a) lists increased light and visual disturbance amongst local-scale impacts from urban development. **Chapter 7** (Flora and Fauna) includes a detailed discussion of the effects of light and concludes that:

- Although some buildings will be visible from near-shore areas, at the closest point the highest buildings will be approximately 740 m away, meaning that the light will be diffused. However, gaps in coastal vegetation will most likely allow some light spill to reach the beach / inshore area.
- Artificial light sources are likely to have differential effects on wildlife depending on a range of factors including the foraging strategy employed by each nocturnal species, and the effect of artificial light on this strategy, including secondary effects of artificial light on the prey items of active hunters, and changes in food consumption. While slower flying, insectivorous microbat species are known to avoid artificially lit areas, there are also beneficial impacts to faster-flying insectivorous microbat species that can exploit insects attracted to artificial light sources. Behavioural changes associated with illumination in small mammals may include avoidance of well-lit areas as an anti-predator response, because of the perceived risk of predation increases with increasing light.
- Artificial lighting may impact on birds by disrupting nesting patterns, disrupting roost sites and changed timing of dawn calling. Birds have been known to be disoriented by lighting. They may become 'trapped' and be unable to leave a lit area. Conversely, the impacts of lighting on-shorebirds foraging at night can be positive as they may increase foraging activity and success due to increased invertebrate activity and visibility.
- Indirect impacts to estuarine and marine fauna may arise from the additional light generated by the proposed resort and ancillary facilities. Light pollution at night is a key factor negatively impacting marine turtle nesting and hatching.
- Given the abundance of artificial light in the Cairns area (including light from the adjacent beach-side suburbs of Yorkeys Knob and Holloways Beach), the actual disruptive influence of artificial light on species other than turtles remains somewhat conjectural.

Proposed Mitigation and Effectiveness

Where appropriate design features can be incorporated into the proposed development impacts to nesting and hatching marine turtles may be minimised. Such design features will include:

- reviewing the need for each light source
- keeping lights off when not needed
- mounting lights low
- shielding lights to stop escaping upwards and outwards
- using long wave length lights (500 – 700 nanometres, orange to red)
- reducing the wattage and brightness of lights
- using natural topography to shield nesting areas from light
- screening interior lights with blinds, screens and / or window tinting (EPA 2010).

These measures will reduce the risk of impact to marine turtles due to changes to the light climate to a low level.

Construction and operation will be mitigated and / or managed via the EMP (Construction) and EMP (Operation & Maintenance).

Noise

Potential Impact

GBRMPA (2013a) lists increased noise amongst local-scale impacts from urban development. **Chapter 7** (Flora and Fauna) includes a detailed discussion of the effects of noise and concludes that:

- There are no specific standards for the range of noise pollution affecting Great Barrier Reef species. Given the increases in man-made underwater noise and the observed effects on marine life around the world, there is an urgent need for a greater understanding of the ecological impacts of noise within the region and for guidance on measures to avoid or mitigate these impacts.
- There is also little data available relating to the effects of artificial noise, apart from the literature regarding the effects of road noise. Studies show that noise can disrupt predator-prey interactions leading to enhanced reproductive success in noisy areas, as well as interfere with mating calls.
- Noise is a factor leading to expanded populations of disturbance-tolerant species, and a corresponding decline of birds less tolerant of noise.
- The construction of the seawater inlet and Richters Creek outlet pipes will result in increased noise and a change in the characteristics of ambient background noise. Increased noise may also arise from construction-related boating traffic, additional human activities and resort operations (e.g. water pumps and generators). This may temporarily disturb fauna such as dolphins, dugongs and turtles, and they may move away from the area. However, this is likely to be a short-term response, and they are expected to return once construction is completed.
- The site experiences occasionally high levels of noise, the sources of which have been in place for some time. By implication, fauna on the site has been subjected to this artificial noise for a long period of time from:
  - traffic on Yorkeys Knob Road
  - aircraft movements (the site is on the northern flight path for Cairns Airport)
  - annual cane harvesting and other agricultural activities.

Proposed Mitigation and Effectiveness

Impacts to marine fauna as a result of noise can be reduced where a marine fauna exclusion zone (nominally 500 m from the noise source) is established prior to the commencement of a noise-intensive activity (e.g. dredging). Impacts to marine fauna can be reduced if noise intensive activities are suspended when listed threatened species (e.g. marine turtles) are sighted within the exclusion zone (until 30 minutes of observations have passed until the last sighting).

Where these measures are implemented, the risk of impact to marine fauna due to increased noise is low.

Noise is likely to be mainly a construction issue (pile driving) and this requires management via the EMP (Construction).

Small Chemical Spills

The management of small chemical spills during the operation phase is considered to be a minor matter proposed to form part of the *Water Quality Management and Stormwater Management Strategy* described in **Table 22-50**.

Urban Discharge

The management of urban discharge during the operation phase is considered to be a minor matter proposed to form part of the *Water Quality Management and Stormwater Management Strategy* described in **Table 22-50**.

Aesthetic Considerations

See **Section 22.6.2b)**.

Tourism

Table 6.2 from GBRMPA (2013a) includes ‘tourism’ as one of the ‘activities in the region’ and lists the following impacts (words in parentheses are ‘scale’ from Table 6.1):

- coastal reclamation (Local)
- modifying supporting terrestrial habitats (Regional)
- exotic species and diseases (Regional)
- marine debris (Reef-wide)
- physical damage – ship grounding and other (Local)
- spill (small chemical or oil) (Local)
- vessel strike on wildlife (Local)
- waste discharge from vessels (Local)
- wildlife disturbance (Local).

The first three items are all impacts of development of tourism infrastructure that are either covered above or are irrelevant to the Aquis Resort, while the balance are all impacts arising from use of tourism infrastructure provided by others (i.e., Aquis Resort will not be operating tourism trips – all guests will use existing commercial operators). Accordingly, a broader discussion is warranted regarding the consequential impact of Aquis Resort guests as an additional demand on the region’s tourism resources. This is relevant to several matters of NES, namely the GBRWHA (and NHP), the WTWHA (and NHP) and the GBRMP and is discussed in detail in the assessment of consequential impacts (see **Section 22.17.6**, **Section 22.17.7** and **Section 22.17.8**).

d) Summary

In summary:

- Although there are some potential minor adverse construction impacts, all are of a local scale and these can be managed by appropriate construction management (see **Section 22.18.3**).
- The potential minor operation impacts are also of a local scale and are restricted to light and potential incidents (spills) that are amenable to contingency planning and management.

- The beneficial impacts arise from improvements in terrestrial habitat and connectivity and water quality. While **Table 22-12** suggests that these are significant at the regional to the reef-wide scales, it is clear that the issue is of this significance, not the actual impact. However, if all parcels of land can achieve improvement in these important issues at the local level, then large scale improvements can be realised. For example, at 45%, the expected reduction in sediment and nutrient export for Aquis approaches the '50% improvement by 2018' target of the *Reef Water Quality Protection Plan 2013* (Reef Plan). It is expected that additional improvements will be able to be achieved as a result of the detailed design process.
- While some negative effects may accrue as a result of artificial light and noise, the ubiquity of these effects in adjacent urban areas suggests that wildlife on the site is not likely to be displaced as a result of these effects in the context of the project.
- Further assessment of these issues will take place in the context of the EMP (Planning) and the proposed *Fauna Management Strategy*.

22.4.2 Impact Avoidance and Minimisation

In the assessment of measures to avoid or reduce impacts, two cases apply:

- impact avoidance and minimisation inherent in the design of the development (as discussed in the prelude to the assessment of impacts in **Chapter 6** to **Chapter 21** – some of these measures will actually enhance values)
- additional mitigation and management measures included in the project's Environmental Management Plan (**Section 22.18.3**).

The overall approach to reducing impacts follows that included in the Great Barrier Reef Region Strategic Assessment (Appendix 2 of GBRMPA 2013a), namely *avoid, mitigate, offset, and adaptively manage* impacts.

At the risk of being repetitive, but in the interests of making this chapter on matters of NES stand-alone, much of this material is repeated below.

a) *Summary of Measures to Protect and Enhance Values*

The following table summarises measures adopted or recommended to achieve the protection and enhancement of values. Locations are shown on **Figure 22-22**.

TABLE 22-13 ADOPTED MEASURES TO PROTECT AND ENHANCE VALUES

TYPE	LOCATION	OBJECTIVES
Protecting Values by Design (impact avoidance / minimisation)		
Ecological – retention of all natural vegetation and buffers	Outer fringe of development north and east of lake. Yorkeys Creek corridor. Half Moon Creek corridor. Northern side of Lot 4 RP749342. Western boundary of all western lots.	No net loss of habitat (all areas of natural vegetation to remain except for minor infrastructure crossings etc. as shown conceptually on the Concept Land Use Plan).
Ecological – waterway connectivity	Farm access track at the crossing of Yorkeys Creek near Yorkeys Knob Road on the western edge of Lot 100 NR3818. Tide gate on eastern edge of Lot 100 NR3818 (Site 16).	Improvement of waterway connectivity (terrestrial and aquatic) by replacing the undersized culverts with a small bridge in conjunction with a planned infrastructure crossing. Improvement of aquatic waterway connectivity by removing tide gate (Note 1).
Water quality – retention of all natural vegetation and buffers	As above.	Maintenance of water quality via natural filtration.
Visual – retention of all natural vegetation and buffers	As above.	Maintenance of existing views to the greatest extent possible.
Air quality – retention of all natural vegetation and buffers	Northern side of Lot 4 RP749342. Western boundary of all western lots.	
Groundwater – quarantining of lake from groundwater	Resort Complex Precinct.	Waterproofing lake. Avoiding contamination of groundwater by saline lake water.
Protecting Values by Construction and Operation Management		
All elements	Whole site, but especially areas of existing natural vegetation and waterways.	Protection of a range of environmental and social values.
Enhancing Values by Design		
Ecological – restoration of new areas	Outer fringe of development north and east of lake Yorkeys Creek corridor Half Moon Creek corridor Northern side of Lot 4 RP749342 Western boundary of all western lots	No net loss / net benefit of habitat. A more ecologically connected landscape (strengthened terrestrial and aquatic connectivity). An increase in the total area of (regional) ecosystems and numbers of endangered, vulnerable or near threatened species. Improvement of water quality. Weed control.

TYPE	LOCATION	OBJECTIVES
Water quality – WSUD, lake design	Throughout.	Protection of water quality or receiving waters (including lake) involving: • harvesting and storing roof water for re-use • treating runoff from polluted surfaces (e.g. paved areas) prior to discharge via a range of techniques • inclusion of large areas dedicated to water quality improvement.
Visual	Eastern side of Yorkeys Knob Road.	Screening of development from users of Yorkeys Knob Road.
Air quality	All boundaries with adjacent agricultural land not already densely vegetated.	Prevention of drift of herbicides, fertilisers etc. from the Aquis Resort to adjacent users. Prevention of drift of herbicides, fertilisers, ash from cane burning from adjacent users to the Aquis Resort.
Interpretation / education	As above.	Fringing forests provide excellent opportunities for bird-watching, walking and other forms of recreation and interpretation of World Heritage values. Indigenous and non-indigenous cultural heritage values can also be interpreted. Opportunities exist for a physical fitness trail.
All elements	Whole site, but especially areas of existing natural vegetation and waterways.	Protection of a range of environmental and social values by design initiatives that form part of the EMP (Planning).

Source: This is a copy of **Table 7-11**.

Note 1. The removal of all tide gates will need to be subject to detailed design to ensure that no unintended consequences ensue.

Key areas described are shown on **Figure 22-22**.

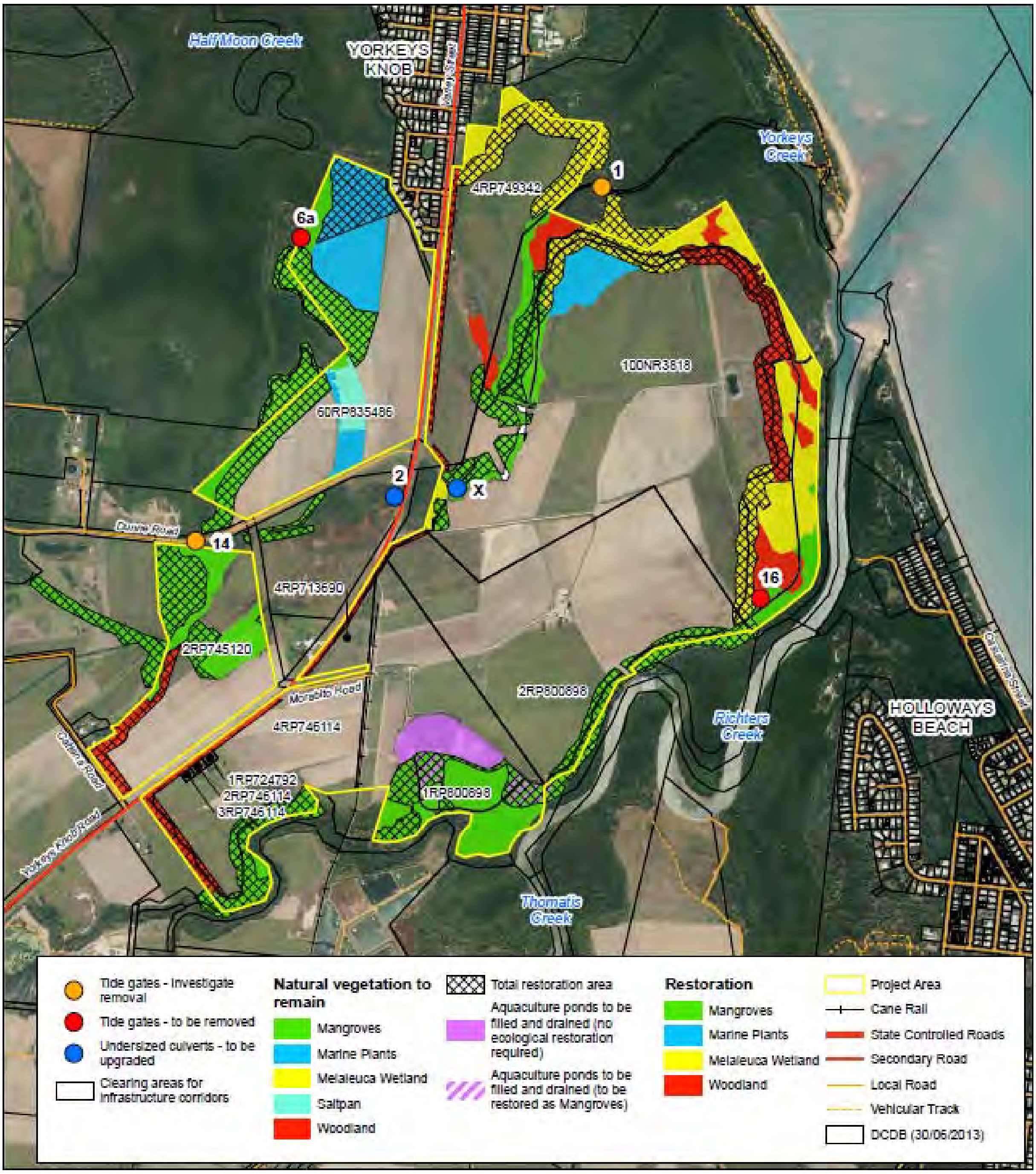


Figure 22-22 Ecological restoration priorities.

Source: This is a copy of **Figure 7-18**. This figure shows vegetation retention and restoration works, as well as the locations of tide gates etc. to be removed (these are referred to in the text below).

b) *Quantifying Benefits*

Most of the above measures cannot be quantified in terms of ecological benefit. However, two metrics can be quantified as follows:

- the area of additional habitat to be provided by the restoration commitments (in the context of protection of existing vegetated areas)
- improvements to the export of sediments and nutrients (in the context of overall management of water quality).

Restoration

Table 22-14 shows the existing, cleared, and restored areas by habitat type.

TABLE 22-14 CLEARING AND RESTORATION BY HABITAT TYPE

BROAD HABITAT TYPE	AREA (ha)			NOTES
	Existing	Clearing	Restoration	
Mangroves / Fringing Mangroves	22.1	0.4	29.8	This planting is designed as a 60 m wide band along the Yorkeys Knob and the edge of Richters Creek to reinforce both watercourses and in the case of Richters Creek, help stabilise the banks.
Melaleuca Wetland	12.4	0.2	12.2	This planting is designed as a 60 m wide band along the northern edge of Lot 4 RP494342 to reinforce the existing forest and buffer the FHA in this area.
Woodland	6.7	0.1	13.7	This planting is designed as a 60 m wide band on the project side of the Richters Creek riparian zone (Lot 100) to reinforce the existing woodland. Includes vegetated spray buffers and roadside plantings.
Marine Plants (other than mangroves)	10.4	0.0	0.0	No restoration of this habitat type is planned.
Saltpan	1.9	0.0	0.0	No restoration of this habitat type is planned.
TOTAL	**53.4**	**0.7**	**55.7**	
Artificial Water Bodies (abandoned aquaculture ponds)	5.4	5.4	(33.0 – area not included in total)	Existing aquaculture ponds are proposed to be drained and filled to reduce birdstrike risk, water quality concerns, and possible river migration. The lake will be designed as a habitat in its own right.

Source: Study team compilation. This is a copy of **Table 7-11**.

Table 22-14 shows that:

- A total of the 53.4 ha of mapped natural vegetation / habitat on-site, 0.7 ha is proposed to be cleared for minor infrastructure not able to be located in existing clearings.
- The abandoned aquaculture ponds (5.4 ha) are currently proposed to be drained and filled to reduce birdstrike risk, address water quality concerns, and reduce the likelihood of river migration.
- Approximately 55.7 ha of new plantings are proposed to restore and reinforce natural areas and provide visual screening and spray barriers around the site boundary as required. The benefit of these plantings is not just in creating new habitat and buffering existing areas of natural vegetation – it will also improve habitat connectivity, especially on Yorkeys Creek, which traverses the site.
- With respect to marine plants (tabulated above as Mangroves / Fringing Mangroves, Marine Plants (other than mangroves), and Saltpan), 34.3 ha currently exists, of which less than 0.5 ha will be cleared and nearly 30 ha will be restored. This means that this resource will benefit from an 85% increase.
- A total of 33 ha of lake habitat will be created. Subject to detailed design, the lake could incorporate stocking of native fish species and native flora species along parts of the banks on the outer lake edge to increase available habitat in the area. However, there are conflicting objectives in terms of crocodile and wading bird management and control of midges and mosquitos that need to be considered. Refer to **Chapter 11** (Water Quality).

This analysis ignores any additional plantings associated with the resort's landscape plan (still under consideration).

<u>Sediments and Nutrients</u>

Water Sensitive Urban Design

The current cane farm exports sediments and nutrients to the GBR in stormwater drainage and thus contributes to one of the reef's most pressing threats. The project concept includes two measures to reduce this and, in addition, reduce any further export arising from the site's operation (e.g. sewage production):

- Most (over 80%) of the project's sewage will be imported back to the site as treated effluent following treatment by CRC's Marlin Coast WWTP, and used to reduce water demand for both potable water and irrigation. In so doing, nutrients from the sewage that would otherwise be exported from the treatment plant will be used on-site.
- WSUD initiatives incorporated into the design dramatically reduce sediment and nutrient generation from the project's operation.

Modelling shows that the effect of these two initiatives will result in the following net changes to the existing (cane farm) use:

- TSS: 132.1 t/a decrease (46%)
- TP: 0.24 t/a decrease (28%)
- TN: 0.7 t/a decrease (12%).

Overall, the export of sediments and nutrients will drop by 133 t (45%) compared with eth existing cane farm. This is the worst case (i.e. after all construction has finished and only 80% of the sewage produced can be re-used). This reduction approaches the '50% improvement by 2018' target of the Reef Plan. It is expected that additional improvements will be able to be achieved as a result of the detailed design process.

Overall Water Quality Impacts

Chapter 11 (Water Quality) provides a detailed assessment of the impacts of the Aquis Resort on the water quality of the receiving environment. The following conclusions are repeated from **Section 11.3**.

In general, and within the limitations of the data collation, model calibration, verification and impact assessments undertaken to date, the following observations can be made for the numerical water quality modelling assessment of Richters Creek and the near/off-shore environment in regard to likely water quality changes post development:

- Limited to negligible change in salinity concentrations in Richters Creek and the near-shore region.
- No notable change in DO levels throughout Richters Creek and the near-shore region.
- Limited to negligible change in nutrient concentrations in Richters Creek and the near-shore region.
- Limited to no change in chlorophyll *a* concentrations in Richters Creek and the near-shore region.

The following observations can be made for the conservative tracer impact assessment to Richters Creek and the near/off-shore environment:

- Ninetieth (90^{th}) percentile changes (i.e. 90% of all modelled observations) in water quality off-shore were less than 0.1%.
- Median tracer concentrations at the mouth and near/off-shore of Richters Creek is in the order of 3.9% to 9.5%. Dilutions within the bed of the channel are notably less and tracer concentrations are in the order of 30% to 42% for 90^{th} percentile concentrations indicating the effect of salt-wedge stratification in this region.
- Dilution rates upstream of the outlet are also generally high with median tracer concentrations in the order of 1% to 7%. Dilution rates are notably less near the bed of the channel and tracer concentrations are in the order of 10% to 62% for the 90^{th} percentile.

It should also be noted that detailed near-field mixing of the discharged lake water has not been assessed in the regional model and additional detailed modelling assessments will be required and are recommended to estimate the degree of near-field dilution associated with the outlet diffuser operation.

The influence of the proposed Aquis lake discharge is expected to have only a small influence on the receiving environment of Richters Creek including the near-shore environment. Furthermore, and as demonstrated above, if lake water quality is maintained in a similar or better condition to Richters Creek, then no discernible reduction in water quality is expected. This is a reasonable expectation as the lake model indicates that water quality is likely to be better than that of Richters Creek, particularly during increased flows from the Barron River.

Modelling shows that further off-shore, dilution effects are even more pronounced. For example, at the boundary of the GBRMP (3.5 km north-east of the lake discharge in Richters Creek), median tracer concentrations are 0.1% (i.e. dilution of 99.9%). This result in indistinguishable from that at the inlet.

As noted, dilution is only of relevance if the lake water quality is less than that of the receiving waters. Modelling suggests that the converse is likely to be true. Therefore, there is a very low risk of any adverse water quality impacts on the GBRWHA and even less for the GBRMP.

Based on the lake impact assessment summary presented above, the risk rating varies from *Negligible* to *Medium*, while following implementation of mitigation measures the residual risk can be reduced to a *Low* level.

22.5 STRATEGIC ASSESSMENTS

22.5.1 Background

The Australian and Queensland governments have entered into an agreement to complete a comprehensive strategic assessment of the Great Barrier Reef World Heritage Area (GBRWHA) and adjacent coastal zone. The comprehensive strategic assessment comprises two parts:

- the Great Barrier Reef Region Strategic Assessment undertaken by GBRMPA (2013a) addressing the marine environment (plus the associated program Report – GBRMPA 2013ab)
- the Great Barrier Reef Coastal Zone Strategic Assessment undertaken by the Queensland Government (DSDIP 2013a) addressing the coastal zone (plus the associated program Report – DSDIP 2013b).

The strategic assessment (i.e. both components) provides for review and assessment of the effectiveness of management arrangements at protecting the GBR's World Heritage values as well as all other matters of NES which are afforded protection under the EPBC Act. The goal is to help identify, plan for and manage existing and emerging risks to the unique environmental values of the matters of NES relevant to the GBR coastal zone. The GBRMP document also provides a comprehensive statement of the values of the GBRWHA and current threats to these values. The study area includes the Queensland coastal zone (defined as Queensland Coastal Waters, islands, and inland areas to a distance of five kilometres or the 10 metre AHD contour, whichever is further) and Commonwealth waters to the edge of the continental shelf.

The ToR require that these reports be considered in the discussion on the GBRWHA as this was the reason for them being prepared. However, the assessments have some relevance to other matters of NES and for both direct and indirect impacts.

22.5.2 Great Barrier Reef Region Strategic Assessment

The draft *Great Barrier Reef Region Strategic Assessment Report* produced by the Great Barrier Reef Marine Park Authority in August 2013 (GBRMPA 2013a) provides a wealth of useful information on values and threats to most Matters of NES and in particular sets the scene for a region-wide assessment of Outstanding Universal Value (OUV) which underpins World Heritage values. The concept of OUV is explored in detail in **Section 22.6.1b)**. The GBRMPA report also provides a structure for assessing a development at a specific location within the context of the Great Barrier Reef region as a whole.

Table 22-15 sets out the key to GBRMPA (2013a)

TABLE 22-15 KEY REFERENCES TO GBRMPA (2013A AND 2013B)

REFERENCE	DETAILS	USE	SECTION
Figure 4.3	Spatial distribution of matters of NES	Explanation of spatial aspects on matters of NES	**Section 22.1.4c)**
Figure 1.4	Local boundaries of the GBR region, the GBRWHA, and the GBRMP	Explanation of boundaries relevant to controlling provisions	**Section 22.1.4c)**
Section 6.1.3	Definition of types of impacts (e.g. direct, consequential, cumulative)	Discussion of types of impacts	**Section 22.4.1a)**
Table 6.1	List of impacts and scale (i.e. local to reef-wide)	Checklist of impacts for all uses and associated scale	**Section 22.4.1b)**
Table 6.2	Impacts and their sources – allocation of Table 6.1 impacts to specific land uses	Impact screening for 'urban development' and 'tourism'	**Section 22.4.1b)** **Section 22.4.1c)**
Table 4.1	Comparison of original and current World Heritage criteria	Details of original and current World Heritage criteria and associated references	**Section 22.6.1**
Table 4.8	Key values and attributes of matters of NES	Key values and attributes (listing criteria and integrity)	**Section 22.6.1**
Table 4.9	Key environmental processes relevant to matters of NES	Key environmental processes (listing criteria and integrity)	**Section 22.6.1**
Table 7.2	Condition and trend – terrestrial habitats	Condition and trend – terrestrial habitats	**Section 22.6.1**
Table 7.3	Condition and trend – species	Condition and trend – species	**Section 22.6.1**
Table 7.11.	Examples of OUV	Impacts on OUV	**Section 22.6.4**
Table 4.8	Key values and attributes of matters of NES	Key values and attributes (migratory species)	**Section 22.14.1** **Section 22.15.1**
Table 4.9	Key environmental processes relevant to matters of NES	Key environmental processes (migratory species)	**Section 22.14.1** **Section 22.15.1**
Table 4.8	Key values and attributes of matters of NES	Key values and attributes (GBRMP)	**Section 22.16.1**
Table 4.9	Key environmental processes relevant to matters of NES	Key values and attributes (GBRMP)	**Section 22.16.1**
Figure 5.15	International visitation to the Great Barrier Reef catchment	Tourism use / impacts	**Section 22.16.2b)**
Section 5.2.4*	Proposed cumulative impacts policy	Assessment of cumulative impacts	**Section 22.17.5**

Source: Study team compilation. All references are to GBRMPA (2013a) unless noted by asterisk (*) – in this case they refer to GBRMPA (2013b).

While **Table 22-15** highlights the main references to the strategic assessment report, many other references are included and these are denoted in the balance of this chapter. The assessment puts Aquis Resort into the context of the GBR as a whole and for its comprehensive links between esoteric listing criteria and the values upon which this is based. At the site level, this context is essential.

22.5.3 Great Barrier Reef Coastal Zone Strategic Assessment

The DSDIP assessment includes an overall assessment of current threats to matters of NES and the effectiveness of current legislation. The focus is on coastal zone and as such covers all issues of relevance to the Aquis Resort.

Table 22-16 identifies the key references to the DSDIP assessment:

TABLE 22-16 KEY REFERENCES TO DSDIP (2013A)

REFERENCE	DETAILS	USE	SECTION
Demonstration Case 3	Wet Tropics Management Plan	Effectiveness of Queensland legislation in assessing and managing impacts (off-site (tourism)	**Section 22.5.3a)**
Demonstration Case 5	Ella Bay Resort	Effectiveness of Queensland legislation in assessing and managing impacts (resort development)	**Section 22.5.3c)**
Demonstration Case 7	Water Quality Improvements in the Mackay Whitsundays Region	Effectiveness of Queensland legislation in assessing and managing impacts (water quality)	**Section 22.5.3b)**
Appendix I p I-6	Impacts on Matters of NES (water quality)	Magnitude of water quality impacts on MNES	**Section 22.5.3b)**
Appendix I p I-7 to I-8)	Scientific Consensus Statement	Summary of key threats to the GBRWHA	**Section 22.5.3b)**
Case Study 3	Mt Peter Master Plan	Effectiveness of Queensland legislation in assessing and managing impacts (consequential impacts of population / housing)	**Section 22.5.3d)**
Demonstration Case 3, 5, and 7 and Case Study 3	Summary of Effectiveness in Protecting Matters of NES		**Section 22.5.3f)**

Source: Study team compilation.

The main use of the strategic assessment has been derived from the demonstration cases and case studies. Those that are highly relevant are (these are numbered in the order that they appear in Table 7.3.2 of DSDIP 2013a):

- Demonstration Case 3: Wet Tropics Management Plan
- Demonstration Case 5: Ella Bay Resort
- Demonstration Case 7: Water Quality Improvements in the Mackay Whitsundays Region
- Case Study 3: Mt Peter Master Plan.

The main outcome of these assessments is an understanding of the effectiveness of Queensland legislation in assessing and managing impacts of relevance to the Aquis Resort, especially consequential impacts of population / housing and tourism and the impacts of coastal development on water quality.

a) Demonstration Case 3: Wet Tropics Management Plan

This demonstration case shows how the Program identifies and protects the WTWHA including its OUV and integrity. Program measures to avoid, mitigate and enhance the OUV of the WTWHA are also described within the demonstration case that investigates the functioning of the *Wet Tropics Management Plan 1998* (Qld) (WTMP).

The Aquis Resort site is 2.5 km from the WTWHA (line-of-site) although in terms of ecological connections it is 8.4 km downstream. This EIS concludes that there will be no direct impact of the Aquis Resort on the WHA's values and that presentation values could be enhanced by on-site interpretation and education. The relevance of the WTMP to the project lies in the management of off-site consequential impacts of possible extra visitation of the WHA by Aquis Resort guests. This is discussed in **Section 22.17.8**.

The WTMP is relevant to the Aquis Resort to the extent that it is the principal means by which tourism infrastructure and use is managed in the WTWHA. Commercial tours are managed by the QPWS' Commercial Activity Permits. Under this regime, day visits to the WTWHA via commercial tours are highly regulated and management has been shown to be effective.

It is concluded that there are sufficient controls in place to ensure that tourism use of the WTWHA by Aquis Resort guests is managed sustainably.

b) Demonstration Case 7: Water Quality Improvements in the Mackay Whitsundays Region

This demonstration case explores how the Queensland and Australian governments are working to halt and reverse the decline in water quality entering the Great Barrier Reef. Specifically, it highlights some of the work being done to improve water quality flowing to the GBR from the Mackay Whitsundays region, including work through Reef Plan. It demonstrates development of best management practices supported by the Queensland Government and the Reef Rescue Program delivered by the Australian Government.

Although the study area is remote from the Aquis Resort site, the issues of runoff to the GBR is relevant. Referring to the discussion on urban runoff, the case study notes that the management of urban stormwater, sewage and trade waste are key local government water quality policy, planning and investment areas. The EPP Water requires specific local governments to undertake this responsibility within a total water cycle management (TWCM) context that addresses the different elements of the water cycle within an urban area and its catchment, advancing a whole system approach to the management of water, while enhancing and protecting the environmental values of receiving waters.

Examples include:

- reducing demands for new and existing water supplies (such as incentives to lower consumption rates and re-using stormwater)
- reducing the disposal of pollutants (such as re-using waste water and managing sediment production on construction sites).

To support TWCM, Queensland Government produced the Urban Stormwater Quality Planning Guidelines in 2010 which provides direction on the development of strategies for improved environmental management of urban catchments and waterways. This includes the preparation of urban stormwater quality management plans as part of the total water cycle management plans required under the EPP Water taking into account any EVs and WQOs in waterways where discharges may occur. Guidelines also exist to support the implementation of Australia's National Water Quality Management Strategy for a range of issues including sewage, stormwater management, groundwater management, effluent from intensive animal production systems and designing monitoring programs.

Table 22-17 is extracted from DSDIP (2013a) for controlling provisions relevant to this EIS.

TABLE 22-17 IMPACTS ON MATTERS OF NES

MATTERS OF NES	DESCRIPTION OF WATER QUALITY IMPACTS	MAGNITUDE OF WATER QUALITY IMPACTS ON MNES
World heritage properties	Overall, water quality is one of the most significant and widespread impacts on the Great Barrier Reef World Heritage Area as identified in the 2009 Outlook Report. Sediments, nutrients and pesticides impact on a range of values including inshore coral and seagrass. Impacts of water quality in the outer reef are likely to be low due to the impacts of dilution but links to Crown of Thorns outbreaks extend impacts potentially to over 1000 midshelf and off-shore reefs.	High (but low off-shore).
National heritage places	Values, spatial extent, pressures and impact overlap with those of the World Heritage Area.	Largely unknown.
Listed threatened species and ecological communities	Some threatened species such as turtles and dugongs are strongly affected during periods of significant runoff impacting seagrass food resources. Some heavy metals can accumulate in species with high fat content (e.g. whales).	High for impacts on key communities e.g. seagrasses which underpin health of inshore species like dugong but lower for species and communities further off-shore.
Migratory species protected under international agreements	Migratory species such as waders strongly affected due to impacts on food resources, turtles and dugong in inshore areas strongly affected during periods of significant runoff impacting seagrass food resources. Outer reef species and populations not impacted or low impacts.	High for inshore species, such as dugong and green turtles graduating to low for off-shore species.
The Great Barrier Reef Marine Park	Values, spatial extent, pressures and impact overlap with those of the World Heritage Area. Significant social and economic values as this region is the second most important for tourism, especially the domestic market	High (but low off-shore).

Source: DSDIP (2013a) Appendix I p I-6 (part).

The above assessment is consistent in that there is agreement that:

- the protection of water quality is a crucial aspect of protecting matters of NES and in particular, with respect to the Aquis Resort, the GBRWHA, listed threatened species, and migratory species
- water quality impacts on the GBRMP are important but diminish with distance off-shore.

The Scientific Consensus Statement (DSDIP (2013a) Appendix I p I-7 to I-8) found that:

1. The decline of marine water quality associated with terrestrial runoff from the adjacent catchments is a major cause of the current poor state of many of the key marine ecosystems of the Great Barrier Reef.

2. The greatest water quality risks to the Great Barrier Reef are from nitrogen discharge, associated with crown of thorns starfish outbreaks and their destructive effects on coral reefs, and fine sediment discharge which reduces the light available to seagrass ecosystems and inshore coral reefs. Pesticides pose a risk to freshwater and some inshore and coastal habitats.

3. Recent extreme weather—heavy rainfall, floods and tropical cyclones—have severely impacted marine water quality and Great Barrier Reef ecosystems. Climate change is predicted to increase the intensity of extreme weather events.

4. The main source of excess nutrients, fine sediments and pesticides from Great Barrier Reef catchments is diffuse source pollution from agriculture.

5. Improved land and agricultural management practices are proven to reduce the runoff of suspended sediment, nutrients and pesticides at the paddock scale.

The 2013 Scientific Consensus Statement again confirmed that the main source of pollutants entering the Great Barrier Reef is from diffuse agricultural sources. The loads from point sources of pollution, such as mining, urban development, ports or shipping, are relatively small but can be locally important and, over short time periods, highly significant.

This case study is relevant to the Aquis Resort in that it supports the Aquis Resort commitments to:

- reducing demands for new and existing water supplies by the use of water conservation measures
- reducing the disposal of pollutants by re-using treated effluent and incorporating Water Sensitive Urban Design initiatives and Erosion and Sedimentation Control Plans.

The demonstration project found that the establishment of the EPP Water in 2009 and subsequent work on setting water quality objectives and guidelines for the region has also ensured that development adequately considers water quality in planning, construction and operation.

It is concluded that the Aquis Resort response to protecting water quality is consistent with current best practice and that there are sufficient controls in place to ensure that water quality is protected.

c) Demonstration Case 5: Ella Bay Resort

This demonstration case shows how the Queensland Government Program ensures that impacts on matters of NES are appropriately assessed through the EIS. The Ella Bay Integrated Resort demonstration case explores the processes and systems used to declare and assess significant projects, and the effectiveness of the EIS process in mitigating impacts on the GBRWHA (matters of NES including OUV).

The review focused on two aspects of the EIS process:

- Impact assessment. The SDPWO Act:
  - requires development proponents to undertake detailed investigations on the impacts of proposals
  - requires the evaluation of proposed management responses to those impacts
  - provides a rigorous and transparent process to avoid impacts to MNES including OUV, or mitigate and offset impacts where they cannot be avoided.
- Conditions and Environmental Management. The Coordinator-General can set binding conditions of approval. In the case of the Ella Bay Resort, the proponent is required to implement a variety of management strategies to mitigate potential construction and operational related impacts on fauna, flora and communities. These include an offsets strategy, EMPs, protected area management and species-specific management sub-plans. Management sub-plans have been developed for the cassowary, stream-dwelling rainforest frogs, spectacled flying-fox, marine turtles and significant flora. These sub-plans identify impacts of the development on these fauna and flora and provide a number of strategies to manage or mitigate these impacts.

The assessment concluded that the process was a thorough and very effective process for managing potential impacts to MNES including OUV. Critical to this effectiveness is the suite of post-approval environmental management strategies that are to be developed and implemented prior to construction and that are intended to mitigate those impacts that were not able to be avoided or minimised by design.

The relevance to Aquis is considered to be as follows:

- The impact assessment process is essentially identical to that being undertaken by Aquis.
- The ability of the Coordinator-General to set conditions requiring, amongst other things, post-approval attention to impact mitigation and management strategies is an essential component of the Aquis Resort and is especially relevant to the current situation where only land use approval is being sought initially. However, all subsequent approvals will be subject to Queensland legislation and this can be expected to adequately regulate construction and operation phase activities and minimise impacts.
- The project context is similar in that both developments are adjacent to the GBRWHA. However, unlike the Ella Bay Resort, the Aquis Resort site is remote from the WTWHA and does not involve the risk of significant impacts on listed threatened species or communities.
- Unlike the Ella Bay Resort, the Aquis Resort includes a large saltwater lake that will involve the exchange of seawater with the waters of the GBRWHA.

Despite these differences, the overall framework of existing Queensland legislation can be expected to adequately protect matters of NES including OUV.

d) Case Study 3: Mt Peter Master Plan

The FNQ Regional Plan 2009-2031 has forecast an additional population of about 70 000 for Cairns by 2031. Most of this additional population is planned to be accommodated in the Mount Peter area north of Gordonvale. The area is less than 2000 hectares and is currently used primarily for sugarcane production.

One of the primary tools under the SP Act for managing urban development is local planning schemes, developed and administered by local government. Planning schemes include existing and future urban areas and local strategic outcomes to be achieved, and the measures to facilitate these outcomes. Local planning schemes also include priority infrastructure plans and may include structure plans for master planned areas. Other Program components relevant to the MPA are the Coastal Act, VM Act, Fisheries Act and the Water Act.

To manage urban drainage, including stormwater, the SP Act is supported by a number of legislative tools:

- Environmental Protection Act 1994
- Environmental Protection (Water) Policy 2009
- SPP for Healthy Waters – now SPP 2013 Planning for environment and heritage (Water)
- Urban Stormwater Quality Planning Guidelines 2010 (Department of Environment and Resource Management 2010d).

The SPP 2013 specifically addresses urban stormwater runoff, waste water and waterway management. The policy ensures that the planning, design, construction and operation of development includes the management of stormwater to protect the environmental values specified in the Environmental Protection (Water) Policy 2009.

This case study demonstrates that housing demand that results from the economic stimulus provided by the Aquis Resort can be sustainably met in the Mt Peter masterplanned area. The strategic assessment concludes that a well-planned and regulated urban development in this area can be expected to have a net positive impact on MNES over the previous land use in these circumstances.

e) Summary of Demonstration Cases and Case Study

The following is a summary of the findings of the above demonstration cases (DC) and case study. In the case of the latter the summary is a verbatim extract from DSDIP (2013a) while the Mt Peter Case Study (CS) summary is derived from the text of the document as no summary is provided.

TABLE 22-18 SUMMARY OF EFFECTIVENESS IN PROTECTING MATTERS OF NES

ITEM	RELEVANCE TO PROGRAM	PROGRAM COMPONENT	MNES AND OUV	TYPE OF ACTIVITY	OVERALL EFFECTIVENESS
DC3 – Wet Tropics Management Plan	Effectiveness of the Wet Tropics Management Plan in the management of the Wet Tropics WHA	*Wet Tropics World Heritage Protection and Management Act 1993 (Qld)* Wet Tropics Conservation Strategy	Wet Tropics WHA/OUV Threatened species	WHA management Tourist development	Effective The Wet Tropics Management Plan and supporting Program components provide specific planning and operational arrangements to avoid and mitigate impacts from development activity within the Wet Tropics WHA.
DC5 – Ella Bay Resort	Effectiveness of the EIS process in identifying and mitigating impacts on MNES	*State Development and Public Works Organisation Act 1971 (Qld)*	Wet Tropics WHA/ OUV Threatened species	Residential development Tourist development WHA management	Very effective The EIS process is considered to be a thorough and very effective process for managing potential impacts to MNES including OUV.

(Continued over)

ITEM	RELEVANCE TO PROGRAM	PROGRAM COMPONENT	MNES AND OUV	TYPE OF ACTIVITY	OVERALL EFFECTIVENESS
DC7 – Water Quality Improvement in the Mackay Whitsundays Region	Effectiveness of actions at reducing impacts on water quality and enhancing resilience of the GBR	Water Quality Improvement Plan EP Act Environmental Protection (Water) Policy 2009 Water Act Great Barrier Reef Water Quality Guidelines Paddock to Reef program	All	All land use	Effective
CS8 – Mt Peter Master Plan	Effectiveness of masterplanning in managing urban growth	*Sustainable Planning Act 2009* (Qld) Environmental Protection Act 1994 Environmental Protection (Water) Policy 2009 SPP 2013 *Planning for environment and heritage (Water)* Urban Stormwater Quality Planning Guidelines 2010	Wet Tropics WHA/ OUV Threatened species	Residential development	Effective A well-planned and regulated urban development in this area can be expected to have a net positive impact on MNES over the previous land use in these circumstances.

Source: DC3, DC5, and DC7: DSDIP (2013a); CS8: Study team compilation based on DSDIP (2013a).

f) Conclusion

The strategic assessment of the coastal zone concludes that:

- Poor water quality from catchment runoff is the major cause of the current poor state of many of the key ecosystems. The three major risks as nitrogen, fine sediment, and pesticide discharge.
- The major source of the key pollutants is broadscale agriculture. Other sources such as urban areas, ports and shipping are relatively small but may be locally and over short time periods highly significant.
- In terms of site specific impacts, population growth and economic development are expected to drive further urban, port and industrial development within the GBR coastal zone. This has potential to cause a number of impacts on MNES. Impacts may include further loss and fragmentation of habitat, and downstream impacts from poor water quality.
- There is evidence that demonstrates the Queensland Government Program is broadly effective in protecting MNES, including OUV of the WHAs.

It is concluded from these demonstration projects and case studies that Queensland legislation can be expected to be effective in managing direct and indirect impacts of the Aquis Resort on matters of NES. Further, the Aquis Resort includes commitments to best-practice measures to reduce habitat loss and fragmentation and to protect water quality.

22.6 GREAT BARRIER REEF WHA

22.6.1 Presence of Matter

a) Overview

In the vicinity of the site the GBRWHA lies seaward of low water – approximately 0.5 km east (downstream) of the site via Richters Creek at its closest – although the WHA includes all internal waters of the state (i.e. follows low water up Yorkeys, Richters, and Thomatis Creeks in the vicinity of the site). Refer to **Figure 22-4**.

b) OUV and Integrity

<u>Outstanding Universal Value</u>

As a WHA, the GBRWHA is recognised under the World Heritage Convention as having OUV. According to SEWPaC (n.d.), OUV:

'… *is the key reference point for the protection and management of world heritage properties and is the central idea of the World Heritage Convention. Broadly, the meaning of outstanding universal value follows the common sense interpretation of the words:*

- *Outstanding: For properties to be of outstanding universal value they should be exceptional, or superlative – they should be the most remarkable places on Earth.*
- *Universal: Properties need to be outstanding from a global perspective. World Heritage does not aim to recognise properties that are remarkable from solely a national or regional perspective. Countries are encouraged to develop other approaches to recognise these places. Australia does this through National Heritage listing.*
- *Value: What makes a property outstanding and universal is its 'value', or the natural and/or cultural worth of a property. This is based on standards and processes established under the World Heritage Convention's Operational Guidelines.' (p1).*

The Operational Guidelines for the Implementation of the World Heritage Convention (UNESCO 2012) define the concept of OUV as 'cultural and/or natural significance, which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity.' The Great Barrier Reef has OUV and has been World Heritage-listed because it meets all four of the natural environment criteria. According to GBRMPA (2013a), recognition of the Great Barrier Reef's outstanding universal value was based on the natural world heritage criteria in place at the time — acknowledging the Reef's natural values, together with the strong ongoing links between Aboriginal and Torres Strait Islanders and their sea country.

The criteria have been amended and renumbered since the Reef was inscribed. See **Table 22-19** below.

TABLE 22-19 COMPARISON OF ORIGINAL AND CURRENT WORLD HERITAGE CRITERIA

SHORT TITLE	CRITERIA AT TIME OF LISTING (1981)	CURRENT CRITERIA (2008)
Major stages of the Earth’s evolutionary history	(i) outstanding examples representing the major stages of the earth's evolutionary history	(viii) be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;
Ecological and biological processes	(ii) outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment	(ix) be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;
Natural beauty and phenomena	(iii) unique, rare or superlative natural phenomena, formations or features or areas of exceptional natural beauty, such as superlative examples of the most important ecosystems to man	(vii) contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
Habitats for conservation of biodiversity	(iv) habitats where populations of rare or endangered species of plants and animals still survive	(x) contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

Source: GBRMPA (2013a) Table 4.1.

Only those values, or attributes, that are consistent with the four criteria for which the Great Barrier Reef was inscribed (i.e. the 1981 criteria in the second column above) can be considered to be its world heritage values. However, given the broad scope of the criteria under which it was listed, almost all aspects of the Reef’s environment contribute to its outstanding universal value. This includes the Region’s biodiversity, geomorphological features, aspects of Traditional Owner connections to the area, its environmental processes, and its aesthetic value. The notable exception is historic heritage values (for example, shipwrecks and light houses etc.) which are not encompassed by the natural criteria but are protected within the GBRMP.

The attributes that contribute to the property’s outstanding universal value are interconnected and are distributed across the entire extent of the property.

A Statement of the Outstanding Universal Value of the Great Barrier Reef World Heritage Area (SOUV) is the official statement adopted by the World Heritage Committee outlining how the property met the criteria for outstanding universal value, integrity, and protection and management at the time of listing. The statement was prepared retrospectively. In line with International Union for Conservation of Nature (IUCN) guidelines, the statement is based on information that was available in 1981 and addresses the criteria in place at the time of inscription.

<u>Integrity</u>

In addition to meeting at least one of the ten criteria to be considered of outstanding universal value, a World Heritage property also needs to meet conditions of integrity. SEWPaC (n.d.) describes integrity as relating to the ‘wholeness and intactness’ of the property as at the time of inscription and how it conveys the values it holds. Integrity can also relate to the size of the property (is it of sufficient size to continue to represent the values?) and to any threats affecting the property (is it likely that the values will be significantly degraded?).

The GBRWHA meets the condition of integrity, namely:

- the property includes all elements necessary to express its outstanding universal value
- is of adequate size to ensure the complete representation of the features and processes which convey the property's significance
- is protected from threats.

In interpreting the values of the GBRWHA for the purposes of impact assessment of a particular development, it is necessary to determine what values are present in the area likely to be impacted by the development and assess the quantum of these impacts. With a property as extensive as the GBRWHA not all values are present in all areas. However, it is important to recognise that OUV are distributed throughout the World Heritage property as explained by the concept of 'wholeness and intactness' described above. Therefore, impacts can be expected to be felt some distance from a development site in some cases.

c) Property Level Values

Notwithstanding the concepts of 'wholeness and intactness', it is appropriate to examine specific values related to the listing criteria of the property as described above and inspect the contribution that the project site and its surrounds makes to OUV. The 'Guidelines' below have been extracted from the document 'Interim Guidelines on the Outstanding Universal Value of the Great Barrier Reef World Heritage Area - for proponents of Actions' (SEWPaC. n.d.). Impacts on these values are considered later in this report.

It is understood that the convention for describing criteria is to list them in the new order, refer to the original and new numbering, and refer to the original description as this is applicable for assessment. This convention has been followed below.

Values

The GBR strategic assessment (GBRMPA 2013a) includes a detailed checklist of key values and attributes of Matters of NES (Table 4.8). For the WHA these are based on the SOUV (SEWPaC 2012b) and cover the four listing criteria as well as integrity. The following table is a subset of Table 4.8 and deals with:

- the key values and attributes (Table 4.8 column 1)
- GBRMPA assessment of presence for the value at the GBR level (Table 4.8 columns 2 to 6) – columns 2, 4, 6, 8, and 10 below) shaded and marked 'G' = GBR
- study team assessment of presence for the value at the Aquis site level (columns 3, 5, 7, 9, and 11 below) – unshaded and marked 'S' = Site.

This table therefore provides a checklist of those WHA values that are present at or in the immediate vicinity of the site (or are likely to be influenced in some way by the proposed development) and these headings are used to structure the following discussion. Note that the order of columns 2, 4, 6, 8, and 10 follows that of the current listing criteria (i.e. (vii) to (x)), rather than the original criteria (i) to (iv) as was the case for the original table.

The symbol '~' indicates that the value is considered relevant at the local (site) level despite not being included in the original GBRMPA tables.

TABLE 22-20 KEY WHA VALUES AND ATTRIBUTES AT GBR AND SITE LEVEL

Key values and attributes	**Criterion vii (was iii)**		**Criterion viii (was i)**		**Criterion ix (was ii)**		**Criterion x (was iv)**		**Integrity**	
	G	**S**	**G**	**S**	**G**	**S**	**G**	**S**	**G**	**S**
Biodiversity – GBR habitats										
Islands	•				•		•		•	
Beaches and coastlines	•	•				~			•	•
Mangrove forests	•	•				~	•	•	•	•
Seagrass meadows							•		•	
Coral reefs (<30 m)	•				•		•		•	
Deeper reefs (>30 m)	•				•		•		•	
Lagoon floor							•		•	
Shoals							•		•	
Halimeda banks					•				•	
Continental slope									•	
Open waters	•	•				~	•	•	•	•
Biodiversity – terrestrial habitats that support the GBR										
Saltmarshes						~				~
Freshwater wetlands						~				~
Forested floodplain						~				~
Heath and shrublands										
Grass and sedgelands										
Woodlands						~				~
Forests						~				~
Rainforests	•	•				~				~
Connecting waterbodies						~	•	•	•	•
Biodiversity – species										
Mangroves	•	•					•	•	•	•
Seagrasses							•		•	
Macroalgae							•		•	
Benthic microalgae							•		•	

Key values and attributes	Criterion vii (was iii)		Criterion viii (was i)		Criterion ix (was ii)		Criterion x (was iv)		Integrity	
	G	S	G	S	G	S	G	S	G	S
Corals	•						•		•	
Other invertebrates					•	•	•	•	•	•
Plankton and microbes							•		•	
Bony fish	•	•			•	•	•	•	•	•
Sharks and rays							•	•	•	•
Sea snakes							•	•	•	•
Marine turtles	•	•					•	•	•	•
Estuarine crocodiles							•	•	•	•
Seabirds	•	•					•	•	•	•
Shorebirds							•	•	•	•
Whales	•	•					•	•	•	•
Dolphins							•	•	•	•
Dugongs							•		•	
Geomorphological features										
Coral reefs	•		•						•	
Islands and shorelines	•	•	•	•					•	
Channels and canyons			•						•	
River deltas			•	•					•	•
Halimeda banks			•						•	
Seagrass meadows			•						•	
Indigenous heritage										
Cultural practices, observances, customs and lore					•				•	
Sacred sites, sites of particular significance, places important for cultural tradition					•	~			•	
Stories, songlines, totems and languages					•	~			•	
Indigenous structures, technology, tools and archaeology					•	•			•	•
Historic heritage										
Places of historic significance — historic shipwrecks										
Places of historic significance — World War II features and sites										
Places of historic significance — lightstations										

Key values and attributes	Criterion vii (was iii)		Criterion viii (was i)		Criterion ix (was ii)		Criterion x (was iv)		Integrity	
	G	S	G	S	G	S	G	S	G	S
Places of historic significance — other										
Places of scientific significance (research stations, expedition sites)										
Places of social significance — iconic sites										
Community benefits of the environment										
Income										
Employment										
Understanding										
Appreciation	•	•								
Enjoyment	•	•								
Access to reef resources										
Personal connection										
Health benefits										
Aesthetics	•	•							•	•

Source: Study team compilation. Key values and attributes and shaded columns (G) relate to the GBR and are extracted from GBRMPA (2013a) Table 4.8. Unshaded columns are the study team's assessments of presence.

Environmental Processes

The GBR strategic assessment (GBRMPA 2013a) includes a companion table to the above that investigates key ecological processes relevant to Matters of NES (Table 4.9). For the WHA these are based on the SOUV and cover the four listing criteria as well as integrity as above. The following table is a subset of Table 4.9 and deals with:

- the key environmental processes (Table 4.9 column 1)
- GBRMPA assessment of presence for the four listing criteria and integrity at the GBR level (Table 4.9 columns 2, 4, 6, 8, and 10) – shaded and marked 'G' = GBR
- study team assessment of presence for the four listing criteria and integrity at the Aquis site level (columns 3, 5, 7, 9, and 11) – unshaded and marked 'S' = Site.

This table therefore provides a checklist of environmental processes relevant to WHA values that are present at or in the immediate vicinity of the site (or are likely to be influenced in some way by the proposed development). These headings are used to structure the following discussion.

As above, the order of columns 2, 4, 6, 8, and 10 follows that of the current listing criteria (i.e. (vii) to (x)), rather than the original criteria (i) to (iv) as was the case for the original table.

TABLE 22-21 KEY WHA ENVIRONMENTAL PROCESSES AT GBR AND SITE LEVEL

Key values and attributes	**Criterion vii (was iii)**		**Criterion viii (was i)**		**Criterion ix (was ii)**		**Criterion x (was iv)**		**Integrity**	
	G	**S**	**G**	**S**	**G**	**S**	**G**	**S**	**G**	**S**
Waves, currents and tides			•	•	•				•	•
Cyclones			•	•	•				•	•
Wind			•		•				•	
Sedimentation			•	•	•				•	•
Sea level			•	•	•				•	
Sea temperature					•				•	
Light					•				•	•
Nutrient cycling					•				•	
Ocean acidity					•				•	
Freshwater inflow and salinity					•				•	•
Microbial processes					•				•	
Particle feeding					•				•	
Primary production					•				•	•
Herbivory					•				•	
Predation					•				•	
Symbiosis					•				•	
Competition					•				•	
Connectivity			•	•	•				•	•
Recruitment					•				•	
Reef building	•		•		•				•	

Source: Study team compilation. Key environmental processes and shaded columns (G) relate to the GBR and are extracted from GBRMPA (2013a) Table 4.9. Unshaded columns are the study team's assessments of presence.

Key values and attributes, integrity, and environmental processes shown as being present at the site level in the tables above are discussed in detail below under the relevant criterion / integrity. Where values and attributes are included under more than one criterion, the treatment is relevant to that value only (e.g. scenic, ecological). However, in many cases there is an unavoidable overlap.

Note that in this chapter the discussion focuses on values of the project site and study area in the context of the GBR as a whole. An assessment of impacts on local and GBR values is provided in **Section 22.6.2**.

Criterion (vii) – Natural Beauty and Phenomena

Criterion (vii) (formerly iii): unique, rare or superlative natural phenomena, formations or features or areas of exceptional natural beauty, such as superlative examples of the most important ecosystems to man.

Guidelines: Consideration may be given to impacts on visual aesthetics, naturalness and water quality. Ecological communities and species listed under this criterion, for example migrating whales, dolphins, dugongs, whale sharks, sea turtles, seabirds and concentrations of large fish may also be considered. The department may consider the nature of the site (any existing developments or changes to natural state), the size and type of the development, the surrounding region and relevant measures proposed to mitigate impacts on visual amenity such as height restrictions and restrictions on buildings on ridgelines.

Key values discussed are those shown in **Table 22-20** and **Table 22-21** as being relevant to this World Heritage criterion. Potential impacts are discussed in **Section 22.6.2**.

Biodiversity – GBR habitats

Beaches and coastlines

In terms of this criterion, the GBRWHA includes the extraordinary system of coral reefs, islands and passages of the Great Barrier Reef plus other environmental and scenic values, which in combination provide some of the most spectacular scenery on earth. The scale and beauty of the Great Barrier Reef, to a greater extent than arguably any other coral reef system on earth, express outstanding universal aesthetic value.

The township, beach and headland of Yorkeys Knob essentially abut GBRWHA waters and the seaward limit of the Aquis site is some 500 landward of the coast. As shown in **Photo 22-6** below, parts of the beach south of Yorkeys Knob, the Richters Creek mouth, the northern part of Holloways Beach, and the natural coastal wetland areas all provide locally significant scenery.

Mangrove forests

The site borders mangroves on Thomatis / Richters Creek, which are part of a more extensive system and Fish Habitat Reserve and Estuarine Protection Zone of the GBR Coast Marine Park (state) associated with the Richters and Yorkeys Creek estuary and similar land fringing Half Moon Creek to the north-west. However, in terms of extent and universal aesthetic value, they are typical of tropical estuarine mangrove areas and not considered representative of the attribute at other than a local scale.

See **Photo 22-2** below.

Photo 22-2 Mangroves at the mouth of Richters Creek, south of Yorkeys Knob.

Photo is looking south-west from the beach to the background mountains (the site is behind these mangroves and dunal vegetation).

Open waters

The open waters off Yorkeys Knob Beach are usually turbid due to wind-driven wave action stirring up fine sediments in the shallow waters. These waters are described as being within the 'high nutrient coastal strip' bioregion of the Great Barrier Reef. This bioregion is characterised by terrigenous mud, high levels of nutrients from the adjoining land, seagrass in sheltered waters and a wet tropic climate. Within this area, there are scattered coastal fringing reefs that generally develop around the mainland and high continental islands that have high coverage of hard coral, soft coral and macroalgae, but low coral diversity (Kerrigan et al. 2010).

The waters of the study area usually lack the appeal expected of a World Heritage experience.

Biodiversity – terrestrial habitats that support the GBR

Rainforest

Technically, there is no rainforest on the Aquis site. There is a small area of vine forest (RE7.3.12b) adjacent to Lot 4 RP749342. However, it does not extend onto the project site, and ground truthing indicates it is much smaller than the mapped extent. Two of the ecological communities present on-site display features of closed or partially closed forests, but only mangroves (RE7.1.1) could be considered as closed forest (rainforest). Although some woodland areas have remained unburnt for many years and this has induced a vine forest understorey, such communities cannot be considered as closed forest.

When observed from the WHA, the dominant vegetation type is the coastal dune vegetation consisting of tall mangroves adjacent to the beach, and taller woodland and *Melaleuca* wetland vegetation on beach ridges and swales flanking these systems. See **Photo 22-2** above.

Biodiversity – species

The SOUV provides the following text to explain this attribute:

> Superlative natural beauty above and below the water. Beneath the ocean surface, there is an abundance and diversity of shapes, sizes and colours; for example, spectacular coral assemblages of hard and soft corals, and thousands of species of reef fish provide a myriad of brilliant colours, shapes and sizes. Other superlative natural phenomena include the annual coral spawning. The internationally renowned Cod Hole near Lizard Island is one of many significant tourist attractions.

The marine flora and fauna in the creeks, and in waters off-shore from Yorkeys Knob, do not exhibit '.. *abundance and diversity of shape, size and colour..'* as are often seen associated with coral reefs. In fact, the riverine and near-shore waters are usually turbid and the local beaches are not consistent with expectations of crystal clear waters associated with the GBR. Although some examples of visually important species are present, these are considered to be significant at the local level only as discussed below.

Mangroves

The site survey confirms the presence of four mangrove associations, namely:

- closed Avicennia
- closed *Ceriops*
- closed mixed
- close Rhizophora.

These are four of the thirteen associations recorded between Bowling Green Bay and Cape Tribulation. These associations contain 14 different mangrove species typical of the Cairns region. As **Photo 22-2** shows, the external view of the general site area from the WHA includes an intact mangrove forest typical of many coastal areas within the WHA. See also Criterion (ix).

Bony fish

These are likely to be present but unlikely to be visible in the study area due to the usually turbid waters. The aquatic ecology survey recorded a total of 94 fish, representing 17 species from 16 families from Thomatis, Richters, and Half Moon Creeks. All fish caught are commonly known to occur in estuarine reaches of rivers and creeks in northern Queensland.

None could be considered to have values representative of this criterion.

Marine turtles

As the marine ecology survey concludes, turtles are not common in the study area. However, **Section 22.15** reveals that six species of marine turtles have been recorded from estuarine waters adjacent to and downstream of the proposed development site. Although there is little significant habitat or food for marine turtles in the vicinity of the site, some species, including green turtles, may forage in these creeks, particularly in the mangrove habitats. Notwithstanding that the beaches of Trinity Bay are not recognised as major nesting areas for any marine turtle species, it is likely that there is some sparse nesting of marine turtles on the beaches in the vicinity of the site.

These are unlikely to be visible on the site or in its immediate vicinity due to the usually turbid waters.

Seabirds

As described in detail in **Section 22.14.1**, 14 bird species were confirmed on the site, 4 may overfly the site, and a further 15 species are likely to occur. Five of these birds are considered terrestrial migrants within the Australian mainland and all are relatively common species that occur over a wide area. Suitable habitat for all of these species exists within the project site, mainly in the seasonal abandoned aquaculture ponds, although some species may also forage on the clay pans following tidal inundation. While mangrove habitats are also valuable, there are no breeding colonies of seabirds recorded on or near the site.

Seabirds such as the White bellied sea eagle (see **Photo 22-3**) are frequently observed on Yorkeys Knob beach. This is a highly attractive bird found in many coastal environments and is commonly seen perched on a high limb that provides expansive views, or on rising air columns above heating islands or headlands.

Photo 22-3 White bellied sea eagle (*Haliaeetus leucogaster*).

This photo was taken on Yorkeys Knob Beach adjacent to the Aquis site. This and other species of seabirds use local habitats.

Whales

As described in **Section 22.15**, five species of whales are recorded in the online protected matters search tool as likely to occur in the study area. The assessment reveals that these species have a low likelihood of occurring adjacent to the project site and a low to moderate (depending on species) likelihood of occurring further off-shore. The small creeks surrounding the project site do not provide habitat for any whale species. Although whale-watching is a common tourism activity in the Cairns area, this is focussed off-shore and targets the humpback whale during the species' annual migration (July to September).

Geomorphological features

Islands and shorelines

There are no barrier reef islands off-shore from the Northern Beaches, except for Double Island and the smaller Haycock (Scouts Hat) Island near Buchan Point / Palm Cove approximately 9 km to the north. See **Photo 22-4** below for an image from the beach showing turbid near-shore waters and Double Island and Haycock Island (part, on right).

The two nearest GBR islands visited by tourists and others for appreciation of GBRWHA scenery and underwater experiences are the coral cay of Green Island (25 km to the east) and Fitzroy Island (33 km to the south-east, behind Cape Grafton). The visualisation (**Figure 22-23**) shows areas from which various height buildings on the Aquis site would theoretically be visible.

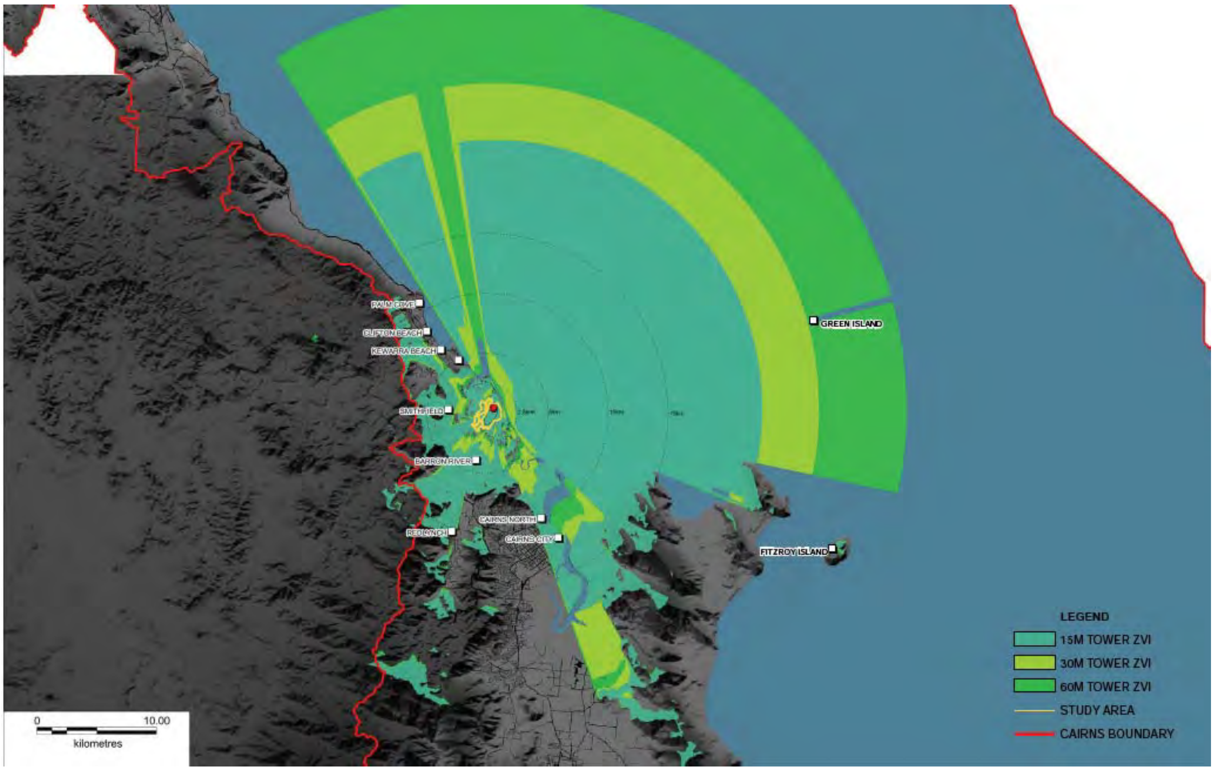


Figure 22-23 Locations from where tall buildings on the Aquis site can theoretcially be seen.

This is an early version of an image produced for the visual analysis (**Chapter 6** – Landscape and Visual). It is used here as it shows a range of building heights and is therfore a good tool for assessing overall visibility.

The above figure is provided not as an assessment of impacts but rather as an indication of places from which the project site (or tall buildings on it) would be visible (depending on sea haze). In this respect, buildings on the project site would be similar to the existing Cairns CBD high rise buildings, which are theoretically visible from Green Island but which are not in fact visible during the day time (due to sea haze). They are discernible at night as a faint distant lights and form part of the Cairns night-time ‘glow’.

Photo 22-4 View of Yorkeys Knob Beach looking north.

Double Island is in background and a part of Haycock island is on the far right.

Indigenous heritage

Nil for this criterion.

Historic heritage

Nil for this criterion.

Community benefits of the environment

The three applicable values (Appreciation, Enjoyment, Aesthetics) are considered together below in terms of human responses to aesthetic and associated values.

Experiential (response to place) Values

An important aesthetic consideration is 'experiential (response to place)' values. The Cairns Region is one of the few places in the world where two World Heritage Areas share a common boundary, but this does not occur in the Yorkeys Knob Area. The rainforest slopes of the Wet Tropics WHA are some 6 km west of the site and meet the shoreline of the GBRWHA to the north of Palm Cove. However residents and visitors to the Cairns region are likely to be aware of their proximity to the Great Barrier Reef and its importance to the local economy and environmental values. Residents of the northern beach suburbs are also likely to be aware that their coastline is the GBRWHA boundary, and close to the boundary of the Great Barrier Reef Marine Park. The off-shore waters, and the distant islands and reefs, are likely to be perceived as 'special' in terms of conservation, tourism and international reputation because they are within the GBRWHA.

However it is arguable as to whether or not this elicits a 'response to place' which is different from beach settlements anywhere on the Queensland coastline. Beaches and places with ocean views, especially those associated with a relatively undeveloped coastline (with mainly natural landform and vegetation) are likely to evoke strong responses, irrespective of whether or not they are within marine parks or World Heritage Areas. As seen from the mainland, the waters off-shore from Yorkeys Knob demonstrate no visible evidence of the Great Barrier Reef, and are equally likely to be perceived as opportunities for fishing, boating and ocean views to the Coral Sea. This is particularly likely at Yorkeys Knob where the Half Moon Bay marina provides recreational boating access to the off-shore waters.

To the extent that the mainland is part of this World Heritage visitor experience, it is seen from the ferry routes to these island tourist attractions, looking back towards Cairns and the background mountains. In this context, the Cairns Region coastline (including the Northern Beaches and the site) is part of the mainland which visitors use as a base, and 'leave behind' in order to visit a distant Great Barrier Reef island (or pontoon, dive site etc.) where they will experience the GBRWHA.

Landscape Integrity

An integral landscape is considered to be an area where the visible patterns, uses and scenic amenity have remained constant for a long time with little visible change, and are in accordance with community expectations. In this context, the following parts of the Barron River delta and the northern beach suburbs are considered to have a high degree of integrity:

- forest-clad mountains, remnant vegetation (wetlands and watercourses), other natural areas
- canefields and similar rural land uses
- coastline, beaches and headlands, and the marine waters of the Coral Sea
- the older and generally linear strip of coastal settlements
- inter-urban and intra-urban breaks.

However, as shown on the following image, areas of lower scenic integrity, where the older patterns and interfaces are changing relatively quickly, are:

- linear infrastructure across the landscapes, including the Captain Cook Highway and associated roundabouts and connecting roads, and the runways and infrastructure associated with Cairns Airport
- urban expansion of the coastal settlements, with newer subdivision patterns and larger more suburban houses
- tourist facilities such as Skyrail and the Tjapukai (Djabugay) Cultural Park, cable ski park, go-kart track, artillery museum etc.
- quarries, sand and gravel extraction and non-traditional rural uses (such as the Ponderosa Prawn Farm)
- Smithfield and its spreading 'centre', including bulky goods outlets and warehouses along the Captain Cook Highway.

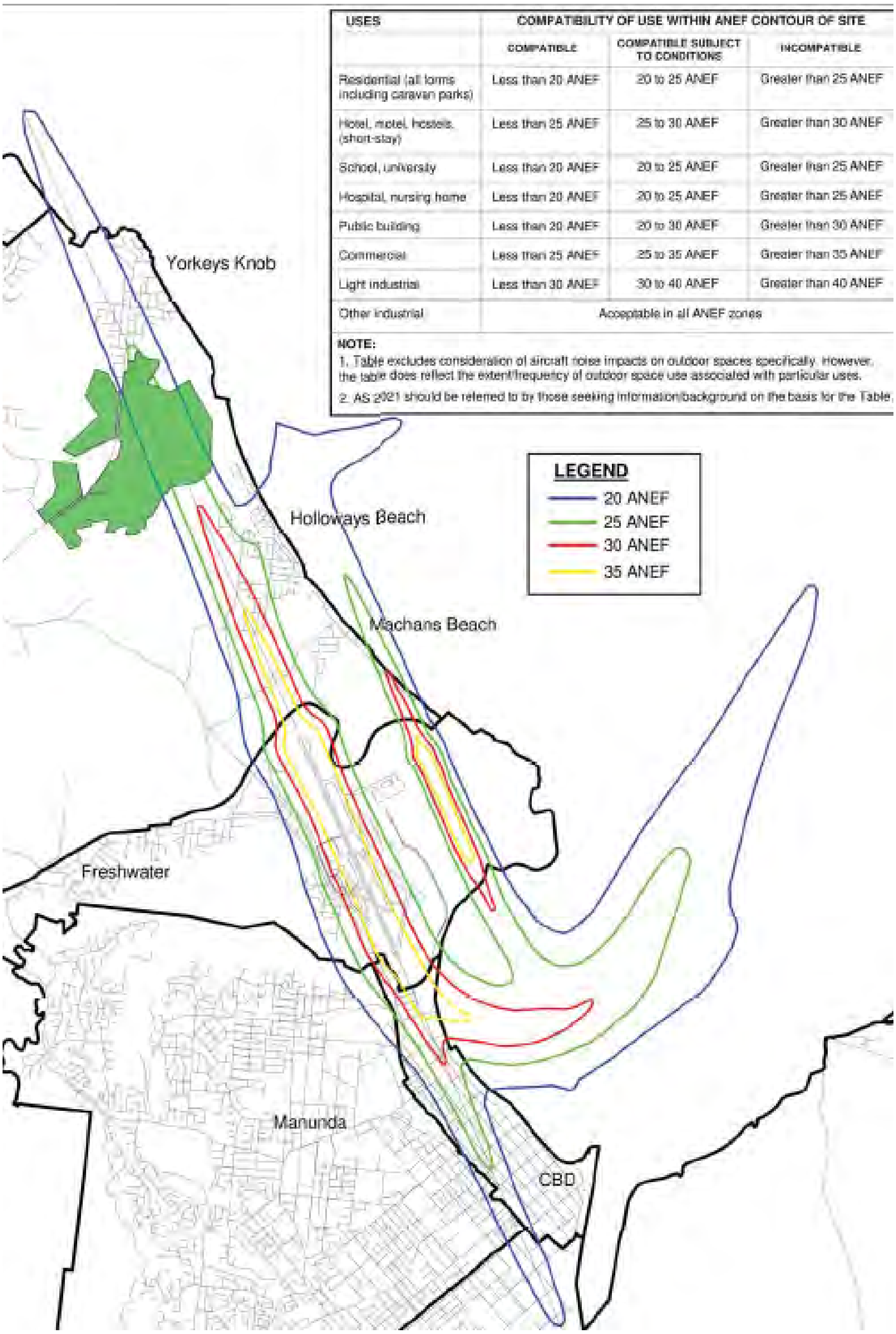
Photo 22-5 Views of the subject site from Skyrail.

The approximate location and footprint of the Aquis site is indicated.

Wilderness (Remoteness)

The concept of 'wilderness' generally applies to extensive road-less places accessible to self-reliant bushwalkers (also and preferably referred to as 'remoteness'), where natural values can be appreciated with minimal intrusion from other human activity. On this theme:

- there are no extensive remote areas in the Barron River delta, or in those parts of mountain ranges west of Smithfield which may be within view of the site
- there are many natural places in these mountains, and along the coastline (including the mouth of Richters Creek), but these are not large enough or sufficiently isolated to express 'remoteness' values
- parts of the rainforest-clad mountains which are inaccessible by vehicle, but within sight of Skyrail, would not be considered 'remote', and the proximity of Cairns Airport (with planes passing overhead at relatively low elevation during take-off and landing) also reduces the impression of remoteness. See **Figure 22-24**.



USES	COMPATIBILITY OF USE WITHIN ANEF CONTOUR OF SITE		
	COMPATIBLE	COMPATIBLE SUBJECT TO CONDITIONS	INCOMPATIBLE
Residential (all forms including caravan parks)	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostels (short-stay)	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

NOTE:
1. Table excludes consideration of aircraft noise impacts on outdoor spaces specifically. However, the table does reflect the extent/frequency of outdoor space use associated with particular uses.
2. AS 2021 should be referred to by those seeking information/background on the basis for the Table.

Figure 22-24 Proximity of Aquis to the Cairns International Airport.

The figure shown is of noise contours that give an indication of environmental noise at and near the site. More importantly, this figure shows the proximity of the site (shown in green) to the airport – the long axis of the contours indicates the flight paths.

Specifically, the attributes that support this aesthetic criterion of the WHA's OUV are considered to be absent, poorly expressed, or not uniquely represented in the project site, relative to other places within the property where such scenic values are distinctive and appreciated by visitors.

Nevertheless, parts of the beach south of Yorkeys Knob, the Richters Creek mouth, the northern part of Holloways Beach, and the natural coastal wetland areas, retain their naturalness (**Photo 22-6**), in that no buildings or structures are visible, despite being in relative close proximity to Cairns.

	**Photo 22-6** The mouth of Richters Creek, south of Yorkeys Knob. Photo is looking south-west from the beach to the background mountains (the site is behind mangroves to the right hand side of photograph). This image is used as the basis of a photomontage in the visual impact assessment (Chapter 6).
	**Photo 22-7** Approaching aircraft viewed over coastal vegetation. The naturalness of the Richters Creek area is regularly disturbed by arriving and departing aircraft. The Aquis site lies under the flight path to Cairns International Airport.

Photo 22-8 Recreational use of Yorkeys Knob beach.

Use of the marine area includes recreational fishing in the Richters Creek estuary and along Yorkeys Knob beach and Holloways Beach, kite surfing adjacent to the coast, and occasional jet ski use in the near-shore waters. The two beaches are popular walking destinations, especially for people taking advantage of the (off-lead) dog exercise environment.

Table 22-22 below summarises the aesthetic attributes recorded in the World Heritage citation of the GBRWHA and their relationship with the project site in terms of:

- attribute
- examples and/or additional information taken from the SOUV (SEWPaC 2011)
- an assessment of the relevance of the attribute to the site.

TABLE 22-22 GBRWHA AESTHETIC ATTRIBUTES REPRESENTED NEAR YORKEYS KNOB

GBRWHA AESTHETIC ATTRIBUTES	EXAMPLES AND/OR ADDITIONAL INFORMATION FROM THE STATEMENT OF OUV	REPRESENTATION NEAR YORKEYS KNOB
1. The vast extent of the reef and Island systems which produces an unparalleled aerial vista:	The vast mosaic patterns of reefs, islands and coral cays produce an unparalleled aerial panorama of seascapes comprising diverse shapes and sizes. It is one of a few living structures visible from space, appearing as a complex string of reefal structures along Australia's north-east coast.	There are no aerial vistas over reef and lagoon systems immediately off-shore from Yorkeys Knob. The closest reefs which form the distinctive Great Barrier Reef patterns of reefs, lagoons and passages occur 25 - 30 km off-shore, extending from Green Island northwards to Batt Reef.
2. Islands ranging from towering forested continental Islands complete with freshwater streams, to small coral cays with rainforest and unvegetated sand cays:	The rugged vegetated mountains and lush rainforest gullies that are periodically cloud-covered on Hinchinbrook Island	There are no islands off-shore from the Northern Beaches, except for Double Island and the smaller Haycock (Scouts Hat) Island near Buchan Point / Palm Cove approximately 9 km to the north. The two islands visited for appreciation of GBRWHA scenery and underwater experiences are the coral cay of Green Island (25 km to the east of the site) and Fitzroy Island (33 km to the south-east, behind Cape Grafton).
3. Coastal and	The vast mangrove forests in	The site borders mangroves on Thomatis /

GBRWHA AESTHETIC ATTRIBUTES	EXAMPLES AND/OR ADDITIONAL INFORMATION FROM THE STATEMENT OF OUV	REPRESENTATION NEAR YORKEYS KNOB
adjacent Islands with mangrove systems of exceptional beauty:	Hinchinbrook Channel.	Richters Creek, which are part of a more extensive system and Fish Habitat Reserve and Estuarine Protection Zone of the GBR Coast Marine Park (state) associated with the Richters and Yorkeys Creek estuary and similar land fringing Half Moon Creek to the north-west. However in terms of extent and universal aesthetic value, they are typical of tropical estuarine mangrove areas and not considered representative of the attribute.
4. The rich variety of landscapes and seascapes including rugged mountains with dense and diverse vegetation and adjacent fringing reefs:	The Whitsunday Islands provide a magnificent vista of green vegetated islands and spectacular sandy beaches spread over azure waters.	There are no rugged vegetated mountains or fringing reef systems within the GBRWHA adjacent to Yorkeys Knob. The hill and headland of Yorkeys Knob (72 m AHD) is a minor topographic feature.
5. The abundance and diversity of shape, size and colour of marine fauna and flora in the coral reefs:	Superlative natural beauty above and below the water. Beneath the ocean surface, there is an abundance and diversity of shapes, sizes and colours; for example, spectacular coral assemblages of hard and soft corals, and thousands of species of reef fish provide a myriad of brilliant colours, shapes and sizes. Other superlative natural phenomena include the annual coral spawning. The internationally renowned Cod Hole near Lizard Island is one of many significant tourist attractions.	The marine flora and fauna in the creeks, and in waters off-shore from Yorkeys Knob, do not exhibit '.. *abundance and diversity of shape, size and colour..'* as are often seen associated with coral reefs. In fact, the riverine and near-shore waters are usually turbid and the local beaches are not consistent with expectations of crystal clear waters associated with the GBR.
6. Spectacular breeding colonies of seabirds and great aggregations of over-wintering butterflies:	On some continental islands, large aggregations of over-wintering butterflies periodically occur.	Similarly, there are no breeding colonies of seabirds or known aggregations of butterflies recorded on or near the site.
7. Migrating whales, dolphins, dugong, whale sharks, sea turtles, seabirds and concentrations of large fish	Other superlative natural phenomena include the migrating whales, nesting turtles, and significant spawning aggregations of many fish species. On many of the cays there are spectacular and globally important breeding colonies of seabirds and marine turtles, and Raine Island is the world's largest green turtle breeding area.	Marine megafauna and concentrations of large fish are most likely present off-shore from Yorkeys Knob and elsewhere along the Northern Beaches, and it is likely that there will occasionally be a visible reminder that these waters are part of the GBRWHA.

Source: Study team compilation based on **Appendix E**.

This assessment concludes that, in terms of the attributes which contribute to the aesthetic World Heritage Values (and hence to OUV), none are expressed in the Yorkeys Knob area except in as much as there are mangroves present and probably migrating whales off-shore. In this respect Yorkeys Knob is similar to many other parts of the Queensland coastline, and these attributes do not represent GBRWHA values nor contribute to diversity, any more than any other section of coastline.

Key environmental processes

Nil for this criterion. See ‘Integrity’

Summary

In terms of criterion (vii) (formerly (iii)):

- The site borders mangroves on Thomatis / Richters Creek, which are part of a more extensive system. These are included in two Fish Habitat Reserves and parts of the Estuarine Protection Zone of the GBR Coast Marine Park (state) associated with the Richters and Yorkeys Creek estuary and similar land fringing Half Moon Creek to the north-west. However, in terms of extent and universal aesthetic value, they are typical of tropical estuarine mangrove areas and not considered representative of the attribute.
- The open waters off Yorkeys Knob Beach are usually turbid due to wind-driven wave action stirring up fine sediments in the shallow waters. This limits the visibility of species with visual appeal. The marine flora and fauna in the creeks, and in waters off-shore from Yorkeys Knob, do not exhibit characteristics associated with coral reefs. So, while marine megafauna and concentrations of large fish are most likely present off-shore from Yorkeys Knob and elsewhere along the Northern Beaches (and when sighted will provide an occasional visible reminder that these waters are part of the GBRWHA), this is not a regular occurrence.
- At a local level, the Richters Creek estuary near the site is in a largely natural state and is characterised by sandy beaches and intact coastal vegetation (particular mangroves and Casuarina spp.) Few signs of human existence are present for beach users although departing and arriving aircraft using the nearby Cairns International Airport are a regular interruption.
- To the extent that the mainland is part of this World Heritage visitor experience, it is seen from the ferry routes to these island tourist attractions, looking back towards Cairns and the background mountains. In this context, the Cairns Region coastline (including the Northern Beaches and the site) is part of the mainland which visitors use as a base, and ‘leave behind’ in order to visit a distant Great Barrier Reef island (or pontoon, dive site etc.) where they will experience the GBRWHA.

Criterion (viii) – Major Stages of the Earth’s Evolutionary History

Criterion (viii) (formerly i): outstanding examples representing the major stages of the earth's evolutionary history.

Guidelines: Impacts on attributes under this criterion may be considered, including the uniqueness of the site in terms of its location within the Great Barrier Reef World Heritage Area. The department may also consider impacts on coral reefs, sand barriers and sand dunes, impacts on ongoing processes of erosion and accretion of coral reefs, and erosion and deposition processes along the coastline.

Key values discussed are those shown in **Table 22-20** and **Table 22-21** as being relevant to this World Heritage criterion. Potential impacts are discussed in **Section 22.6.2**.

Biodiversity – GBR habitats

Nil for this criterion.

Biodiversity – terrestrial habitats that support the GBR

Nil for this criterion.

Biodiversity – species

Nil for this criterion.

Geomorphological features

Islands and shorelines

As for Criterion (vii), there are no special attributes present for this criterion. A detailed review of coastal processes and their role in forming the local coastline is provided below under environmental processes.

River deltas

The site is situated at the seaward limit of the delta of the Barron River and is within several hundred metres of the Coral Sea. At a local level, the site lies within the sub-catchments of Richters Creek, Yorkeys Creek, and Half Moon Creek. Of these, Richters Creek is the largest of the waterways, being a distributary of the Barron River due to its connection via Thomatis Creek.

The Barron River delta floodplain, together with the Barron Falls and the steep escarpment, is a regionally significant landscape. The Barron River is one of two regional examples of river capture (the other is the Herbert / Wild system) where a short and steep coastal stream eroded the escarpment (at what is now the Barron Falls) and 'captured' part of what was then the Mitchell River system. In the context of the WTWHA, the Barron River delta is part of the largely developed coastal plain that lies seaward of the World Heritage area.

An important value of the local terrestrial environment to the GBRWHA is the close proximity of the Wet Tropics and Great Barrier Reef WHAs – each is visible from the other and this enhances the evidence of land-forming processes, the relationship between the GBR and its catchment, and the overall perception of protected areas. The Aquis site lies within this narrow intervening area as part of the mosaic of remnant waterways, cane fields, residential areas, and commercial / industrial developments although this is not apparent from the sea.

Catchment overview

Indigenous heritage

Nil for this criterion.

Historic heritage

Nil for this criterion.

Community benefits of the environment

Nil for this criterion. Arguably 'appreciation' of the land-building processes of the Barron River delta would be relevant.

Environmental Processes

Refer to Criterion (ix).

Summary

In terms of criterion (viii) (formerly (i)):

- The site is situated at the seaward limit of the delta of the Barron River and is within several hundred metres of the Coral Sea. At a local level, the site lies within the sub-catchments of Richters Creek, Yorkeys Creek, and Half Moon Creek. Of these, Richters Creek is the largest of the waterways, being a distributary of the Barron River due to its connection via Thomatis Creek. The Barron River is locally significant as an example of river capture.
- Over geological timescales, the beaches adjacent to the Barron River delta have been accreting, although local disturbances such as interruptions to the fluvial supply from rivers such as the Barron River have caused large scale disturbances. These fluctuations pre-date the arrival of Europeans and are a natural rather than anthropogenic (human-induced) occurrence. The Barron River delta is the largest source of sediment to Cairns' northern beaches and supplies about 23 000 m^3 annually.
- Estimated long term 'coastal bite' in the beach adjacent to the Aquis site is 400 m which is within the forested part of the property but seaward of the eastern extent of the Aquis site.
- Off-shore geomorphic features such as islands are present at a distance (e.g. Double Island and Haycock Island) while reefs, seagrass meadows and coral islands are absent.

The Aquis site does not contribute to these values to any great extent, although as part of a delta feature it is a remnant of geomorphological processes and is adjacent to an active coastal zone subject to long-shore drift. The site is landward of the Holocene accretion boundary and proposed development is well outside the area of 'coastal bite' predicted by coastal erosion studies.

Criterion (ix) – Ecological and Biological Processes

Criterion (ix) (formerly ii): outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment.

Guidelines: Impacts on the diversity of flora and fauna and on feeding and/or breeding grounds for internationally important migratory seabirds, cetaceans and sea turtles may be considered. The department may also consider matters such as breeding, spawning and nursery habitats for resident species of the Great Barrier Reef World Heritage Area. Flora and fauna would not necessarily be considered for their conservation status under this criterion, but for the ecosystem services they provide that support the biological health and long term viability of the outstanding universal value of the Great Barrier Reef World Heritage Area. Consideration may also be given to how the values of the proposed site contribute to the outstanding universal value of the property overall.

Key values discussed are those shown in **Table 22-20** and **Table 22-21** as being relevant to this World Heritage criterion. Potential impacts are discussed in **Section 22.6.2**.

Biodiversity – GBR habitats & terrestrial habitats

GBRMPA (2013a) includes an assessment of the condition (and trends in this condition) of GBR (off-shore) and terrestrial (in-shore) habitats relevant to GBR health. Although not shown in GBRMPA Table 4.8 (and hence **Table 22-20**), this is of use in the Aquis assessment as it provides a finer scale of values description that can then be used for impact assessment.

In terms of GBR (off-shore) habitats, the Aquis site is within the southern in-shore (S.I.) and southern off-shore (S.O.) areas defined in GBRMPA (2013a). The north-south dividing line is in the vicinity of Port Douglas, which marks the broad division between the more developed and less developed catchments adjacent to the GBR Region. The inshore-off-shore dividing line is generally about 20 kilometres off-shore. It corresponds to enclosed coastal and open coastal water bodies described in the *Water Quality Guidelines for the Great Barrier Reef Marine Park* but also includes areas further off-shore that are habitats for recognised in-shore specialist species such as dugongs.

The assessment of terrestrial (on-shore) habitats that support the Great Barrier Reef is also presented for four areas. Again, the north-south dividing line is around Port Douglas and the Aquis site is in the southern inland (S.In) area. The coastal areas are defined as being a minimum of five kilometres landward from the coastline or where land reaches the height of 10 metres AHD, whichever is furthest from the coast (the project site is within these bounds). The inland area is the remainder of the Great Barrier Reef catchment.

This area-based classification was used by GBRMPA (2013a) as the basis of the trend assessment. The following table is extracted from Tables 7.2 and 7.3 of that report for the Aquis areas (i.e. S.I. and S.In). The fourth column is the study team's assessment of relevance to the Aquis Resort (i.e. 'is the habitat present or nearby?'). Some habitat types not included in Table 4.8 of GBRMPA (2013a) (**Table 22-20** and **Table 22-21** above) are considered to be relevant at the site level, although it is clear that they are not regionally significant.

TABLE 22-23 CONDITION AND TREND (S.I AND S.IN)

HABITAT	CONDITION	TREND	RELEVANT?
GBR habitats			
Beaches and coastlines	Good	Deteriorating	✓
Mangrove forests	Good	Stable	✓
Seagrass meadows	Poor	Deteriorating	
Coral reefs	Poor	Deteriorating	
Lagoon floor	Good	Stable	
Shoals	Good	Stable	
Open waters	Poor	Deteriorating	✓
Terrestrial habitats			
Freshwater wetlands	Poor	Deteriorating	✓
Forested floodplain	Poor	Deteriorating	✓
Heath and shrublands	Very good	Stable	
Grass and sedgelands	Very poor	No clear trend	
Woodlands	Very poor	Stable	✓
Forests	Poor	Stable	✓
Rainforest	Good	Stable	~
Connecting waterbodies	Very poor	Deteriorating	✓

Source: GBRMPA (2013a) Tables 7.2 and 7.3.

This table shows that the following habitats are of some relevance to Aquis in its role as a development in the GBR catchment:

- off-shore:
  - Beaches and coastlines
  - Mangrove forests
  - Open waters
- on-shore:
  - Freshwater wetlands
  - Forested floodplain
  - Woodlands
  - Forests
  - Rainforest (not present on-site but exists nearby)
  - Connecting waterbodies.

Although not shown in GBRMPA table 7-2, a small area of saltmarshes is present on the Aquis site. There is a difficulty in applying what are regional values at the local level. Notwithstanding, it is concluded that the Aquis site currently plays a small but important role (i.e. commensurate with its size) in supporting the above habitats and their overall functioning.

These habitats are all discussed under 'Integrity'.

Biodiversity – species

See Criterion (x) and 'Integrity'.

Geomorphological features

Nil for this criterion.

Indigenous heritage

Aboriginal people have lived in Australia for at least 40 000 years. Throughout this time, there have been environmental and sea level changes, some of which appear to be described in local oral traditions.

At the time of white settlement, Aboriginal people in the Cairns district were hunter/gatherer/fishers, exploiting the rich resources of the marine, estuarine, woodland and rainforest environment available in the area. Settlements were semi-permanent, with well thatched substantial huts. People moved though the country on a seasonal round, harvesting material for food, medicines, fish poisons, material for baskets, implements, decoration etc.

Different clan groups owned and were responsible for their own clan territory, but people frequently lived in and used other clan territories. All parts of the land were known and named, and associated with Stories of 'creation time', traditional and historical events, and/or traditional use. The local group with association with the land is the Yirrganydji.

Following European settlement, Aboriginal people were displaced, and forcibly moved around. However, most people still know their origins, and wish to practice their culture as much as possible, including protecting significant cultural heritage places.

Sacred sites, sites of particular significance, places important for cultural tradition

Most of the studies undertaken in the Barron River delta have found no cultural heritage places in the area. Archaeological sites that have been found tended to be small, sparse, and disturbed by cultivation. However, it is known from many studies in the Cairns area that cultural material can still exist on degraded agricultural land. Cribb and Lee Long (1995) have developed a predictive model of site occurrence of archaeological material. This model predicts that:

- the least likely areas for sites are coastal and inland mangroves, saltpans, and urban/developed areas
- the most likely locations for sites are on sand ridges and in *Melaleuca* open forest.

They also noted that cultivated areas were unlikely to retain surface archaeological material except in a very disturbed state, although intact material might well survive below the level of ploughing (c 600 mm). It should be added that Aboriginal archaeological sites may also still exist within urban/developed areas; buried deposits have been found in such situations in many parts of Australia. It is of relevance that in his survey of the Ponderosa Prawn Farm site just south of the project site, Cribb (1995) found no evidence of cultural heritage material despite a targeted search.

Stories, songlines, totems and languages

No specific attributes have been identified although there is evidence that there are still strong language and cultural connections between local indigenous people and the Cairns lowlands.

Indigenous structures, technology, tools and archaeology.

In terms of the site itself, local indigenous values were assessed in **Appendix U** and documented in **Chapter 21** (Cultural Heritage). In this work, a desktop review of heritage databases and registers was undertaken. No sites on the (former) Register of the National Estate, World Heritage List, National Heritage List, or the Commonwealth Heritage List were found on the site. Similarly, no sites listed on the Queensland Heritage Register occur within the site.

There are a number of relevant Indigenous cultural heritage (ICH) sites registered on the local DATSIMA database. These sites and their general location are listed below. It should be noted that all of the registered sites were physically located during a former field assessment of the Aquis site in 1991 by Grimwade & Cribb (1991) although they could not be located in 2013 despite extensive search effort. Specific location data has been deleted for confidentiality.

TABLE 22-24 INDIGENOUS CULTURAL HERITAGE SITES ON THE AQUIS SITE

AREA	SITE ID	LATITUDE	LONGITUDE	RECORD DATE	ATTRIBUTE	ABORIGINAL PARTY
Lot 100 NR3818	FA:A28	Deleted *	Deleted *	10 / 01 / 1991	Shell Midden	No registered party
Lot 100 NR3818	FA:A29	Deleted *	Deleted *	06 / 01 / 1991	Hearth Oven, Shell Midden	No registered party
Lot 100 NR3818	FA:A30	Deleted *	Deleted *	10 / 01 / 1991	Shell Midden	No registered party

Source: Appendix U (Table 1). * coordinates deleted for confidentiality reasons.

Although the 2013 field inspection failed to locate any of these sites, a review of the coordinates and a review of the original 1991 report reveals that they are all located in areas wooded areas proposed to be retained as part of the development.

As the three identified sites are all outside the development footprint, there will be no direct impacts. Preparation of a Cultural Heritage Management Plan (CHMP) under the *Aboriginal Cultural Heritage Act 2003* (ACH Act) has commenced with the Yirrganydji.

Included in the project concept is a Cultural Heritage Centre. Subject to the outcomes of the CHMP it is proposed that relevant interpretive material regarding ICH be included in this Centre and that appropriate signage be place at strategic locations on the proposed walking tracks / viewing platforms shown indicatively on the Concept Land Use Plan. These concepts will be developed further in the *Interpretation Strategy* (see **Table 22-50**).

Historic heritage

Some locally significant NICH sites were located (see **Chapter 21** – Cultural Heritage) but these do not fall within this criterion.

Community benefits of the environment

Nil for this criterion.

Environmental processes

Contribution to Integrity of the GBRWHA

Putting the previous description of GBR and terrestrial habitats into a GBR context, GBRMPA (2013a) notes that 'areas adjacent to the Region directly support the biodiversity of the Marine Park, for example the trapping of nutrients and sediments in wetlands'. Relevant habitats from the analysis above are described below (GBRMPA 2013a):

- **Saltmarshes** are an important, highly productive, interface between the marine and terrestrial environments, providing feeding and breeding areas for many marine species.
- **Freshwater wetlands** slow the overland flow of water; cycle nutrients and sediments; are important dry season refugia for many species; and are used by some marine species for parts of their life cycle.
- **Forested floodplains** help slow, capture and recycle nutrients and sediments; protect the soil surface from the erosive forces of rain; and are important nursery areas for many species with connections to the Great Barrier Reef.
- **Heath and shrublands** [not present] help slow the overland flow of water; prevent erosion; recycle nutrients and sediments; and are important as buffers on steep coastal hill slopes.
- **Grass and sedgelands** [not present] are used for feeding and roosting by migratory birds; help slow the overland flow of water; and capture nutrients and sediment.

In terms of limiting nutrient supply to the Great Barrier Reef:

- **Forests** contribute to the hydrological cycle through evapotranspiration, cloud formation and rainfall generation.
- **Rainforests** minimise soil loss from erosion, including binding and stabilising soils, and provide habitat for species that also use Great Barrier Reef islands.
- **Connecting waterbodies,** such as rivers, creeks, estuaries and floodplains, are the aquatic link between the marine and terrestrial environment, transporting water, nutrients and sediments, and providing a movement corridor, as well as feeding and breeding areas for some marine and coastal species. Aquatic connectivity is provided through surface waterbodies and groundwater.

Aquis habitats

A detailed discussion of habitats on and adjacent to the project area is provided in the discussion on 'Integrity'.

Contribution to Ecosystem Services

Overall, the site and its surrounds, while experiencing degradation resulting from rural and urban development since European colonisation, continues to function and deliver various ecosystem services. These are defined as:

> … actions or attributes of ecosystems of benefit to humans, including regulation of the atmosphere, maintenance of soil fertility, food production, regulation of water flows, water filtration, pest control and waste disposal. It also includes social and cultural services, such as the opportunity for people to experience nature. (Australia State of the Environment Report –SEWPaC (2011))

Ecosystem services have a strongly anthropocentric flavour – they are generally what are good for humans. Within these services, however, are functions that benefit the natural world. Of these, the project site would provide the following:

- hydrologic services related to routing flood runoff and groundwater storage
- nutrient dispersal and cycling
- seed dispersal
- primary production
- carbon sequestration and climate regulation
- waste decomposition and detoxification
- purification of water and air.

The following figure, extracted from GBRMPA (2009a) shows these contributions graphically.

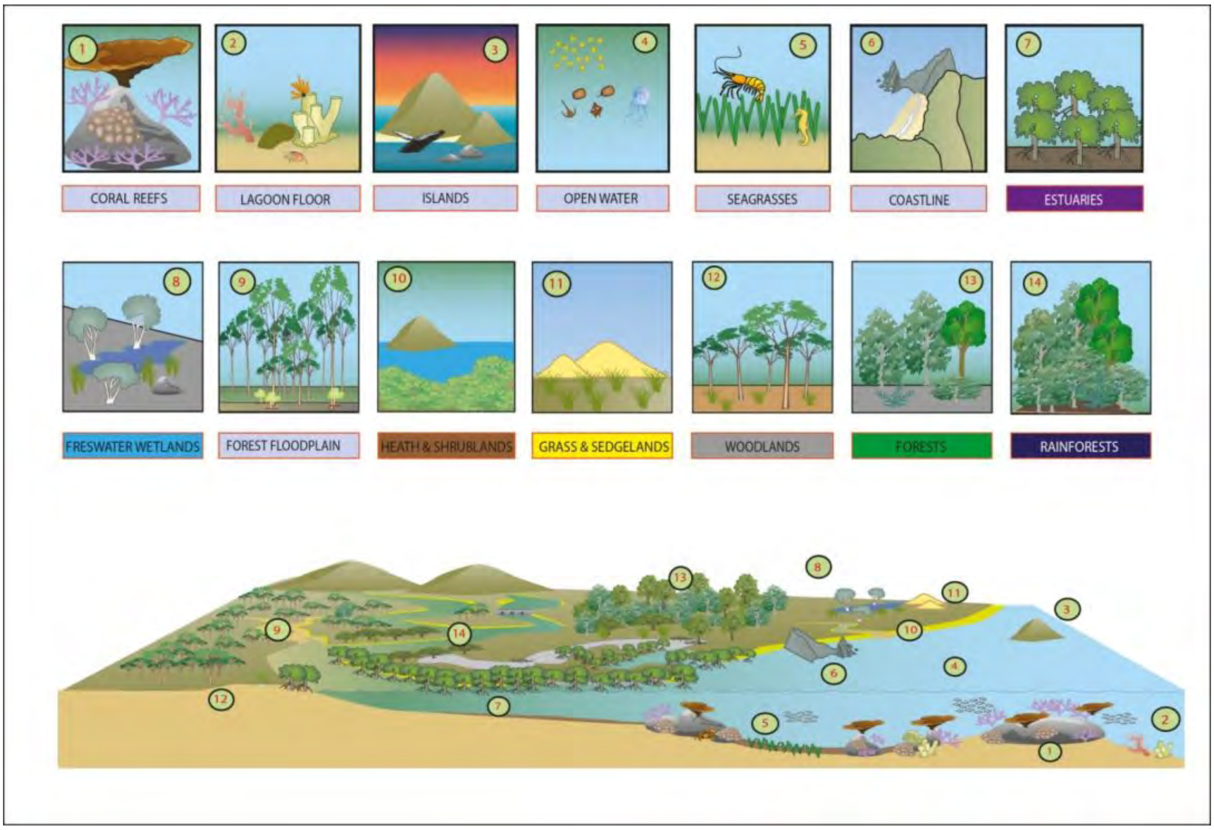


Figure 22-25 Categorisation and description of some of the ecological functions provided by coastal ecosystems

Source: GBRMPA 2009a.

As one of the responses to the strategic environmental assessment of the GBR, GBRMPA has embarked on what is called the 'Blue Map' project. This work, which still in preparation (GBRMPA 2014), seeks to quantify the contribution made by on-shore areas to the values of the GBR in terms of locally-derived ecological processes / services. The maps prepared model three situations:

- Case 1: pre-colonisation conditions
- Case 2: current conditions
- Case 3: future conditions following development / management.

Members of the Aquis EIS team collaborated with GBRMPA officers to use Aquis as a case study. A Case 1 map was generated using standard Queensland Government data. This map shows the best estimate of land cover pre-clearing, based on topography, soils, and knowledge of current regional ecosystems.

Information on Cases 2 and 3 was provided to GBRMPA in the form of GIS coverages of existing vegetation to remain and committed restoration, both as described in **Section 22.4.2**. The Case 2 map (essentially pre-Aquis condition, values, and protection/management priorities) is shown below.

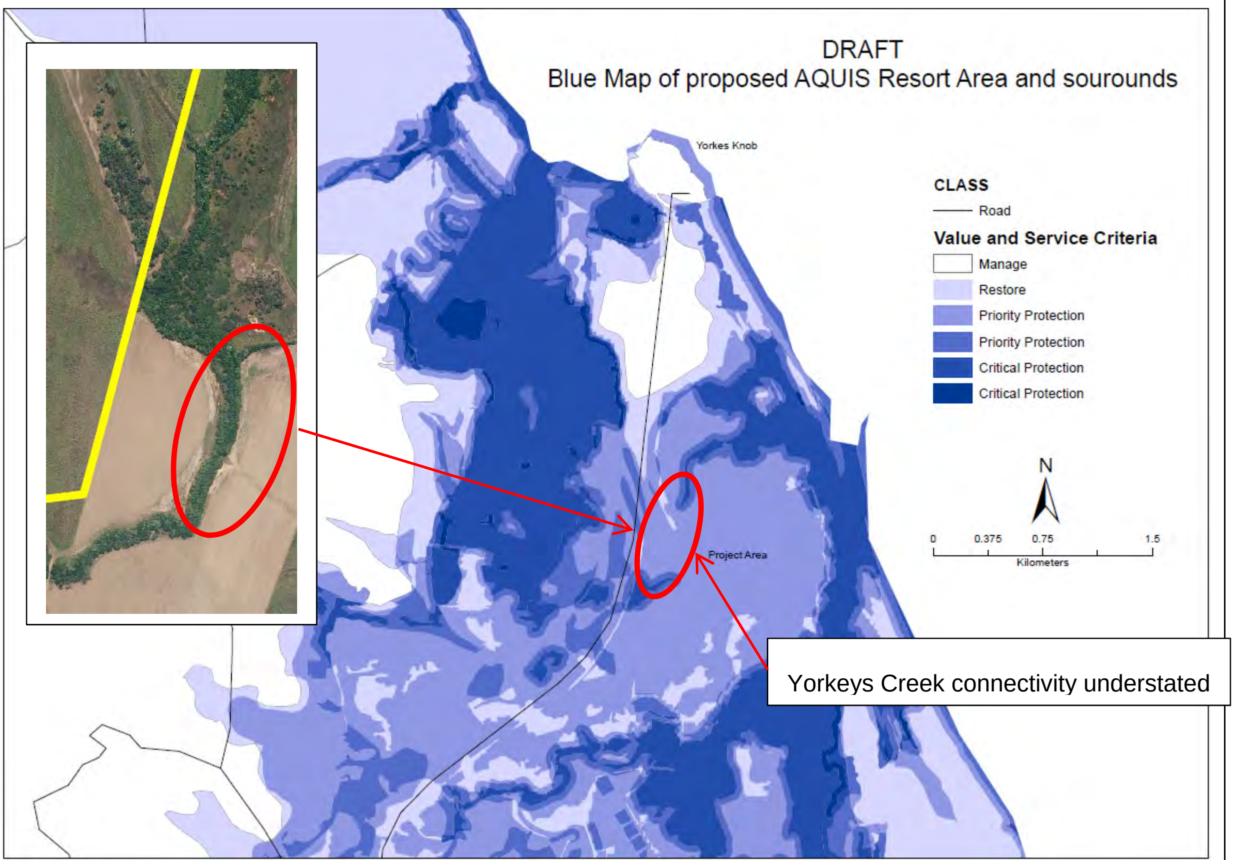


Figure 22-26 Draft Blue Map of Aquis site and surrounds (Case 2 – pre-Aquis).

Source: GBRMPA (D Audas pers. comm. 25 February 2014).

This map shows that:

- the existing mangrove forests to the north-east and north-west of the site as well as the Richters Creek corridor are in need of critical protection
- the Aquis site itself is recommended for restoration.

It is considered that the regional ecosystem mapping that underlies the Blue Maps work understates the integrity of the Yorkeys Creek corridor through the Aquis site. Aquis fieldwork has confirmed that this corridor, while reduced in width by historic agricultural activities within the Aquis site, is nonetheless sufficiently intact to provide functional connectivity.

Water Quality

GBR Issues

The rate of flow and quality of water entering the GBR is critical to its integrity. In terms of rate, GBRMPA (2013a) observes that:

> … activities such as agriculture, urbanisation and industrial development can increase the magnitude and timing of freshwater inflows into the Region. For example, roads, stormwater drains and other urban infrastructure can increase the volume and speed of freshwater inflow, compared to natural vegetation and soil which retard water movement. Stormwater drains release large quantities of fresh water into the sea that would normally percolate through the groundwater along shorelines and in riparian areas. (p 6-18)

The quality of water is also important, and dissolved inorganic nitrogen and phosphorous continue to enter the GBR at greatly enhanced levels compared to those prior to European settlement. As noted, a key target of Reef Plan is to achieve a 50 per cent reduction in nutrient loads entering the Great Barrier Reef by 2018. Total fertiliser and pesticide / herbicide use on farming lands in the catchment has been reduced in recent years and recent monitoring and modelling show current initiatives are successfully reducing nutrient concentrations in catchment run-off. More importantly, early evidence shows reductions in the nutrient load entering the marine system.

Sediments transported to the reef via coastal rivers during the wet season are believed to be one of the most important threats to the WHA. Sediments typically arise from increased soil erosion where areas have been cleared of native vegetation for agricultural and urban development. According to GBRMPA (2013a), increasing sediment loads have far-reaching effects on the GBR values. For example:

- The heavier erosion sediments, which flow more slowly through the system, are filling freshwater stream beds and deep waterholes. This degrades these habitats, affecting the distribution, abundance and recruitment of many freshwater species and some marine-related species such as sawfish.
- Increases in suspended sediment significantly alter light regimes — lower light levels reduce primary production, both pelagic and benthic (including in the coral-algae symbiosis).
- As the increased sediment load settles, it can smother benthic organisms such as seagrass and corals, making it harder or impossible for them to grow, survive and reproduce. This has significant flow-on effects to organisms and animals dependent on these habitats.
- The resuspension of sediments increases the turbidity of open waters and releases additional nutrients previously bound up or buried in sediments.

Site Water Quality

Water quality and sediment testing (including benthic microorganisms) undertaken in the surrounding watercourses (i.e. Richters Creek, Yorkeys Creek, and Half Moon Creek) reveals that current water quality in the catchment of the proposed development is generally good. However, the waters do not meet the Queensland Water Quality Guidelines (QWQG) prepared by DERM (2009c) for various nutrients and turbidity. It appears that water quality is adversely affected by agricultural runoff from the surrounding land, predominantly cane farming in the overall catchment and the prawn farm on Richters Creek, and the Marlin Coast Wastewater Treatment Plant (WWTP) on Half Moon Creek.

Metal concentrations in the sediments indicate that, potentially, acid sulfate soils are active in each of the three creeks and/or their catchments. However, the water quality currently sustains fisheries values so this effect is not of a long term nature.

Recent water quality testing found that the water quality results collected in situ were similar to the earlier findings, although, as expected, turbidity and nutrient levels in Richters Creek during high wet season flows are higher than those recorded during the dry season.

Sedimentation & Nutrient Cycling

The effect of the Aquis development on sediment and nutrient export and proposed mitigation measures is discussed in **Section 22.4.2b)**. This shows that the proposed WSUD features will significantly reduce the export of pollutants when compared with the existing cane farm.

Summary

In terms of Criterion (ix) (formerly (ii)):

- Many off-shore habitats of value to the GBRWHA are present in the study area (Beaches and coastlines, Mangrove forests, and Open waters) while on-shore the project area and surrounds contributes to environmental processes via Saltmarshes, Freshwater wetlands, Forested floodplain, Woodlands, Forests, Rainforest, and Connecting waterbodies.
- Biodiversity (species) attributes are relevant to this criterion but to avoid repetition are described under Criterion (x) and Integrity.
- Aboriginal people have lived in Australia for at least 40 000 years. Throughout this time, there have been environmental and sea level changes, some of which appear to be described in local oral traditions. At the time of white settlement, Aboriginal people in the Cairns district were hunter/gatherer/fishers, exploiting the rich resources of the marine, estuarine, woodland and rainforest environment available in the area for food, medicines, fish poisons, and materials for baskets, implements, and decoration. Limited examples remain of indigenous use of land and sea resources in the study area, although some cultural material (middens and a hearth oven) was found on-site as recently as 1991 (but not in a 2013 survey). All sites lie outside the development footprint and there is an opportunity for on-site interpretation and education on indigenous culture based partly on these physical remains. Preparation of a Cultural Heritage Management Plan under the *Aboriginal Cultural Heritage Act 2003* (ACH Act) has commenced.
- All on-site habitats contribute to some extent to the integrity of the WHA in that they supply numerous ecosystem services including hydrologic services related to routing flood runoff and groundwater storage, nutrient dispersal and cycling, seed dispersal, primary production, carbon sequestration and climate regulation, waste decomposition and detoxification, and purification of water and air.
- Water quality in the creeks surrounding the project area is generally good, although these waters do not meet the QWQG for various nutrients and turbidity. Water quality may be being adversely affected by agricultural runoff from the surrounding land, aquaculture discharge, and effluent disposal from the Marlin Coast WWTP on Half Moon Creek. Metal concentrations in the sediments indicate that, potentially, acid sulfate soils are active in each of the three creeks and/or their catchments. However, the water quality currently sustains fisheries values so this effect is not of a long term nature. The site in its current condition is estimated to be exporting 285 t/a of sediments and nutrients via runoff.

Criterion (x) – Habitats for conservation of biodiversity

Criterion (x) (formerly iv): habitats where populations of rare or endangered species of plants and animals still survive.

Guidelines: Impacts on biological diversity would be considered, including for example, impacts on species diversity, abundance and endemic species and on habitat diversity such as seagrass, mangroves and coral diversity. Impacts on EPBC listed ecological communities and species of conservation significance and their habitat (for example, dugongs and seagrass beds) would be considered both as matters of national environmental significance and as components of the outstanding universal value of the Great Barrier Reef World Heritage Area. Impacts on non-EPBC listed communities that contribute to this criterion, for example coral habitat, would also be taken into account with reference to the extent of similar habitat elsewhere within the world heritage area, the amount of habitat to be impacted and the amount of fragmentation due to habitat loss and development.

Key values discussed are those shown in **Table 22-20** and **Table 22-21** as being relevant to this World Heritage criterion. Potential impacts are discussed in **Section 22.6.2**.

Biodiversity – GBR and terrestrial habitats

A detailed discussion of habitats on and adjacent to the project area is provided in the discussion on 'Integrity'.

Biodiversity – species

Mangroves

Mangrove associations and distribution are discussed above under GBR habitats. In terms of species**,** **Table 22-25** sets out a full species list of mangroves observed on and within 100 m of the site.

TABLE 22-25 MANGROVE SPECIES

FAMILY	GENUS / SPECIES	COMMON NAME
ACANTHACEAE	*Acanthus ilicifolius*	Holly-leaf mangrove
ACANTHACEAE	*Avicennia marina*	Grey mangrove
COMBRETACEAE	*Lumnitzera littorea*	Black mangrove
COMBRETACEAE	*Lumnitzera racemosa*	Black mangrove
EUPHORBIACEAE	*Excoecaria agallocha*	Blind-your-eye mangrove
FABACEAE	*Cynometra iripa*	Wrinkle-pod mangrove
MALVACEAE	*Heritiera littoralis*	Looking-glass mangrove
MELIACEAE	*Xylocarpus moluccensis*	Cannonball mangrove
MYRSINACEAE	*Aegiceras corniculatum*	Black mangrove
PLUMBAGINACEAE	*Aegialitis annulata*	Club mangrove
RHIZOPHORACEAE	*Bruguiera gymnorhiza*	Orange mangrove

FAMILY	GENUS / SPECIES	COMMON NAME
RHIZOPHORACEAE	*Ceriops australis*	Yellow mangrove
RHIZOPHORACEAE	*Rhizophora apiculata*	Tall stilt-root mangrove
RHIZOPHORACEAE	*Rhizophora stylosa*	Stilt-root mangrove

Source: Appendix G.

Invertebrates

Estuarine Benthic Invertebrates

Recent monitoring reveals that estuarine benthic invertebrate communities in Thomatis and Richters creeks were dominated by isopods (sub-order Flabellifera), tanaids (order Tanaidacea) and Nereid polychaetes (family Nereididae), while benthic invertebrate communities in Half Moon Creek were dominated by polychaetes (families Capitellidae and Magelonidae). There were low abundances of bivalves and gastropods throughout the survey area.

In Thomatis and Richters creeks, benthic invertebrate abundances decreased with distance downstream. Benthic invertebrate abundances were dominated by crustaceans (i.e. isopods and tanaids) at each site.

The abundance of estuarine benthic invertebrates in the lower reaches of Half Moon Creek was similar to the lower reaches of Richters Creek; however, abundances were dominated by polychaetes.

Mangrove Macroinvertebrates

Mangrove macroinvertebrate communities were dominated by a variety of crustaceans and molluscs. Mangrove invertebrate communities in closed *Ceriops* communities were slightly different to those associated with other mangrove communities. A survey in the closed mixed mangrove community near the mouth of Richters Creek found that this site was significantly different from all other sites with only one gastropod, *Littoraria luteola*, being recorded. This was likely to be due to the different substrate type at this site compared to the other sites in that it was dominated by sand, while all other sites were dominated by finer muds and clays.

Macroinvertebrate communities in closed *Ceriops* forests were different to macroinvertebrate communities in other mangrove forest types due to the presence of flatworms and the gastropod, *Telescopium telescopium*; these species were not recorded at any other site.

Across all sites, the most common species was the crab, *Paracleistostoma wardi*, recorded at twelve sites.

The relative abundance and taxonomic richness of macroinvertebrates was typically highest in closed *Ceriops* mangrove communities, except for one site located in a closed *Rhizophora* mangrove community. The lowest abundance and taxonomic richness of macroinvertebrates was in a mixed mangrove community. The relative abundance and taxonomic richness at all other sites were relatively similar to each other.

In terms of OUV, mangrove macroinvertebrate communities are an important part of estuarine ecosystems and are key components of aquatic food webs. They also directly influence many aquatic ecological processes such as primary production, sedimentation and the processing of organic matters (e.g. shrimps and crabs).

The composition of mangrove macroinvertebrate communities varies according to the mangrove community composition. Mangrove macroinvertebrate communities may respond to short-term and long-term changes in the environment and their community composition and abundance and therefore serve as an indicator of impact.

Bony Fish

During the February 2014 survey, a total of 94 fish, representing 17 species from 16 families, were caught in Thomatis, Richters and Half Moon Creeks. All fish caught are commonly known to occur in estuarine reaches of rivers and creeks in northern Queensland.

In Thomatis and Richters creeks, 74 fish were caught with the highest abundance and species richness of fish near Richters Creek mouth. The fish communities in Thomatis and Richters Creeks were dominated by juveniles (57% of the catch) and adults of smaller fish species (30% of the catch). All fish caught were in good condition, with no visual defects to signify poor or impaired health (e.g. lesions or parasites).

In Half Moon Creek, a total of 20 fish were caught, representing ten species. The fish communities in Half Moon Creek were dominated by intermediates (60% of the catch) and adults (35% of the catch). All fish caught were in good condition, with no visual defects to signify poor or impaired health (e.g. lesions or parasites).

Fish recorded in the creel surveys along Thomatis, Richters, and Half Moon Creeks were typically limited to species of recreational importance. Thirty-three fish families were identified as being caught in the area.

In the dune lakes on the Aquis site, a total of 183 fish consisting of three species were caught. The catch was dominated by juvenile eastern Rainbowfish. The water quality recorded at the dune lake was poor at the time of survey and unsuitable for many freshwater fish species.

Migratory Species and Other Matters of NES Species

The contribution that the Aquis site and its immediate surrounds makes to the OUV of the GBRWHA in terms of species is described in following sections of this chapter in terms of listed threatened species and the habitats and processes upon which they depend. This concludes that the Aquis site itself includes a small area of natural vegetation that provides on-site habitats for the following terrestrial species:

- flora – one species confirmed, one species likely/ may possibly occur
- fauna – one species confirmed, one species may overfly the site, two species likely to / may possibly occur
- migratory – 14 species confirmed, 4 species may overfly the site, 15 species likely to occur.

No listed threatened communities occur within 1.1 km of the project area. See detailed discussion on species and communities (**Sections 22.9** to **22.15**).

Geomorphological features

Nil for this criterion.

Indigenous heritage

Nil for this criterion.

Historic heritage

Nil for this criterion.

Community benefits of the environment

Nil for this criterion.

Key environmental processes

See 'Integrity'.

Summary

In terms of Criterion (x) (formerly (iv)):

- The Aquis site is fringed on the north-west and north-east by intact mangrove forests that, together with the remnant band of natural vegetation around the central area cleared for cane, provides habitat and fisheries resources, and helps filter land runoff. There is a viable and healthy assemblage of mangrove species on and around the Aquis site. External areas to the north-west and north-east are within the Half Moon Creek and Yorkeys Knob Fish Habitat Areas respectively and the latter is also within the *Estuarine Protection* zone of the Great Barrier Reef Coast Marine Park (State).
- The nearest recorded seagrass beds are approximately 9 km south-east of the Aquis site and the nearest mapped coral is approximately 25 km north-east of the site.
- The near-shore habitat is typical of the coastal zone in the Wet Tropics, with often turbid waters and few bathymetric features.
- The site contains habitats for a small number of listed threated terrestrial, aquatic and migratory species, some of which have been confirmed as present and some are likely to be present. See detailed discussion on species and communities (**Sections 22.9** to **22.15**).

<u>Integrity</u>

A World Heritage property needs to meet conditions of integrity as well as meeting at least one of the ten criteria to be considered of outstanding universal value. It has been observed that a World Heritage property needs to include all elements necessary to express its outstanding universal value and in particular be of adequate size to ensure the complete representation of the features and processes which convey the property's significance.

GBRMPA (2013a) observes that 'inclusion of the terrestrial habitats that support the Great Barrier Reef as values reflects the important role these habitats have in maintaining ecosystem processes and supporting biodiversity within the Region.' According to GBRMPA (2013a):

> At the time of inscription it was considered that to include virtually the entire Great Barrier Reef within the property was the only way to ensure the integrity of the coral reefs in all their diversity. The Statement of Outstanding Universal Value also notes that some of the key ecological, physical and chemical processes that are essential for the long-term conservation of the marine and island ecosystems and their associated biodiversity occur outside the boundaries of the property. A description of environmental processes which support and connect the Great Barrier Reef environment is provided in Section 4.9. (p 4-8)

The above reference includes Table 4.9 which is reproduced as **Table 22-21**. This table summarises the relationship between environmental processes and matters of NES. Many of these have been previously discussed with respect to one or more separate World Heritage criteria. Overall, it is evident that the Aquis site, even in its degraded condition, is contributing at a local level to the integrity of the GBRWHA in a number of ways. This contribution, however, depends largely on the adjacent protected areas and the Aquis site acting as a unit. Of particular relevance are the two FHAs and the upstream Cattana Wetlands, as well as the connections with these areas.

Biodiversity – GBR habitats

Beaches and coastlines

The beach and coastline adjacent to the project area provides habitat for estuarine crocodiles, seabirds, shorebirds and possibly marine turtles. The species that depend on these habitats are discussed in **Section 22.14** and **Section 22.15**.

Mangrove Forests

The site is fringed on the north-west and north-east by intact mangrove forests that provide habitat and fisheries resources, and help filter land runoff.

A detailed program of mangrove monitoring commenced in December 2013 as part of the Aquis EIS and environmental monitoring program and as a follow-up to the 2013 dry season work. As part of this, program, ground survey of the Aquis development area confirmed the presence of the five mapped associations described by Bruinsma (2001), although the actual extent, distribution and type of associations varied as would be expected at a finer scale of survey. Closed Mixed, Closed *Ceriops* and Closed *Rhizophora* are the dominant systems present on the Aquis development area with smaller areas of Samphire-Dominated Saltpan and Closed *Avicennia*. Some of the Closed *Avicennia* association is bordered by small strips of Open *Avicennia* and there is often no distinct separation of these two associations based on canopy considerations alone. There are also small areas of *Melaleuca* wetland and *Corymbia / Eucalyptus* woodland interspersed in sites of higher relief.

In addition to these associations, ground survey also revealed the presence of discernible areas of additional associations, namely:

- the Closed *Bruguiera* association in the north-east corner of the Aquis development area
- areas of the Closed *Rhizophora*/*Avicennia* and Samphire-dominated Saltpan associations near Dunne Road and along parts of Yorkeys Creek
- an area of Saltpan also near Dunne Road.

Survey also confirmed the presence of a clay pan comprised of a cracking clay substrate not seen elsewhere on the property or within the local area. Very small (e.g., <0.25 ha) patches of other associations were also sighted but their small size precluded mapping. The Closed *Bruguiera*, Closed *Rhizophora*/*Avicennia*, Samphire-dominated Saltpan, and Saltpan associations and general distribution and extent of mangroves within 100 m / on the property is shown on **Figure 22-27**.

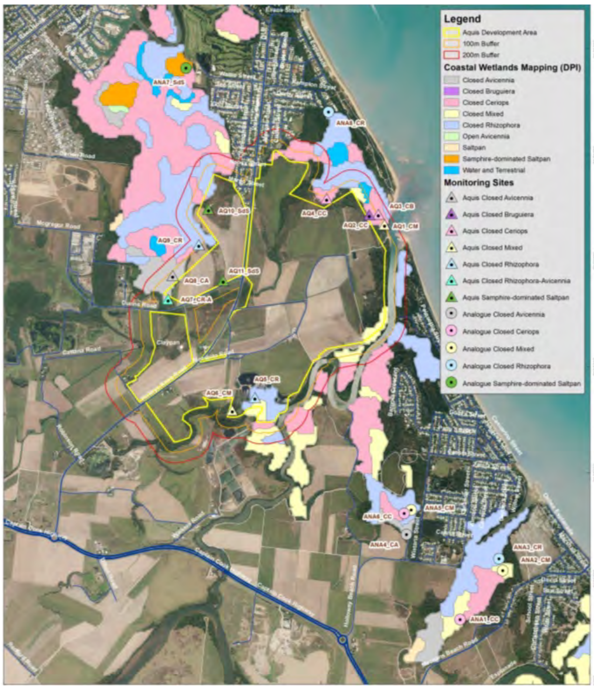
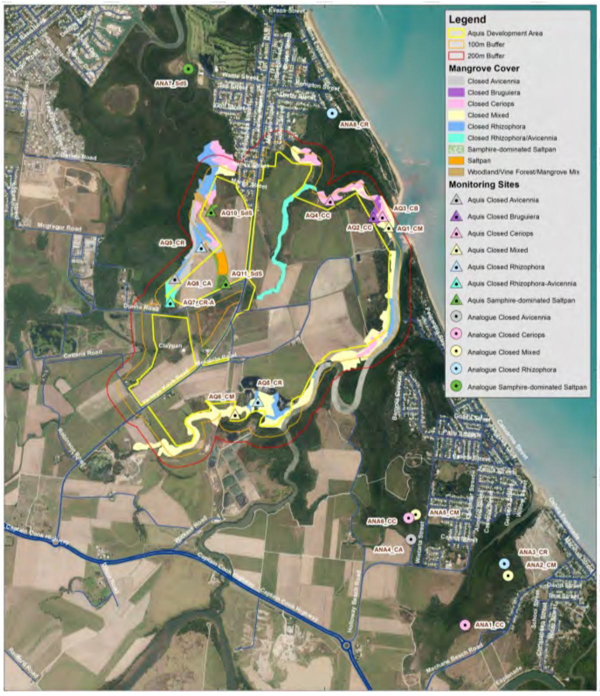
 	

Figure 22-27 Coastal wetlands mapping and Aquis monitoring sites. **Source:** N Tucker (pers. comm January 2014).	**Figure 22-28** Additional Aquis mangrove mapping. **Source: Appendix G** (Map 13).

This desktop and site survey work confirms that there is a viable and healthy assemblage of mangrove species on and around the Aquis site. External areas to the north-west and north-east are within the Half Moon Creek and Yorkeys Knob Fish Habitat Areas respectively and the latter is also within the *Estuarine Protection* zone of the Great Barrier Reef Coast Marine Park (State).

Seagrass Meadows

No seagrass has been observed in any of the creeks near the site, nor at the mouth of the creeks. No seagrass has been recorded off-shore of the creek mouths. The nearest recorded seagrass beds in Trinity Inlet are approximately 9 km south-east of the Aquis site. In the past four years, above average wet season rainfall combined with the 2010/11 La Niña and tropical cyclone Yasi has resulted in a major decrease in the distribution of seagrass along the North Queensland coast.

The nearest mapped coral is approximately 25 km north-east of the site. The near-shore habitat is typical of the coastal zone in the Wet Tropics, with often turbid waters and few bathymetric features.

See more detailed discussion in **Table 22-27**.

Open Waters

The coastal waters off-shore of the site are described as being within the 'high nutrient coastal strip' bioregion of the Great Barrier Reef. This bioregion is characterised by terrigenous mud, high levels of nutrients from the adjoining land, seagrass in sheltered waters and a wet tropic climate. Within this area, there are scattered coastal fringing reefs that generally develop around the mainland and high continental islands that have high coverage of hard coral, soft coral and macroalgae, but low coral diversity (Kerrigan et al. 2010). The integrity of aquatic habitats of the GBRWHA that are near the project site is assessed in **Table 22-27**.

The following is a brief description of the open water habitat along the route of the proposed off-shore inlet pipeline:

- The first 1.3 km of the proposed pipeline runs through the estuary and shallow bar of Richters Creek. The sediment along this section of the alignment consisted of shifting coarse riverine sand deposits with mud. A fine layer of silt was found on the sediment surface due to settling turbid freshwater runoff. There was an approximately 250 m long, 150 m wide and 1.5 m high sand bank that ran through the middle of the mouth of the creek that was exposed at low tide. The sediment transitioned to mud with fine sand approximately 1.3 km from the pipeline intake sump, and remained relatively uniform to the seaward end of the pipe.
- The surface sediment at the mouth of the creek and on the sand bank was loosely consolidated and there was no evidence of faunal activity or seagrass observed, which is likely due to the rapidly shifting nature of the sediment in this zone. Further off-shore, the benthic communities were dominated by polychaete worms and bivalves. Based on recent experience of soft-sediment benthic communities in tropical Queensland, the communities along the alignment are likely to be typical of much of the Trinity Bay area and in-shore areas of the Great Barrier Reef; however the richness and abundance of benthic invertebrates is still being determined based laboratory processing of the grab samples collected during the survey.
- Due to the turbid conditions at the time of the survey it was not possible to get good video footage of the pipeline alignment close to shore. However, alternative techniques (grapple and benthic grab samples) failed to find evidence of seagrass. The epifaunal communities in this area are likely to be typical of other river mouths along the coast, being influenced by high turbid flows from the catchment during summer. Further off-shore the water clarity was suitable to assess the benthic communities using video, grapple and benthic grab techniques, and no seagrass or other epifauna was recorded. Faunal activity also appeared low based on the low density of burrows over the sediment surface and low numbers of crustaceans and other invertebrates in the benthic grab samples.
- At the time of the survey approximately half of the pipeline alignment was within turbid surface water plumes coming from both Richters Creek and the Barron River. These plumes were caused by heavy rainfall in the days preceding the survey. There was a 0.5 - 1 cm layer of fine red-brown sediment over the surface of the mud, which was likely due to fine sediment settling from these freshwater plumes. During the survey, the turbid freshwater surface plume shifted extent by hundreds of metres based on the prevailing conditions, being blown further in-shore by increasing wind and wave action from the southeast.
- It is currently unknown whether seagrass could occur in the area during winter; however previous surveys (Rasheed et al. 2013) suggest that seagrass is unlikely to occur along the alignment.

See more detailed discussion in **Table 22-27**.

Biodiversity – terrestrial habitats that support the GBR

Saltmarshes

The Aquis site contains a small area (1.9 ha) of saltpan / saltmarsh in the north-west corner adjacent to the Half Moon Creek FHA. This contains occasional stunted Avicennia marina or absent, the shrub layer is generally absent, and the marine plants Tecticornia australasica and Sesuvium portulacastrum are common at the margins of saltpan environments where inundation is rare.

TABLE 22-26 SALTMARSH / SALTPAN COMMUNITY

ITEM	DETAILS
Habitat	Occurs along the landward edge of the intertidal zone in a hypersaline environment that is only inundated by the highest spring tides.
Canopy	Sparse stunted (<1m) individuals of various mangrove species may occur (e.g., *A. marina, C. tagal* and *L. racemosa*).
Shrub Layer	Some samphire species may be present as very small shrubs.
Ground Cover	Commonly an open coverage of samphires. However may be virtually unvegetated or have an algal covering.

This habitat is shown on the following photo.

Photo 22-9 Saltpan on north-west corner of site during wet season.

Connecting Waterbodies

Connecting waterbodies, such as rivers, creeks, estuaries and floodplains, are the aquatic link between the marine and terrestrial environment. Their roles include transporting water, nutrients and sediments, and providing a movement corridor, as well as contributing feeding and breeding areas for some marine and coastal species. Aquatic connectivity is provided through surface waterbodies and in some cases groundwater. The ecological analysis of the site (see **Chapter 7** – Flora and Fauna) confirms the valuable role played by the watercourses that run through and around the Aquis site while **Section 22.4.2** details how these are to be protected and enhanced.

Biodiversity – terrestrial habitats that support the GBR

See discussion below on integrity of habitats (**Table 22-27**).

Biodiversity – species

See discussion below on integrity of habitats (**Table 22-27**).

Environmental processes

Light

The project area does not currently contain any significant light sources and in any event is well-screened from the WHA by dense fringing vegetation.

Freshwater inflow and salinity

As previously discussed under Criterion (viii), the creeks surrounding the project area (Richters, Yorkeys and Half Moon Creeks) are responsible for major contributions of freshwater inflow although they are all tidal in their lower reaches. Salinity drops markedly during the wet season and this is dominated by the Barron River which drains a catchment of 217 500 ha.

The site itself contains some small freshwater lakes / water holes (see Wetlands) but their contribution would be insignificant in the GBR context.

Microbial processes and Primary production

The mangrove forests that occupy part of the site and adjacent lands are known to be highly productive and contribute to a large suite of fish, invertebrates and macroinvertebrates as described under Criterion (x).

Connectivity

Prior to European settlement, the Barron River delta contained a mosaic of coastal, riverine, and lowland vegetation communities dissected by the Barron River itself, the Thomatis Creek distributary, and many major creeks. Within the study area lie Thomatis Creek, Richters Creek, Yorkeys Creek, and Half Moon Creek. These waterways have intact riparian vegetation in their lower reaches in the vicinity of the site and the latter two terminate in Fish Habitat Areas / Estuarine Conservation Zones as previously described.

Like most of the Barron River delta, the site has been used for sugar cane farming and this has resulted in a fragmentation of the natural landscape. Typical of most farms in the area, the site contains little natural vegetation apart from remnants around some boundaries and several (internal) degraded streams. The land use assessment reveals that 210.9 ha (62%) of the 340.6 ha Aquis site is currently used predominantly for sugar cane production. Only 53.3 ha (16%) of the site contains native vegetation and internal habitat connectivity is limited to a narrow ring around the site's boundary, together with some remnant connection to external areas via Yorkeys Creek that runs through the site.

This pattern of clearing and degradation is typical of the broader in the Barron River delta. According to a report on the natural resources of the Barron River (Russell et al. 2000), over 89% of the total length of streams is classified as degraded, where adjacent land is defined as sugar cane farming. However, as noted below, it is likely that despite the extent of catchment clearing for farming and urbanisation, the ecological function of the site and its surrounds remains to some extent. For example, the Cattana Wetlands that lie upstream of the site are in good condition, despite the loss and fragmentation of adjacent forests and modifications to drainage systems. Similarly, the fish habitat areas that lie downstream of the site are known to contain considerable biological resources, despite being impacted by acid sulfate soil runoff on occasion (Barron & Haynes 2009).

The environmental and landscape attributes of the study area were initially subjected to a desktop review in May 2013 (Biotropica 2013a) which contributed to the preliminary ecological assessment (Environment North 2013b).

In this review a variety of ecological and planning attributes of the Aquis study area were identified, and discrete ecological units (eco-units) developed, using proximal ecosystem/remnant vegetation extents based largely on hydrological patterns and processes. An ArcGIS platform was used to produce discrete polygons depicting the boundaries of each identified eco-unit, and to assess the ecological value of the lots in a broader landscape context. A range of attributes was developed to evaluate and score the ecological values of each eco-unit. These were based on known environmental values displayed within the various mapping units, and desktop assessment of the quality of existing (aquatic/terrestrial) connectivity using aerial photography.

In this initial review the study area was classified into eight eco-units and these were evaluated to produce three broad classes of values, resulting in a small number of high value eco-units, a larger number with intermediate values, and a small group with more limited environmental values. The recent wet season work has verified this initial analysis. Referring to **Figure 22-29** below:

- areas bordered in red, orange or yellow and labelled 1 to 8 are recognised ‘Ecological Units’ (eco-units) – composite remnant areas with recognisable ecological values that interact to provide some ecological function in the landscape
- blue lines are existing riparian areas – these serve to connect the Ecological Units, often despite the degraded condition of adjacent areas (i.e. where no Ecological Unit is shown adjacent)
- unshaded areas within the designated Ecological study area have virtually no remaining ecological values.

The values of the Ecological Units also take into account mapped areas of significance (i.e. Fish Habitat Areas, marine parks, wetlands etc.).

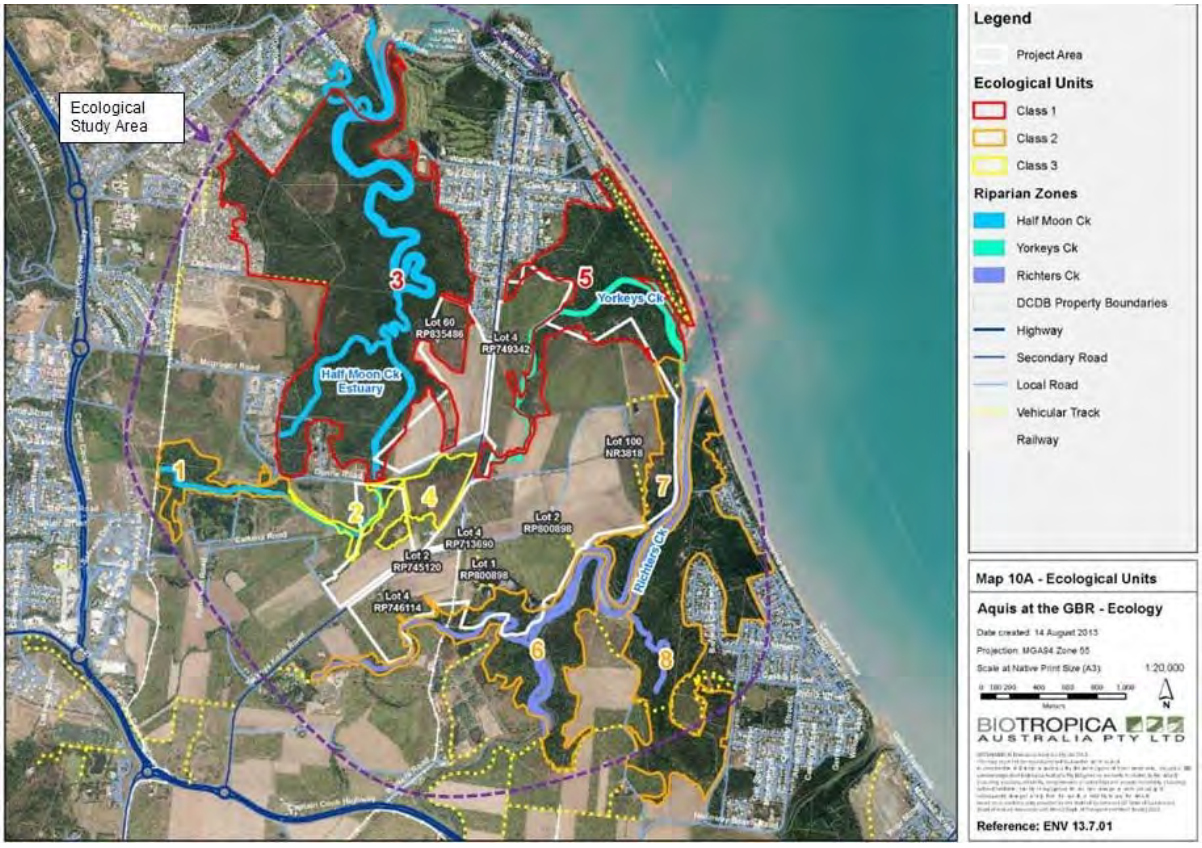


Figure 22-29 Ecological units for the May 2013 analysis.

Source: Appendix G (Map 10A).

This analysis shows that the majority of the site has relatively low to moderate conservation values (the exception being Yorkeys Creek (EU5)) and that adjacent areas contain most of the higher value units. The site sits within a highly disturbed landscape and even adjacent natural areas are ecologically isolated and subject to pressures from the surrounding developed landscape. However, in the broader landscape context, the site still contains important fringing vegetation and a number of watercourses which provide varying levels of aquatic connectivity. In this way the site is intimately linked to adjacent areas of higher conservation value.

This assessment provides an indication of the contribution of various areas to the ecological functioning of the site and the broader study area. It also reveals that the maintenance of ecological values of the site and its surrounds depends on the continuation of key landscape-scale ecological processes and functions, namely:

- connectivity of habitats (terrestrial connectivity)
- watercourses that permit the free movement of aquatic fauna (aquatic connectivity)
- absence of pollution of surface and groundwater (water quality)
- maintenance of overland flows under natural flooding regimes.

Figure 22-29 can be simplified to show broad habitats and connections at the site level as shown below. This map simplistically but adequately shows how the Aquis site and its surrounds contribute to broad ecological processes.

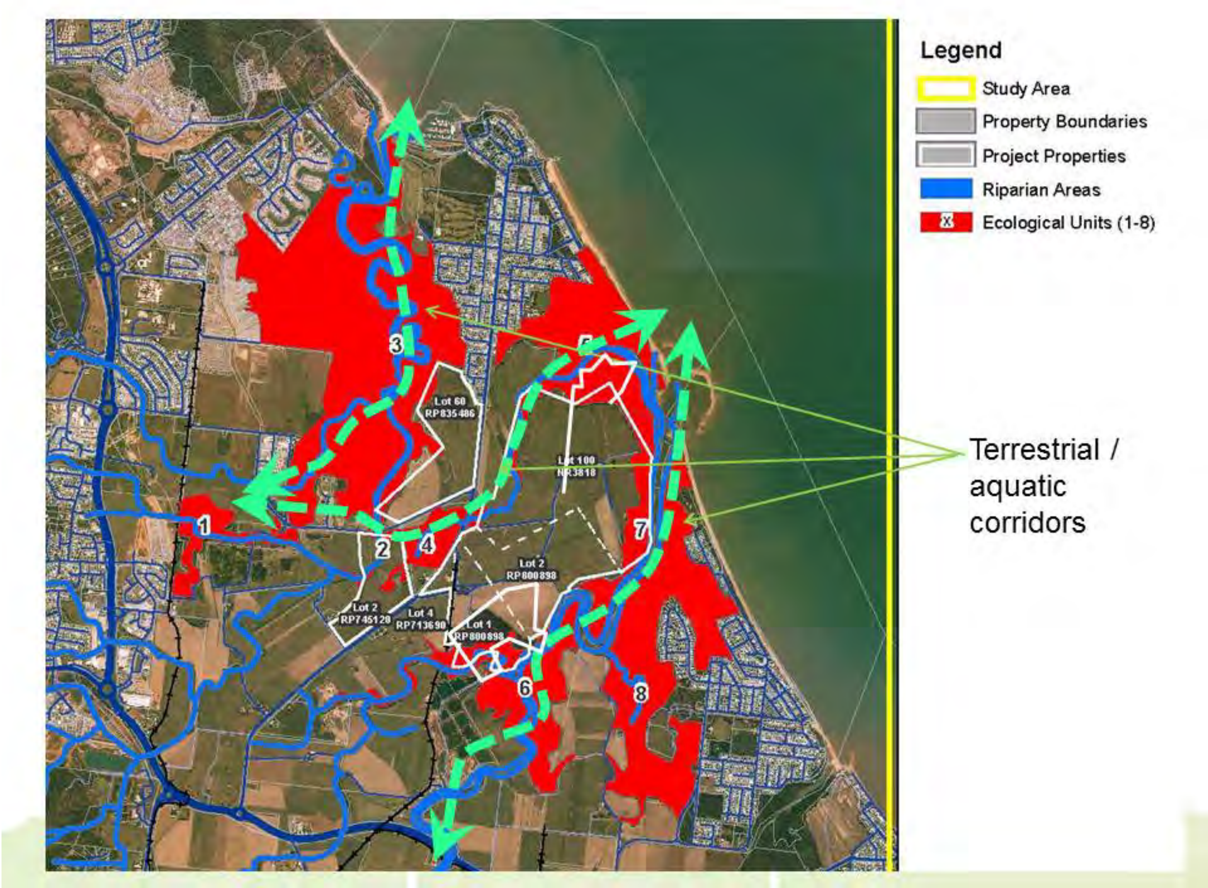


Figure 22-30 Ecological units – habitats (red) and connections (green).

Key site habitats, connectivity, and connectivity gaps are shown on the following figure (**Figure 22-31**).

Both the terrestrial and aquatic ecology studies reveal the presence of several man-made features that reduce integrity on or near the site designated on **Figure 22-31** below as ‘Tide Gate / Access’:

- On-site:
  - the small culverts under a farm access track at the crossing of Yorkeys Creek near Yorkeys Knob Road on the western edge of Lot 100 NR3818
  - the tide gate adjacent to Richters Creek on Lot 100 NR3818.
- Off-site:
  - the tide gates on Yorkeys Creek and Half Moon Creek
  - the small culverts under Yorkeys Knob Road at the crossing of Yorkeys Creek.

The terrestrial ecology study also identifies several off-site areas of low integrity west of Yorkeys Knob Road.

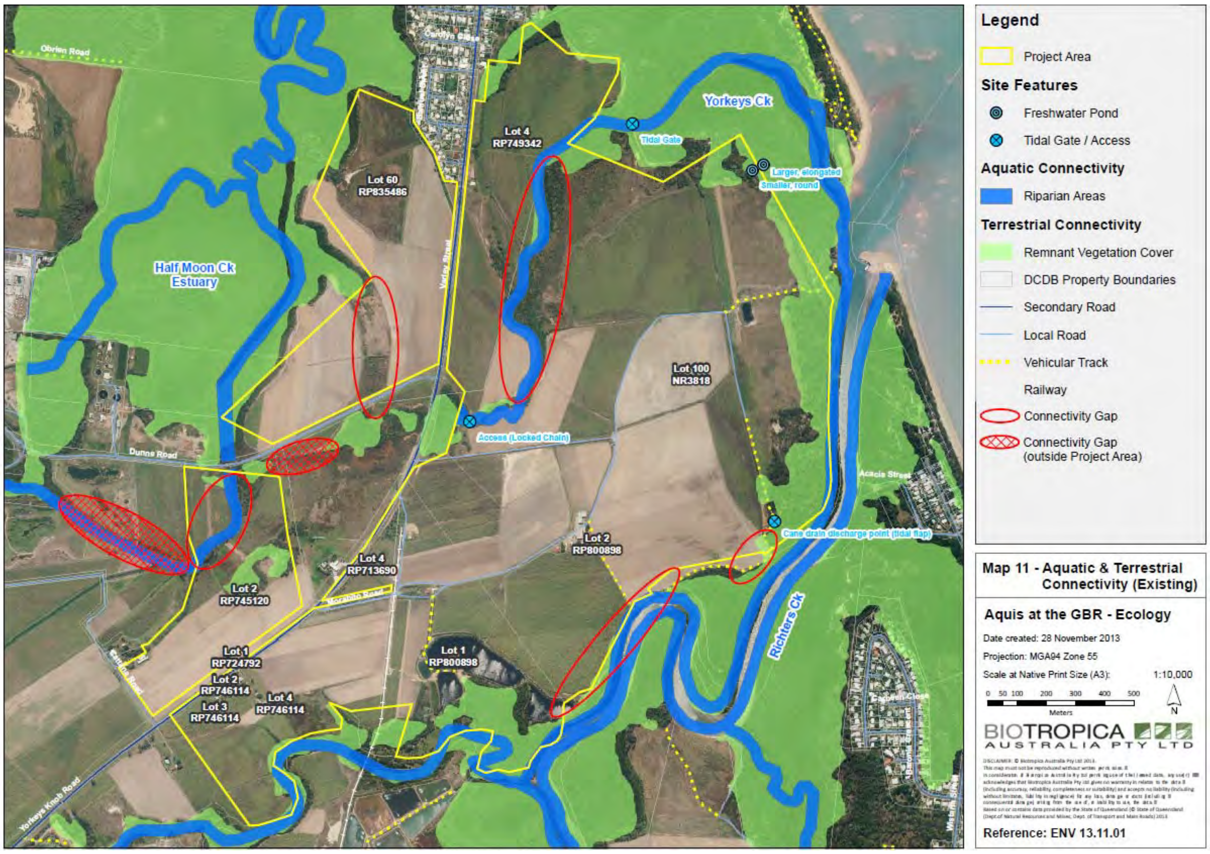


Figure 22-31 Site habitats, connectivity, and connectivity gaps.

Source: Appendix G (Map 11).

Integrity of Habitats

The following table is an assessment of the integrity of terrestrial and aquatic habitats in the vicinity of the project site.

TABLE 22-27 ASSESSMENT OF THE INTEGRITY OF TERRESTRIAL AND AQUATIC HABITATS

HABITAT	DESCRIPTION
On-site and near-site habitats	
Woodland (6.7 ha on-site)	Woodlands occupy 12% of the natural vegetation on the site, and include remnant woodlands mapped under Queensland legislation. The woodland and vine forest habitat recorded the highest diversity of species with 124 species recorded, of which birds were the dominant group (104 species recorded). This habitat is structurally complex providing significant values for the faunal community including multilevel vegetation, tree hollows, fallen timber and seasonal flowers and fruit. Across the site these remnant systems are confined to a strip along the better drained, relict dune systems adjacent to Richters Creek, between mangroves and cultivated/disturbed areas. They are generally forests of high ecological integrity and niche complexity. Fire scars are conspicuously evident, and along with the presence of a range of age and size classes of the dominant Eucalyptus/Corymbia, they suggest that fire has occurred on a number of occasions in the past ten years. There is no evidence that fire has had a negative effect on species diversity or ecosystem health. A majority of these woodland canopy species contain nest hollows of varying dimensions.
Aquaculture ponds (5.4 ha on-site)	The abandoned aquaculture ponds have become a seasonal freshwater wetland. This habitat showed high species diversity through a range of families including wetland birds, mammals (microbat species) and amphibians, with this habitat recording the highest number of listed species (73).
Melaleuca wetlands (12.4 ha on-site)	Across the site, Melaleuca forests occupy 23% of the natural vegetation on the site and include RE 7.3.25a: [Riverine wetland or fringing riverine wetland. *Melaleuca leucadendra* open forest and woodland. Stream levees and prior streams on well-drained sandy clay loam alluvial soils] in small patches at the northern fringe of the study area and 7.2.9a: [Palustrine wetland (e.g. vegetated swamp). *Melaleuca quinquenervia* open forest to woodland and shrub land. Dune swales and swampy sand plains of beach origin] that occurs in a small area directly adjacent to the patch of RE 7.3.25a on Lot 4RP749342. There are other areas across the site where Melaleuca-dominated assemblages are found. These are typically in low-lying swales adjacent to woodlands, where microrelief favours their development and persistence. These Melaleuca patches also occur in a mosaic of mangroves and anthropogenic grasslands, and occasionally in association with marine plants Within the stands of Melaleuca on the northern side of Lot 100 NR3818, there are a number of small freshwater pools. With the exception of the aquaculture ponds, these are the only sources of freshwater found in the site during ground survey. Observations showed these are high value areas, being visited by a large number of woodland birds. Integrity is high with 70 species having been recorded.

HABITAT	DESCRIPTION
Mangroves. (22.1 ha on-site) See also Criterion (ix).	The site is fringed on the north-west and north-east by intact mangrove forests that provide habitat and fisheries resources, and help filter land runoff. This includes the five mapped associations described by Queensland Government mapping as well as three additional discernible associations. Mangroves constitute 41% of the natural vegetation on the site. These mangrove areas are in good condition and represent a viable and healthy assemblage of mangrove species on and around the Aquis site. External areas to the north-west and north-east are within the Half Moon Creek and Yorkeys Knob Fish Habitat Areas respectively and the latter is also within the *Estuarine Protection* zone of the Great Barrier Reef Coast Marine Park (State). The detailed wet season survey (**Appendix G**) reveals that all woody mangrove sites, both within the development area and analogues, exhibited healthy mangrove communities that are unaffected by biotic (e.g., insects, dieback, anthropogenic isolation) or abiotic (e.g., hydrological change) influences (Mangrove Health Category 1). There was no evidence of any leaf curling / yellowing, or insect defoliation at any site. Mangrove habitats showed the second highest total with 72 vertebrate species recorded within or directly adjacent to the mangrove survey sites, with 41 species recorded within the mangrove vegetation – although this may have been skewed by the additional time undertaking fauna surveys in this habitat type. Vertebrate diversity within the mangroves was dominated by birds (31 species recorded).
Saltpan / saltmarsh (1.9 ha on-site)	The Aquis site contains a small area (1.9 ha) of saltpan / saltmarsh in the north-west corner adjacent to the Half Moon Creek FHA. This contains occasional stunted *Avicennia marina* or absent, the shrub layer is generally absent, and the marine plants *Tecticornia australasica* and *Sesuvium portulacastrum* are common at the margins of saltpan environments where inundation is rare. Integrity is high although the community dies back significantly in the dry season.
Balance of site (282 ha on-site)	The remainder of the site consists largely of cane fields, other cleared areas and planted exotic species which provide limited ecological value to a range of common and widespread fauna species.
Of-site habitats	
Seagrass	No seagrass was observed within any of the estuarine creeks nor at the mouth of the creeks in surveys undertaken in 2007, 2013, and 2014. No seagrass has been recorded in this area by Queensland Fisheries or James Cook University, although there have not been any surveys in the Yorkeys Knob area since 2007 (Rob Coles pers. comm.). There are no other known records of seagrass in Half Moon, Yorkeys, Thomatis or Richters Creek, nor in the waters off-shore of these creeks. The closest recorded seagrass bed is at the mouth of Trinity Inlet, approximately 8 km south-east of the proposed development site (Map 4) (DAFF 2013). Detailed surveys extending from the mouth of Richters Creek along the route of the seawater inlet pipeline confirm the absence of seagrass in the deeper subtidal areas. In addition, no seagrass beds are visible on recent aerial photography in this area.
Coral reefs	The nearest coral reefs to the project site are Green Island (approximately 25 km east of Richters Creek mouth), Haycock Reef and Double Island Reef (approximately 10 km north of Richters Creek mouth). Green Island reef has an area of 7.1 km^2 (AIMS 2014b). Massive growth forms, with some plate and branching growth forms, dominate the coral communities (AIMS 2014a). Coral cover at Green Island reef is low (0 – 5%) and has declined in recent years due to outbreaks of crown of thorns starfish (AIMS 2014a). The western side of the reef closest to the proposed development has a low level of reef structure (AIMS 2014a). Algae are the dominant growth form on the reef but there is a moderate cover of soft corals (AIMS 2014a). Fish abundance on Green Island reef is moderate with reef fish such as parrotfish, butterflyfish and damselfish present (AIMS 2014a).

HABITAT	DESCRIPTION
Rocky reefs	There is limited information available regarding intertidal rocky shores of the region. Rocky headlands such as those found at Yorkeys Knob (2.7 km north of the mouth of Richters Creek) provide hard surfaces for sessile marine communities. The habitat diversity (including rock pools, gullies and ledges) of these environments often supports diverse ecological communities that include fishes, reptiles (such as sea snakes and turtles), echinoderms, polychaetes and crustaceans. These habitat types are of importance to many species that require hard substrate for colonisation. Artificial structures, such as jetties, seawalls and pipes, are also likely to provide hard surfaces for sessile marine communities.
Soft substrate	Non-vegetated soft substrate is found in the creek systems adjacent to the project site, and off-shore of the project site. Soft substrate provides habitat for benthic marine invertebrates such as polychaetes and crustaceans. Species richness and abundance are typically lowest in fine muddy substrates of intertidal areas, and highest in coarse sandy sediments (Currie & Small 2005; 2006). Abundance typically increases with regional rainfall and freshwater inflow (Currie & Small 2005; 2006). Detailed surveys extending from the mouth of Richters Creek along the route of the seawater inlet pipeline confirm the presence of non-vegetated soft substrate from the edge of the estuary sand deposits to the limit of the survey.

There is a relatively low diversity and abundance of weeds across the site. Those weeds that are present are typically those associated with agriculture and/or abandoned areas, and weed penetration into native ecosystems is rare to absent. Exotic species (plants and animals) are present mainly along woodland margins, with limited incursions into the forest.

A total of 64 exotic species were recorded on the site, and their relative abundance noted. Of the exotic species recorded, ten species are listed as either Weeds of National Significance, Class 2 or Class 3 pest plants under the *Land Protection (Pest and Stock Route Management Act) 2002* (Qld), and/or locally declared under categories in the FNQROC Pest Management Plan. Both listed and unlisted exotic flora on-site are capable of altering and degrading natural areas. None of the exotic species which have penetrated woodland (e.g., ephemeral Asteraceae) are considered likely to persist or affect ecosystem function. The habitat type with by far the greatest number of weed species is the anthropogenic grassland while the shoreline and mangrove forest habitats contain the least number of weed species.

Seven species of pest animals were recorded, all of which are common in the Cairns area.

Nine exotic non-indigenous species have been recorded in the broader Barron River catchment, with one species, mosquitofish, observed on the site. Weeds are common along the waterways with rubber vine (*Cryptostegia grandiflora*) choking the riparian flora throughout the catchment. Three species of aquatic plant declared under the Queensland's *Land Protection (Pest and Stock Route Management) Act 2002* (the Land Protection Act) are recorded in the region but were not observed during the detailed aquatic or terrestrial site surveys. Several other aquatic pest species (e.g. Tilapia) are likely to occur on the site and within the proposed development footprint.

All pest plants and animals are common in the Cairns lowlands and do not present a significant threat to local values.

Water quality

Discussed in Criterion (ix). Overall, water quality in the waters adjacent to the site is good (although not meeting QWQG requirements for various nutrients and turbidity). However, it is evident from sampling of water quality, sediments, and aquatic flora and fauna that current environmental processes are functional.

Summary

In terms of integrity (and the integrity implications for the four World Heritage criteria described above):

- Despite clearing and fragmentation of habitat in the project site, biological processes in the project site are still largely intact. This area is still fringed by a band of natural vegetation and this abuts protected areas of high integrity (FHAs and QMP) to the north-east and north-west. Together these remnants maintain a high degree of biological function.
- Upstream of the site, connectivity is less effective and the area is characterised by waterway barriers (tide gates and undersized culverts) and degraded riparian areas.
- However, agricultural and urban uses in the catchment are known to result in exports of sediments, nutrients, and other pollutants and to some extent these detract from the water quality values of the near-shore waters. These effects are likely to diminish with distance from the coast.
- The site contributes to World Heritage values by virtue of the following on-shore and off-shore habitats:
  - off-shore (Beaches and coastlines, Mangrove forests, Open waters
  - on-shore (Freshwater wetlands, Forested floodplain, Woodlands, Forests, Rainforest, Connecting waterbodies).

d) Summary of OUV

The previous discussion reveals that the Aquis site and its immediate surrounds contribute to some GBRWHA values while others are definitely absent.

Criterion (vii) – formerly (iii): Natural Beauty and Phenomena

- Mangroves and dunal vegetation line the shoreward borders of the site and provide an attractive backdrop when viewed from the beach and in-shore waters. In terms of extent and universal aesthetic value, they are typical of tropical estuarine mangrove areas and not considered representative of the attribute at a regional level.
- The open waters off Yorkeys Knob Beach are usually turbid and this limits the visibility of species with visual appeal. The marine flora and fauna in the creeks and in-shore waters do not exhibit the characteristic of coral reefs, which is central to a GBR experience. Marine megafauna and concentrations of large fish are most likely present off-shore but are rarely seen due to the turbid waters.
- At a local level, the Richters Creek estuary near the site is in a largely natural state and is characterised by sandy beaches and intact coastal mangroves and casuarinas. Few signs of human existence are present for beach users although departing and arriving aircraft are a regular interruption.
- The mainland adjacent to the site can be seen in the distance from ferry routes to GBR destinations. It is an area that visitors ‘leave behind’ in order to visit a distant Great Barrier Reef island (or pontoon, dive site etc.) where they will experience the GBRWHA. It is not part of the experience itself.

Criterion (viii) – formerly (i): Major Stages of the Earth’s Evolutionary History

- The site is situated at the seaward limit of the delta of the Barron River which includes the sub-catchments of Richters Creek, Yorkeys Creek, and Half Moon Creek. The Barron River is locally significant as an example of river capture. Over geological timescales (i.e. thousands of years), the beaches adjacent to the Barron River delta have been accreting, although there have been large scale natural disturbances in this trend. The Barron River delta is the largest source of sediment to Cairns’ northern beaches and supplies about 23 000 m^3 annually. Estimated long term ‘coastal bite’ in the beach adjacent to the Aquis Resort site is 400 m, which is within the forested part of the property but seaward of proposed infrastructure.

- Off-shore geomorphic features such as islands are present at a distance (e.g. Double Island and Haycock Island) while reefs, seagrass meadows and coral islands are absent.
- The Aquis Resort site does not contribute to Criterion (viii) values to any great extent, although as part of a delta feature, it is a remnant of geomorphological processes and is adjacent to an active coastal zone subject to long-shore drift. There is an opportunity for on-site interpretation and education on physical history.

Criterion (ix) – formerly (ii): Ecological and Biological Processes

- Many off-shore and on-shore habitats of value to the GBRWHA are present in the study area. Of these, mangroves are the most significant.
- Limited examples remain of Indigenous use of land and sea resources in the study area, although some cultural material (middens and a hearth oven) may be present outside the development footprint.
- All on-site habitats contribute to some extent to the integrity of the WHA in that they supply numerous ecosystem services including hydrologic services related to routing flood runoff and groundwater storage, nutrient dispersal and cycling, seed dispersal, primary production, carbon sequestration and climate regulation, waste decomposition and detoxification, and purification of water and air.
- Water quality in the creeks surrounding the project area is generally good, although nutrient levels and turbidity are higher than desirable. Water quality may be being adversely affected by adjacent land uses and acid sulfate soils are active in local creeks. However, the water quality currently sustains fisheries values so this effect is not of a long term nature.
- The Aquis site and the broader study area contribute significantly to Criterion (ix) values, through the provision of ecosystem services, although this contribution is commensurate with its area. There is an opportunity for on-site interpretation and education on Indigenous culture and ecosystem services.

Criterion (x) – formerly (iv): Habitats for conservation of biodiversity

- The edges of the site and its surrounds to the north-east and north-west and Yorkeys Creek that traverses the property contain intact mangrove forests that provide habitat and fisheries resources, and help filter land runoff.
- Seagrass beds and corals are absent and the near-shore habitat is typical of the coastal zone in the Wet Tropics, with often turbid waters and few bathymetric features.
- The site contains habitats for a small number of listed threatened terrestrial, aquatic and migratory species, some of which have been confirmed as present and some are likely to be present.
- The site and the broader study area contribute to a small extent to Criterion (x) values, with species of conservation significance depending on local habitats to only a limited degree. There is an opportunity for on-site interpretation and education on listed species, especially the Ant plant and local birds.

Integrity: 'wholeness and intactness'

- Despite clearing and fragmentation of habitat in the project site, biological processes are still largely intact and maintain a high degree of biological function. Upstream of the site, connectivity is less effective and the area is characterised by waterway barriers (tide gates and undersized culverts) and degraded riparian areas.
- However, agricultural and urban uses in the catchment are known to result in exports of sediments, nutrients, and other pollutants and to some extent these detract from the water quality values of the near-shore waters. These effects are likely to diminish with distance from the coast.

- The site contributes to World Heritage values by virtue of integrity of a suite of mainly on-shore habitats. There is an opportunity for on-site interpretation and education on environmental systems and the role of on-shore areas in maintaining the WHA.

Overall

Overall, the values supported by the site and surrounds are:

- small (i.e. not regionally significant) on-shore habitats surrounding the land cleared for cultivation and reasonably intact connectivity via the three creeks and the surrounding mangrove forests
- local (i.e. not regionally significant) resources for a small number of listed threatened species that are widespread throughout the area
- ecosystem services of various types as measured by GBRMPA's Blue Maps project and in particular the protection of water quality
- local (but not regionally significant) examples of scenic amenity provided by the vegetated buffer between the site and the mouth of Richters Creek where few signs of human existence are present for beach users.

22.6.2 Potential Impact

a) Relevant Impacts

Reference to **Table 22-12** reveals that the relevant 'urban development' impacts for this matter of NES are:

- potential minor adverse construction impacts of local significance on the following impact categories:
  - acid sulfate soil
  - dredging
  - light
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off
  - small chemical spills
  - urban discharge
  - aesthetic considerations
- potential minor adverse operation impacts of local significance on the following impact categories:
  - light
  - small chemical spills
  - urban discharge
  - aesthetic considerations
- potential minor beneficial operation impacts of local significance on the following impact categories:
  - artificial barriers to flow
  - increased freshwater inflow
  - outbreak of crown-of-thorns starfish

- potential major regional to reef-wide beneficial operation impacts on the following impact categories (probably only locally significant):
  - modifying supporting terrestrial habitats
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off.

See also the discussion on tourism (**Section 22.17.8**). With the exception of aesthetic considerations (discussed below), these adverse and beneficial impacts have been discussed in **Section 22.4.1c)** and **Section 22.4.2**.

b) Aesthetic Considerations

Landscape Integrity and Wilderness (Remoteness)

As discussed in **Section 22.6.1c)**, the Yorkeys Knob area has no areas which exhibit 'remoteness', although the Yorkeys / Holloways Beach at Richters Creek mouth has local value as a place which is relatively free of visible development. There will be localised impacts of the proposed development on this section of beach, because the tops of tall buildings will be visible and there will be increased lighting at night that will be visible despite vegetative screening. The visible presence of tall buildings will reduce the perceived naturalness of this beach and the estuarine inlet.

The canefields and wetlands around Yorkeys Knob display landscape integrity, in the sense of long-standing patterns of natural vegetation, rural production and community expectations regarding the character of canefields. However in wider context, the Barron River delta is a mosaic of different land uses, with some parts of the Yorkeys Knob-Smithfield areas undergoing rapid changes, and the sense of an 'integral landscape' is being eroded. The Aquis development will change the character of the local area, and introduce a scale and modernity of development in marked contrast to its surrounds, and will accelerate the rate of change. These are considered to be the most significant visual impacts of the Aquis Resort.

Impact on Aesthetic Values Associated with GBRWHA

The proximity and accessibility of the Great Barrier Reef are major reasons for locating the Aquis Resort in the Cairns area, and it is expected that many resort guests will be attracted to Far North Queensland in order to experience the reef. The project site is located so as to minimise any direct impacts on the GBRWHA and deliberately excludes any connection to Richters Creek (e.g. marina, boat access channel). While the project site *per se* does not abut GBRWHA waters, and the proposed tall buildings will not be seen from Green Island or from the Fitzroy Island shoreline, they will be visible from off-shore and by GBRWHA visitors including tourists on ferry routes, and other boat-based users.

There are no aesthetic OUV attributes of the GBRWHA which are present on the project site or will be directly affected by the proposed development, although the taller buildings will potentially be visible from off-shore areas and islands within the GBRWHA. There is also a potential intangible effect relating to 'response to place', whereby GBRWHA visitors and the community generally may consider that the naturalness of the waters off Cairns is reduced by the sight of tall buildings near Yorkeys Knob.

Photo 22-10 below shows a view of the Cairns CBD taken from a tourist ferry on the Cairns / Green Island route.

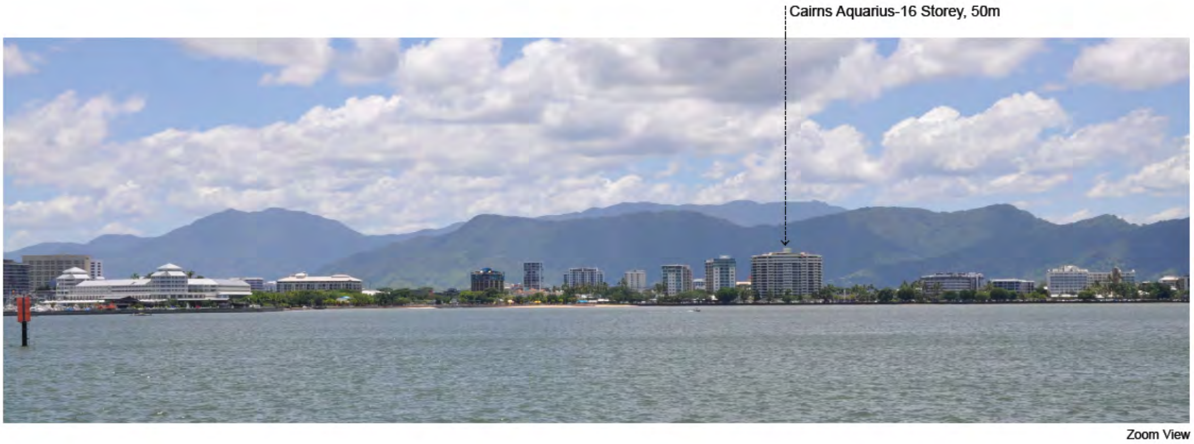


Photo 22-10 View of the Cairns CBD from a tourist ferry.

Source: Appendix E (Figure 15).

This view is an everyday part of a typical GBRWHA experience and includes tall buildings against backdrop of the WTWHA. The Aquis Resort buildings will be of similar in height to existing Cairns CBD buildings. However, as **Photo 22-11** shows, they will be barely visible and are highly unlikely to detract from a GBRWHA experience.

Photo 22-11 Wide angle view of the Cairns CBD from a tourist ferry.

Source: Appendix E (Figure 14). Aquis Resort study area is shown on far right with proposed buildings modelled to scale. **Photo 22-10** is a zoomed view of the area in the red box.

These views demonstrate that, in terms of a GBRWHA experience, the Aquis Resort will become part of the 'leaving and returning' experience as will be associated with the Cairns CBD and other nodes of built form along the coast (e.g. Buchans Point). A similar response will apply for air travellers air, as the Aquis Resort is directly under the northern flight path on a few seconds away from the airport. See **Figure 22-24** and **Photo 22-7**.

World Heritage Values and Integrity

In terms of scenic (aesthetic) values associated with the GBRWHA, the proposed Aquis Resort will have no direct impacts on any land or waters within the World Heritage Area. There will be an indirect visual impact, in that the proposed tall buildings on the mainland will be visible from GBRWHA waters (as seen by tourists on ferry routes, other GBRWHA visitors and other boat-based users), but this is considered to be minor and acceptable because:

- As seen from off-shore, the Aquis Resort buildings will be perceived as part of the Cairns node of intensive development (comprising a major coastal city, port and airport), and the tall buildings will be of similar height and night-time lighting as existing buildings in the Cairns CBD which are closer to the shoreline.
- The proposed development will not visually intrude upon nor affect a part of the Wet Tropics coastline where rainforest-clad mountains fall to the sea (the distinctive juxtaposition of two World Heritage Areas which occurs north of Cairns). In the Yorkeys Knob area, the forested mountains are set well back from the shoreline, with an intervening coastal plain which includes the subject land.
- There are no GBRWHA aesthetic attributes on the project site, the nearby beach or in the adjacent bay waters which will be affected by the proposed development.

In terms of impacts on the experiential 'response to place', it is considered likely that residents and visitors perceive the Northern Beaches suburbs and canefields generally as part of the mainland, not as part of the Great Barrier Reef *per se*. The coastal beaches and headlands are interface places offering views outwards to less accessible places (ocean, reef and islands) i.e. the mainland is an 'everyday' place, the tropical islands and Great Barrier Reef is an 'other' more exotic place. In this context, visually prominent buildings on the mainland are unlikely to impact detrimentally on GBRWHA experiential values for most visitors, provided they are perceived to be part of the Cairns-airport-Northern Beaches node of development. For Aquis Resort guests, the tall buildings offer views outwards to the tropical ocean with its promise of coral reefs and islands, and in that sense reinforce the distinction between the mainland and the 'other' World Heritage place.

Similar considerations apply to the issue of integrity of the World Heritage property. There will be no direct effects of the proposed Aquis Resort development which could adversely impact the integrity of the GBRWHA, because it will be adequately buffered from the shoreline with no connection to Richters Creek (i.e.no marina or boat access channel is proposed). In terms of indirect impacts on the integrity of the World Heritage property, for example impacts arising from the activities of Aquis Resort guests or staff, there will be little discernible effect. There is unlikely to be a resort-related increase in boating in the bay waters around Yorkeys Knob, although there may be an increase in boating associated with regional or local population increases. While there may be a noticeable increase in tourism visitation to Green Island and Fitzroy Island, and activities relating to reef diving/snorkelling, these are well-controlled activities capable of absorbing additional tourist numbers without impacting GBRWHA values.

Accordingly, it is considered that neither the aesthetic attributes of the GBRWHA, nor its essential integrity, will be significantly affected by the proposed Aquis Resort development, and that the OUV of this unique World Heritage property will not be affected.

Similar considerations apply with respect to the Wet Tropics WHA. Although there will be no direct effects of the Aquis Resort on the WTWHA, hotel guests will see the distinctive rainforest-clad mountains from their windows, and parts of the WTWHA (for example the Kuranda Lookout) will be within distant view of the resort buildings.

Management and Presentation Responsibilities / Opportunities

As a signatory to the World Heritage Convention, Australia (and in particular the GBRMPA) has a responsibility to protect, manage and present the GBRWHA and its values. The proposed Aquis Resort will assist in meeting these 'presentation' responsibilities, in that it will:

- Attract international visitors to Cairns, many of whom are expected to (and will be encouraged to) take advantage of tourism industry opportunities to visit the GBR directly, or learn about the GBR while in North Queensland. Similar considerations apply to the WTWHA.
- Raise international awareness of the GBR by 'branding' the facility as 'Aquis Resort at The Great Barrier Reef (and capitalise on such branding, in a 'win-win' strategy), and provide a venue and opportunities for on-site education and awareness-raising through the proposed aquarium, conference venue, theming and promotions.

The increase in visitor use of and activities within the GBRWHA arising from the proposed Aquis Resort is likely to be controlled and well-managed through existing tourism and GBRMPA programs such as tourist ferries, overflights (joy rides), whale-watching, underwater dive training and charter boats etc., rather than uncontrolled increase in private boating, camping, trekking and driving. While any increase in tourism within sensitive natural areas brings challenges, the Cairns-based GBR tourist industry is close to an 'ideal' visitor management situation – the GBR has high visual attraction appeal, visitors will be mainly a 'new' audience, receptive to conservation and management messages, and they will have little capacity for independent travel (so their numbers, location and impacts can be controlled).

The Aquis development has the potential to be a place from which a large number of people can experience at least some of the World Heritage values. For example:

- direct views of the WHA from the upper levels of buildings
- interpretive centre
- trips on licensed vessels
- vicarious use / international reputation / Asian perceptions.

22.6.3 Proposed Mitigation and Effectiveness

a) Terrestrial and Aquatic Ecology and Water Quality

Key areas of impact mitigation include:

- design-based mitigation (i.e. avoidance / minimisation commitments inherent in the project concept), namely:
  - restoration of degraded areas and enhancement of connectivity
  - removal of waterway barriers
  - reduction of export of sediments, nutrients, and other water-borne pollutants
  - the hydrologic, hydraulic, and water quality attributes of the lake
- construction phase management (i.e. project commitments inherent in the EMP (Planning)):
  - management of acid sulfate soil
  - management of agrichemicals etc. contained within soils
  - temporary storage and use of chemicals, fuel, pesticides etc.
- operation phase management (i.e. project commitments inherent in the EMP (Planning)):
  - management of lake water quality
  - management of on-site chemicals, fuels, pesticides etc.
  - management of weeds and pest.

These are all likely to be effective in mitigating impacts.

b) Built Form

The main impact on this criterion is the fact that some of the built form may be visible from users of Yorkeys Knob beach, visitors on ferries en route to or from the GBRMP, possibly visitors on Green Island, and from arriving and departing air travellers. Effects may be greater at night when lights from the resort will contrast with the otherwise dark landscape.

The only practical mitigation of these impacts are:

- Visual screening of the low-rise parts of the development by retention, replacement and/or augmentation of boundary vegetation. In particular, additional planting on foredunes behind Yorkeys Knob beach adjacent to Richters Creek mouth is proposed in order to fill in gaps in the current vegetation to screen the northern buildings (in particular Hotel/tower B) and its night-time lighting from the beach.
- Lighting should be designed so as to restrict glare to within the site, screened by surrounding vegetation, with all lights above tree height shielded or downward-directed so as to reduce impacts on beaches, waterways, wetlands and existing nearby residents.

As noted, there are opportunities to enhance the understanding and appreciation of the GBRWHA (and WTWHA) to one million visitors per year via the proposed *Interpretation Strategy* (see **Table 22-50**).

22.6.4 Significance of Mitigated Impact

Table 22-28 below is an assessment of the significance of impacts of the Aquis development on the OUV of the GBRWHA, based on the retrospective statement of values (SEWPaC 2012b). It makes use of a draft template developed by the GBRMPA and provided to the study team for use in this report. This has been modified extensively to allow for a more robust treatment of OUV. In particular, in column 2 it refers to the detailed condition statements assigned by GBRMPA to the SOUV excerpts (column 1) and assesses for each of these:

- the presence of the described value in the investigation area (defined as either the project site or the broader study area, depending on context)
- the likely impact on the value
- the significance of the impact using the categories No impact, Not significant, Beneficial impact, Significant impact.

TABLE 22-28 SUMMARY OF NATURE AND EXTENT OF POSSIBLE IMPACTS ON WH VALUES AND INTEGRITY

<table>
<tr><th>Excerpt from SOUV for GBRWHA</th><th>Examples of values/ attributes in GBRWHA and conditional statement</th><th>Representation of the WHA values within the Investigation Area</th><th>Assessment of potential impact(s) on WH values</th><th>Level of impact</th></tr>
<tr><td colspan="5">Criterion (vii) formerly (iii): Natural beauty and phenomena
The GBR is of superlative natural beauty above and below the water, and provides some of the most spectacular scenery on earth. It is one of a few living structures visible from space, appearing as a complex string of reefal structures along Australia's northeast coast.
From the air, the vast mosaic patterns of reefs, islands and coral cays produce an unparalleled aerial panorama of seascapes comprising diverse shapes and sizes. The Whitsunday Islands provide a magnificent vista of green vegetated islands and spectacular sandy beaches spread over azure waters. This contrasts with the vast mangrove forests in Hinchinbrook Channel, and the rugged vegetated mountains and lush rainforest gullies that are periodically cloud-covered on Hinchinbrook Island.
On many of the cays there are spectacular and globally important breeding colonies of seabirds and marine turtles, and Raine Island is the world's largest green turtle breeding area. On some continental islands, large aggregations of over-wintering butterflies periodically occur.
Beneath the ocean surface, there is an abundance and diversity of shapes, sizes and colours; for example, spectacular coral assemblages of hard and soft corals, and thousands of species of reef fish provide a myriad of brilliant colours, shapes and sizes. The internationally renowned Cod Hole near Lizard Island is one of many significant tourist attractions. Other superlative natural phenomena include the annual coral spawning, migrating whales, nesting turtles, and significant spawning aggregations of many fish species.</td></tr>
<tr><td>Superlative natural beauty above and below the water</td><td>The natural beauty of most of the Region remains intact, especially for off-shore coral reefs and aerial vistas, as well as for neighbouring islands. The significant loss of coral cover has reduced underwater aesthetic value.</td><td>The township, beach and headland of Yorkeys Knob and the Aquis site essentially abuts GBRWHA waters. Parts of the beach south of Yorkeys Knob, the Richters Creek mouth, the northern part of Holloways Beach, and the natural coastal wetland areas provide locally significant scenery characterised by largely un-modified beaches and intact dunal vegetation.
Mangroves and dunal vegetation line the shoreward borders of the site and provide an attractive backdrop when viewed from the beach and in-shore waters. In terms of extent and universal aesthetic value, they are typical of tropical estuarine mangrove areas and not considered representative of the attribute at a regional level.</td><td>Modelling shows that glimpses of the taller buildings will be seen from some off-shore WHA vantage points. However, these will be distant views and screened almost entirely by coastal vegetation.</td><td>Not significant.</td></tr>
</table>

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Some of the most spectacular scenery on Earth	Both above and below the water, the area's scenery remains spectacular. There have been some declines in the aesthetics of in-shore reefs in the southern two-thirds.	Parts of the beach south of Yorkeys Knob, the Richters Creek mouth, the northern part of Holloways Beach, and the natural coastal wetland areas, retain their naturalness, in that no buildings or structures are visible, despite being in relative close proximity to Cairns and its International Airport. Departing and arriving aircraft regularly disrupt this tranquillity. The open waters off Yorkeys Knob Beach are usually turbid and this limits the visibility of species with visual appeal. The marine flora and fauna in the creeks and in-shore waters do not exhibit the characteristic of coral reefs which is central to a GBR experience. Marine megafauna and concentrations of large fish are most likely present off-shore but are rarely seen due to the turbid waters.	There will be some reduction in naturalness for users of the area near the Richters Creek mouth from where parts of the development will be visible. However, this is of local significance only and will not detract from the World Heritage experience.	Not significant.
One of a few living structures visible from space	The Reef remains visible from space and technological advances make these images more accessible.	The site is a very small feature when considering this landscape-level perspective.	The development will take place behind the beach and coastal vegetation. With appropriate technology it will be visible from space but will appear as an edge feature similar to the mosaic of existing urban and industrial development of the delta.	Not significant.
A complex string of reefal structures along Australia's north-east coast	Reefal structures remain intact. Recent estimates vastly increase the extent of coral with the identification of more deepwater reefs.	N/A. There are no reef structures within 25 km of the investigation area.	Nil.	No impact.
Unparalleled aerial panorama of seascapes comprising diverse shapes and sizes	Aerial vistas remain spectacular, with scenic flights a popular tourism activity.	There are no aerial vistas over reef and lagoon systems immediately off-shore from Yorkeys Knob. The closest reefs which form the distinctive Great Barrier Reef patterns of reefs, lagoons and passages occur 25 - 30 km off-shore, extending from Green Island northwards to Batt Reef. Scenic flights are a popular from of tourism in the Cairns / Port Douglas area. The focus of these is on the reef.	Due to its proximity to the Cairns airport, the Aquis site will be perceived as part of the departure / arrival process and not of the trip itself.	Not significant.

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Whitsunday Islands provide a magnificent vista of green vegetated islands and white sandy beaches spread over azure waters	The majority of the Whitsunday Islands are protected and managed as national parks. There have been some changes to island scenery, such as on resort islands.	There are no islands off-shore from the Northern Beaches, except for Double Island and the smaller Haycock (Scouts Hat) Island near Buchan Point / Palm Cove approximately 9 km to the north. The two islands visited by tourists and others for appreciation of GBRWHA scenery and underwater experiences are the coral cay of Green Island (25 km to the east) and Fitzroy Island (33 km to the south-east, behind Cape Grafton).	The development will have no impact on local beaches. No access is proposed and the resort will be behind 500 m of coastal / restored vegetation. Resort infrastructure will be partly visible from Yorkeys Knob beach as shown in the visualisations.	Not significant.
Vast mangrove forests in Hinchinbrook Channel, or the rugged vegetated mountains and lush rainforest gullies	All of Hinchinbrook Island is protected and managed as a national park. Patches of mangrove forests and rainforest were affected by cyclone Yasi.	The site contains mangroves associated with the Richters and Yorkeys Creek estuary and similar land fringing Half Moon Creek to the north-west. However in terms of extent and universal aesthetic value, they are typical of tropical estuarine mangrove areas and not considered representative of the attribute at other than a local scale. Mangrove forests are widespread along much of the GBR coast and on continental islands. The Yorkeys Knob beach is a good example of locally-significant coastal vegetation.	There will be no loss of mangroves and the development will be barely visible from the WHA.	No impact.
On many of the cays there are spectacular and globally important breeding colonies of seabirds and marine turtles	There have been serious declines in some populations of seabirds and some marine turtle species.	There are no breeding colonies of seabirds or marine turtles although some are present in small numbers. The study area is not known for bird-watching or turtle-viewing.	The detailed assessment concludes that the development will be neutral regarding shorebirds and not significant regarding turtles. Visually there will be no impact.	No impact.
Raine Island is the world's largest green turtle breeding area	Long-term data indicates that, since the mid-1970s, green turtle nesting on Raine Island has increased and then plateaued over the past two decades. It is thought to have declined recently.	Six species of marine turtles have been recorded in the investigation area. Although there is little significant habitat or food for marine turtles in the vicinity of the site, some species may forage in these creeks. It is likely that there is some sparse nesting of marine turtles on the beaches in the vicinity of the site. These are unlikely to be visible on the site or in its immediate vicinity due to the usually turbid waters	There will be no loss of turtle habit or interference with nesting. Minor impacts may occur due to resort lighting. Most light spill will be able to be screened by appropriate plantings seaward of the development area.	Not significant.

Excerpt from SOUV for GBRWHA	**Examples of values/ attributes in GBRWHA and conditional statement**	**Representation of the WHA values within the Investigation Area**	**Assessment of potential impact(s) on WH values**	**Level of impact**
Beneath the ocean surface, there is an abundance and diversity of shapes, sizes and colours.. Spectacular coral assemblages of hard and soft corals	Since 1986, average hard coral cover is estimated to have declined from 28% to 13.8%, principally in the southern two-thirds of the Region. This is mainly due to storm damage (48%), crown-of-thorns starfish (42%), and bleaching (10%).	The marine flora and fauna in the creeks, and in waters off-shore from Yorkeys Knob, do not exhibit '.. *abundance and diversity of shape, size and colour..'* as are often seen associated with coral reefs. The nearest coral reefs to the project site are Green Island (approximately 25 km east of Richters Creek mouth), Haycock Reef and Double Island Reef (approximately 10 km north of Richters Creek mouth).	Nil.	No impact.
Thousands of species of reef fish provide a myriad of brilliant colours, shapes and sizes	There are about 1500 species of bony fish. Long-term monitoring of about 200 species of coral reef fish has not detected declines in the species monitored. Some targeted species are under significant pressure.	Ninety-four species of bony fish have been recorded in the investigation area. While these fish contribute to local fisheries values, these populations are not significant at the regional level. Local fish are unlikely to be visible on the site or in its immediate vicinity due to the usually turbid waters.	Resort activities will not affect local fish and certainly not those identified with the WHA.	No impact.
The internationally renowned Cod Hole is one of many significant tourist attractions	There is anecdotal evidence of severe declines in the number and condition of potato cod at Cod Hole.	N/A.	Nil.	No impact.
Superlative natural phenomena include the annual coral spawning, migrating whales, nesting turtles, and significant spawning aggregations of many fish species	The number of migrating humpback whales is increasing. Nesting numbers have declined for at least two of the six species of marine turtle. Protection for fish spawning aggregations has improved, but most sites are unknown.	Marine megafauna and concentrations of large fish are most likely present off-shore from Yorkeys Knob and elsewhere along the Northern Beaches, and it is likely that there will occasionally be a visible reminder that these waters are part of the GBRWHA. Although whale-watching is a common tourism activity in the Cairns area, this is focussed off-shore and targets the humpback whale during the species' annual migration (July to September).	Nil.	No impact.

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Criterion (viii) – formerly (i): Major stages of the Earth's evolutionary history The GBR, extending 2,000 kilometres along Queensland's coast, is a globally outstanding example of an ecosystem that has evolved over millennia. The area has been exposed and flooded by at least four glacial and interglacial cycles, and over the past 15,000 years reefs have grown on the continental shelf. During glacial periods, sea levels dropped, exposing the reefs as flat-topped hills of eroded limestone. Large rivers meandered between these hills and the coastline extended further east. During interglacial periods, rising sea levels caused the formation of continental islands, coral cays and new phases of coral growth. This environmental history can be seen in cores of old massive corals. Today the GBR forms the world's largest coral reef ecosystem, ranging from in-shore fringing reefs to mid-shelf reefs, and exposed outer reefs, including examples of all stages of reef development. The processes of geological and geomorphological evolution are well represented, linking continental islands, coral cays and reefs. The varied seascapes and landscapes that occur today have been moulded by changing climates and sea levels, and the erosive power of wind and water, over long time periods. One-third of the GBR lies beyond the seaward edge of the shallower reefs; this area comprises continental slope and deep oceanic waters and abyssal plains.				
Globally outstanding example of an ecosystem that has evolved over millennia	The Reef remains an outstanding example of evolutionary history. Recent research has identified deepwater reefs that extend for hundreds of kilometres along the outer shelf at between 40 and 70 m depth.	The site is situated near the seaward limit of the delta of the Barron River and is within several hundred metres of the Coral Sea. Over geological timescales, the beaches adjacent to the Barron River delta have been accreting, although local disturbances such as interruptions to the fluvial supply from rivers such as the Barron River have caused large scale disturbances. The Aquis site does not contribute to Criterion (viii) values to any great extent, although as part of a delta feature it is a remnant of geomorphological processes and is adjacent to an active coastal zone subject to long-shore drift.	There is an opportunity for on-site interpretation and education on physical history.	Beneficial impact.

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Area has been exposed and flooded by at least four glacial and interglacial cycles, and over the past 18,000 years reefs have grown on the continental shelf	The deepwater reefs are providing valuable records of past coral reef responses to climate and sea level change.	The Barron River gorge is a regionally significant example of river capture. While of interest, this is unrelated to the GBR. Local river gradients have changed along with sea levels, leading to episodes of accretion and erosion. The site itself is representative of delta-forming processes and lies landward of the Holocene accretion zone.	There is an opportunity for on-site interpretation and education on physical history.	Beneficial impact.
Today, the Great Barrier Reef forms the world's largest coral reef ecosystem.. Including examples of all stages of reef development	The Great Barrier Reef remains the world's largest coral reef ecosystem and, while its condition has deteriorated, it remains one of the most world's most healthy reef systems, including examples of all stages of reef development.	The nearest mapped coral is approximately 25 km north-east of the site. The near-shore habitat is typical of the coastal zone in the Wet Tropics, with often turbid waters and few bathymetric features. The site is not associated with reef development.	Nil.	No impact.
Processes of geological and geomorphological evolution are well represented, linking continental islands, coral cays and reefs	Geomorphological features and processes are well represented. Most remain in most good condition but some processes are declining, especially in the in-shore southern two-thirds.	Off-shore geomorphic features such as islands are present at a distance (e.g. Double Island) while reefs, seagrass meadows and coral islands are absent.	Nil.	No impact.

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
The varied seascapes and landscapes that occur today have been moulded by changing climates and sea levels, and the erosive power of wind and water, over long time periods	The impacts of modern climate change are beginning to have effects on seascapes, for example through reduced reef building.	The forested hills of the WTWHA lie some 6 km landward of the Aquis site and provide a visually pleasing backdrop. The Barron River and its escarpment and delta are typical of a large number of coastal rivers and streams. These areas provide remnants of former landscapes and evidence of landforming processes.	There is an opportunity for on-site interpretation and education on physical history.	Beneficial impact.
One-third of the Great Barrier Reef lies beyond the seaward edge of the shallower reefs (and) comprises continental slope and deep oceanic waters and abyssal plains	Evidence of cold water coral communities have been found on deepwater knolls along the edge of the Great Barrier Reef at depths of more than 1000 metres, but these deep areas are hardly known.	Nil. Investigation area is adjacent to the in-shore area. The coastline adjacent Aquis is adjacent to the 'high nutrient coastal strip' bioregion of the Great Barrier Reef. This bioregion is characterised by terrigenous mud, high levels of nutrients from the adjoining land, seagrass in sheltered waters and a wet tropic climate. Within this area, there are scattered coastal fringing reefs that generally develop around the mainland and high continental islands that have high coverage of hard coral, soft coral and macroalgae, but low coral diversity.	Nil.	No impact.

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Criterion (ix) – formerly (ii): Ecological and biological processes The globally significant diversity of reef and island morphologies reflects ongoing geomorphic, oceanographic and environmental processes. The complex cross-shelf, longshore and vertical connectivity is influenced by dynamic oceanic currents and ongoing ecological processes such as upwellings, larval dispersal and migration. Ongoing erosion and accretion of coral reefs, sand banks and coral cays combine with similar processes along the coast and around continental islands. Extensive beds of Halimeda algae represent active calcification and accretion over thousands of years. Biologically the unique diversity of the GBR reflects the maturity of an ecosystem that has evolved over millennia; evidence exists for the evolution of hard corals and other fauna. Globally significant marine faunal groups include over 4,000 species of molluscs, over 1,500 species of fish, plus a great diversity of sponges, anemones, marine worms, crustaceans, and many others. The establishment of vegetation on the cays and continental islands exemplifies the important role of birds, such as the Pied Imperial Pigeon, in processes such as seed dispersal and plant colonisation. Human interaction with the natural environment is illustrated by strong ongoing links between Aboriginal and Torres Strait Islanders and their sea-country, and includes numerous shell deposits (middens) and fish traps, plus the application of story places and marine totems.				
Significant diversity of reef and island morphologies reflects ongoing geomorphic, oceanographic and environmental processes	There remains a diverse range of reef and island morphologies. Most geomorphic, oceanographic and environmental processes remain in good condition but some are declining, especially in the in-shore southern two-thirds.	Many off-shore and on-shore habitats of value to the GBRWHA are present in the study area. Of these, mangroves are the most significant.	Ecological processes will be enhanced by the habitat and connectivity restoration works. Thirty ha of mangroves will be restored.	Beneficial impact.
Complex cross-shelf, longshore and vertical connectivity is influenced by dynamic oceanic currents	Most marine species and habitats are thought to remain well connected. There is increasing evidence of intensified flow and accelerated warming in the East Australian Current.	N/A.	Nil.	No impact.

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Ongoing ecological processes such as upwellings, larval dispersal and migration	Ecological processes remain in good condition in northern areas. Some processes are in poor condition in-shore in the southern two-thirds of the Region and are deteriorating.	All on-site habitats contribute to some extent to the integrity of the WHA in that they supply numerous ecosystem services including hydrologic services related to routing flood runoff and groundwater storage, nutrient dispersal and cycling, seed dispersal, primary production, carbon sequestration and climate regulation, waste decomposition and detoxification, and purification of water and air. Many off-shore habitats of value to the GBRWHA are present in the study area (Beaches and coastlines, Mangrove forests, and Open waters) while on-shore the project area and surrounds contributes to environmental processes via Saltmarshes, Freshwater wetlands, Forested floodplain, Woodlands, Forests, Rainforest, and Connecting waterbodies.	Ecological processes will be enhanced by the habitat and connectivity restoration works. Over 55 ha of natural vegetation will be restored and five waterway barriers will be removed.	Beneficial impact.
Ongoing erosion and accretion of coral reefs, sand banks and coral cays combine with similar processes along the coast and around continental islands	Reef building is likely to be in good condition for much of the Region, especially in the north, but has been affected by cyclones and reduced coral cover, especially in the southern two-thirds of the Region.	The Barron River delta is the largest source of sediment to Cairns' northern beaches and supplies 23 000 m^3 annually. Long-shore drift of sediments and a net accretion of the shoreline adjacent to the site show that natural processes are progressing largely free of human intervention, although the mouth of Richters Creek has recently been dredged for beach replenishment purposes.	Nil. The project will not affect on-going coastal processes in any way.	No impact.
Extensive beds of Halimeda algae represent active calcification and accretion over thousands of years	Halimeda beds are poorly studied, but are likely to be in very good condition given their isolation from land-based impacts and level of protection from trawling.	N/A.	Nil.	No impact.

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Biologically the unique diversity of the Great Barrier Reef reflects the maturity of an ecosystem that has evolved over millennia; evidence exists for the evolution of hard corals and other fauna	The diversity of species remains high, but some species are in poor condition, especially in-shore in the southern two-thirds of the Region.	The Aquis site and the broader study area contribute significantly the provision of species diversity and ecosystem services, although this contribution is commensurate with its area. Water quality in the creeks surrounding the project area is generally good, although nutrient levels and turbidity are higher than desirable. Despite some evidence that adjacent land uses and acid sulfate soils impacts exist in local creeks, these currently sustain locally significant fisheries values. The project site currently plays its part pro rata in the maintenance of reef-wide processes and despite habitat fragmentation, overall connectivity remains.	Water quality will be enhanced due to change of land use and commitment to water sensitive urban design principles. Export of sediments and nutrients to the GBR will be reduced.	Beneficial impact.
Vegetation on the cays and continental islands exemplifies the important role of birds in seed dispersal and plant colonisation	Many islands are national parks or protected within the Marine Park. There are introduced plants on most islands.	Fourteen bird species were confirmed on the site, 4 may overfly the site, and a further 15 species are likely to occur. Five of these birds are considered terrestrial migrants within the Australian mainland and all are relatively common species that occur over a wide area. Suitable habitat for all of these species exists within the project site, mainly in the seasonal abandoned aquaculture ponds, although some species may also forage on the clay pans following tidal inundation. While mangrove habitats are also valuable, there are no breeding colonies of seabirds recorded on or near the site.	The planned draining and filling of the abandoned aquaculture ponds will remove 6 ha of seasonal habitat utilised by some bird species. However, all other habitats will be retained and enhanced, leading to a slight beneficial impact. Airport safety is a major driver for the removal of this habitat.	Beneficial impact.

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Human interaction with the natural environment is illustrated by strong ongoing links between Aboriginal and Torres Strait Islanders and their sea country, and includes numerous shell deposits (middens) and fish traps, plus the application of story places and marine totems	Traditional Owners with connections to the Great Barrier Reef maintain their cultural practices and customs. Indigenous heritage is under pressure especially in the southern two-thirds of the Region.	Limited examples remain of indigenous use of land and sea resources (middens and a hearth oven). The Yirrganydji people retain links with the site and have an interest in the on-going management of cultural heritage values.	All known archaeological material lies outside the development footprint. The project includes a Cultural Heritage Centre. Subject to the outcomes of the CHMP ICH material will be included in this Centre and otherwise include in the *Interpretation Strategy*.	Beneficial impact.
Criterion (x) – formerly (iv): Habitats for conservation of biodiversity The enormous size and diversity of the GBR means it is one of the richest and most complex natural ecosystems on earth, and one of the most significant for biodiversity conservation. The amazing diversity supports tens of thousands of marine and terrestrial species, many of which are of global conservation significance. As the world's most complex expanse of coral reefs, the reefs contain some 400 species of corals in 60 genera. There are also large ecologically important inter-reefal areas. The shallower marine areas support half the world's diversity of mangroves and many seagrass species. The waters also provide major feeding grounds for one of the world's largest populations of the threatened dugong. At least 30 species of whales and dolphins occur here, and it is a significant area for humpback whale calving. Six of the world's seven species of marine turtle occur in the GBR. As well as the world's largest green turtle breeding site at Raine Island, the GBR also includes many regionally important marine turtle rookeries. Some 242 species of birds have been recorded in the GBR. Twenty-two seabird species breed on cays and some continental islands, and some of these breeding sites are globally significant; other seabird species also utilize the area. The continental islands support thousands of plant species, while the coral cays also have their own distinct flora and fauna.				

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
One of the richest and most complex natural ecosystems on Earth, and one of the most significant for biodiversity conservation	The Great Barrier Reef remains a complex ecosystem, rich in biodiversity. Some key habitats are under pressure, especially in southern in-shore areas.	A total of 164 species of native flora and over 100 species of native terrestrial fauna occur on-site. Four species – the green turtle, hawksbill turtle, flatback turtle and humpback whale – are moderately likely to occur off-shore of the project site and the green turtle is also moderately likely to occur in the estuaries surrounding the project site. Many of the on-shore habitats of value to the GBR are present on or near the project site. Saltmarshes, Freshwater wetlands, Forested floodplain, Woodlands, Forests, Rainforest, and Connecting waterbodies.	There will be no loss of turtle habit or interference with nesting. Minor impacts may occur due to resort lighting. Most light spill will be able to be screened by appropriate plantings seaward of the development area.	Not significant.
Tens of thousands of marine and terrestrial species, many of which are of global conservation significance	Some populations (dugong, sharks, seabirds and marine turtles) are known to have declined. Others such as humpback whales, loggerhead turtles and estuarine crocodiles are increasing.	Estuarine crocodiles are present. The study area does not support an important population of loggerhead turtles and does not provide habitat critical to the survival of the species.	The project will not result in a significant impact on listed species.	Not significant.
The world's most complex expanse of coral reefs.. Contain some 400 species of corals in 60 genera	There remain more than 400 species of hard coral and at least 150 species of soft corals, sea fans and sea pens, living in a complex reef system. There has been a serious decline in hard coral cover in the southern two-thirds of the Region.	The nearest coral beds are some 25 km distant from the site.	Nil.	Nil.

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Large ecologically important interreefal areas. The shallower marine areas support half the world's diversity of mangroves	The Region's mangrove forests remain very diverse with at least 39 mangrove species and hybrids recorded.	Mangrove forests are evident on the WHA boundary and these are typical of similar areas along the GBR coastline. Five of the 15 regional associations are present and 14 mangrove species are present. Mangroves constitute 41% of the natural vegetation on the site and cover 22 ha.	Very little (< 0.5 ha) of mangroves will be cleared and 30 ha extra mangroves will be planted. These will provide additional habitat but more importantly, enhanced connectivity of Yorkeys Creek.	Beneficial impact.
Large ecologically important interreefal areas. The shallower marine areas support … many seagrass species	Seagrass diversity remains; however, there have been recent severe declines in abundance and community composition in the in-shore southern two-thirds of the Region.	No seagrass exists on or near the site, with the nearest recorded seagrass beds being approximately 9 km to the south-east.	Ni.	No impact.
Waters also provide major feeding grounds for one of the world's largest populations of the threatened dugong	The dugong population in northern areas remains robust. The population in the southern two-thirds of the Region was very low at the time of listing and remains so. Declines in the condition of seagrass meadows have had profound effects on dugongs in recent years.	Dugong are moderately likely to occur in areas off-shore of the project site, and have a low likelihood of occurring in the estuaries surrounding the project site.	The project is unlikely to have any effect on dugong as there will be no significant adverse impacts on habitat or water quality and no direct contact.	Not significant.
At least 30 species of whales and dolphins occur here	Little is known about the populations of most whale species. Two in-shore dolphin species are known to be at risk.	Nine species of whales and other cetaceans are likely to inhabitant the Commonwealth Marine Area off-shore of the proposed development.	The project is unlikely to have any effect on these species as there will be no significant adverse impacts on habitat or water quality and no direct contact.	Not significant.

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
A significant area for humpback whale calving	The humpback whale population is recovering strongly after being decimated by whaling. The calving habitats are well protected.	The likelihood of occurrence of humpback whales in the estuaries surrounding the project site is low, and in off-shore marine waters is moderate.	The project is unlikely to have any effect on this species as there will be no significant adverse impacts on habitat or water quality and no direct contact.	Not significant.
Six of the world's seven species of marine turtle occur in the Great Barrier Reef. As well as the world's largest green turtle breeding site at Raine Island, the Great Barrier Reef also includes many regionally important marine turtle rookeries	Of the habitats that support marine turtles, the condition of seagrass meadows and coral reefs have declined significantly. While nesting habitats are generally in good condition, sea level rise, increasing air temperature and extreme weather events are affecting their condition.	Six species of marine turtles have been recorded in the investigation area. Although there is little significant habitat or food for marine turtles in the vicinity of the site, some species may forage in these creeks. It is likely that there is some sparse nesting of marine turtles on the beaches in the vicinity of the site.	There will be no loss of turtle habit or interference with nesting. Minor impacts may occur due to resort lighting. Most light spill will be able to be screened by appropriate plantings seaward of the development area.	Not significant.
Some 242 species of birds have been recorded in the Great Barrier Reef. Twenty-two seabird species breed on cays and some continental islands, and some of these breeding sites are globally significant	While the nesting habitats for seabirds remain in generally good condition, declines of up to 70 per cent in some nesting populations have been recorded. There is evidence this may relate to reduced availability of pelagic prey.	Fourteen bird species were confirmed on the site, 4 may overfly the site, and a further 15 species are likely to occur. Five of these birds are considered terrestrial migrants within the Australian mainland and all are relatively common species that occur over a wide area. Suitable habitat for all of these species exists within the project site (aquaculture ponds, clay pans, mangroves. There are no breeding colonies of seabirds recorded on or near the site. Five migratory shorebird species are supported by the site to some extent.	The detailed assessment concludes that the effect of the development on birds is likely to be neutral.	Not significant.

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
The continental islands support thousands of plant species, while the coral cays also have their own distinct flora and fauna	Plant diversity is generally well protected, with about one-third of the islands contained within national parks.	There are no barrier reef islands off-shore from the Northern Beaches, except for Double Island and the smaller Haycock (Scouts Hat) Island near Buchan Point / Palm Cove approximately 9 km to the north.	Nil.	Nil.

Integrity

The ecological integrity of the GBR is enhanced by the unparalleled size and current good state of conservation across the property. At the time of inscription it was felt that to include virtually the entire Great Barrier Reef within the property was the only way to ensure the integrity of the coral reef ecosystems in all their diversity.

A number of natural pressures occur, including cyclones, crown-of-thorns starfish outbreaks, and sudden large influxes of freshwater from extreme weather events. As well there is a range of human uses such as tourism, shipping and coastal developments including ports. There are also some disturbances facing the GBR that are legacies of past actions prior to the inscription of the property on the World Heritage list.

At the scale of the GBR ecosystem, most habitats or species groups have the capacity to recover from disturbance or withstand ongoing pressures. The property is largely intact and includes the fullest possible representation of marine ecological, physical and chemical processes from the coast to the deep abyssal waters enabling the key interdependent elements to exist in their natural relationships.

Some of the key ecological, physical and chemical processes that are essential for the long-term conservation of the marine and island ecosystems and their associated biodiversity occur outside the boundaries of the property and thus effective conservation programs are essential across the adjoining catchments, marine and coastal zones.

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Integrity of terrestrial habitats and environmental processes including connectivity.	Connecting waterbodies, such as rivers, creeks, estuaries and floodplains, are the aquatic link between the marine and terrestrial environment, transporting water, nutrients and sediments, and providing a movement corridor, as well as feeding and breeding areas for some marine and coastal species. Aquatic connectivity is provided through surface waterbodies and groundwater.	Terrestrial habitats that support the Reef are generally in very good condition in the northern catchment. However, these habitats have been substantially modified in southern areas (south of about Port Douglas), especially saltmarshes, wetlands, woodlands and forests. The functioning of connecting waterbodies has deteriorated, reducing connectivity to the marine environment.	Design / impact mitigation initiatives will have a beneficial impact on ecological and biological processes by: supplementing the protection of most of the 53 ha of natural vegetation on-site with a further 55 ha of ecological plantings that will enhance habitat, habitat connectivity, and water quality removal of three waterway barriers on or adjacent to the site (one tide gate and two undersized culverts).	Beneficial impact

(Continued over)

Excerpt from SOUV for GBRWHA	Examples of values/ attributes in GBRWHA and conditional statement	Representation of the WHA values within the Investigation Area	Assessment of potential impact(s) on WH values	Level of impact
Water quality	The quality of runoff from the land is important, and dissolved inorganic nitrogen and phosphorous continue to enter the GBR at greatly enhanced levels compared to those prior to European settlement. A key target of the *Reef Water Quality Protection Plan 2013* (Reef Plan) is to achieve a 50 per cent reduction in nutrient loads entering the Great Barrier Reef by 2018.	Current water quality in the catchment of the proposed development is generally good, although the waters do not meet the QWQG for various nutrients and turbidity. Agricultural and urban uses in the catchment are known to result in exports of sediments, nutrients, and other pollutants and to some extent these detract from the water quality values of the near-shore waters. These effects are likely to diminish with distance from the coast. It is estimated that the current site in its agricultural use is resulting in the following quantities annual exports (t/a): total suspended solids: 290 total nitrogen: 5.8 total phosphorus: 0.85. Water quality is essential to function and this relies on freshwater inputs and nutrients within narrow bands of quality and quantity.	Design / impact mitigation initiatives will have a beneficial impact on water quality by: importing as much as possible of the 1800 ML/a sewage effluent generated by the site after treatment to tertiary standard and using this on-site to substitute for potable water consumption treating all stormwater generated by the development to a standard that is a significant improvement to that discharged by agricultural use. The net effect of the water quality initiatives is a 133 t/a decrease in TSS, TN, and TP.	Beneficial impact

Source: Columns 1 and 2: GBRMPA (2013a) Table 7.11. Columns 3 to 5: study team compilation.

This assessment concludes that, in terms of the four OUV criteria and integrity, there are:

- No significant adverse impacts.
- Beneficial impacts on the following Criterion (viii) attributes, principally through the presentation of GBRWHA values as part of the Aquis Resort *Interpretation Strategy* (see **Table 22-50**):
  - Globally outstanding example of an ecosystem that has evolved over millennia.
  - Area has been exposed and flooded by at least four glacial and interglacial cycles, and over the past 18,000 years reefs have grown on the continental shelf.
  - The varied seascapes and landscapes that occur today have been moulded by changing climates and sea levels, and the erosive power of wind and water, over long time periods.
- Beneficial impacts on the following Criterion (ix) attributes, principally through restoration of site habitat (55.7 ha), enhancement of connectivity (restoration of riparian vegetation and removal of five waterway barriers), improvement in water quality, and through the presentation of Indigenous cultural heritage values as part of the Aquis Resort *Interpretation Strategy* (see **Table 22-50**):
  - Significant diversity of reef and island morphologies reflects ongoing geomorphic, oceanographic and environmental processes.
  - Ongoing ecological processes such as upwellings, larval dispersal and migration.
  - Biologically the unique diversity of the Great Barrier Reef reflects the maturity of an ecosystem that has evolved over millennia; evidence exists for the evolution of hard corals and other fauna.
  - Vegetation on the cays and continental islands exemplifies the important role of birds in seed dispersal and plant colonisation.
  - Human interaction with the natural environment is illustrated by strong ongoing links between Aboriginal and Torres Strait Islanders and their sea country, and includes numerous shell deposits (middens) and fish traps, plus the application of story places and marine totems.
- Beneficial impacts on the following Criterion (x) attribute, principally through restoration of an additional 30 ha of mangroves:
  - Large ecologically important interreefal areas. The shallower marine areas support half the world's diversity of mangroves.
- Beneficial impacts on the following Integrity attributes, principally through restoration of site habitat, enhancement of connectivity, and reduction of net export of sediments and nutrient to the GBR lagoon:
  - Integrity of terrestrial habitats and environmental processes including connectivity.
  - Water quality.

Minor construction impacts will be effectively managed via the EMP (Construction).

22.6.5 Need for Offsets

The assessment concludes that there are no significant residual adverse impacts. Accordingly, no offsets under the EPBC Act Offsets Policy (SEWPaC 2012a) are required.

22.6.6 Consistency with International Obligations

On the basis that there are likely to be no impacts of significance on the GBRWHA, the development of the Aquis Resort will not be contrary to Australia discharging its responsibilities under the World Heritage Convention.

22.7 WET TROPICS OF QUEENSLAND WHA

22.7.1 Presence of Matter

a) Overview

At its closest point, the Wet Tropics of Queensland World Heritage Area (usually simply referred to as the Wet Tropics World Heritage Area or WTWHA) lies approximately 2.5 km west (upstream of the development) measured line-of-sight, but is 8.4 km distant via connecting watercourses. It has a tenuous connection to the site via the Barron River / Thomatis Creek / Richters Creek corridor and other watercourses as shown on **Figure 22-32**.

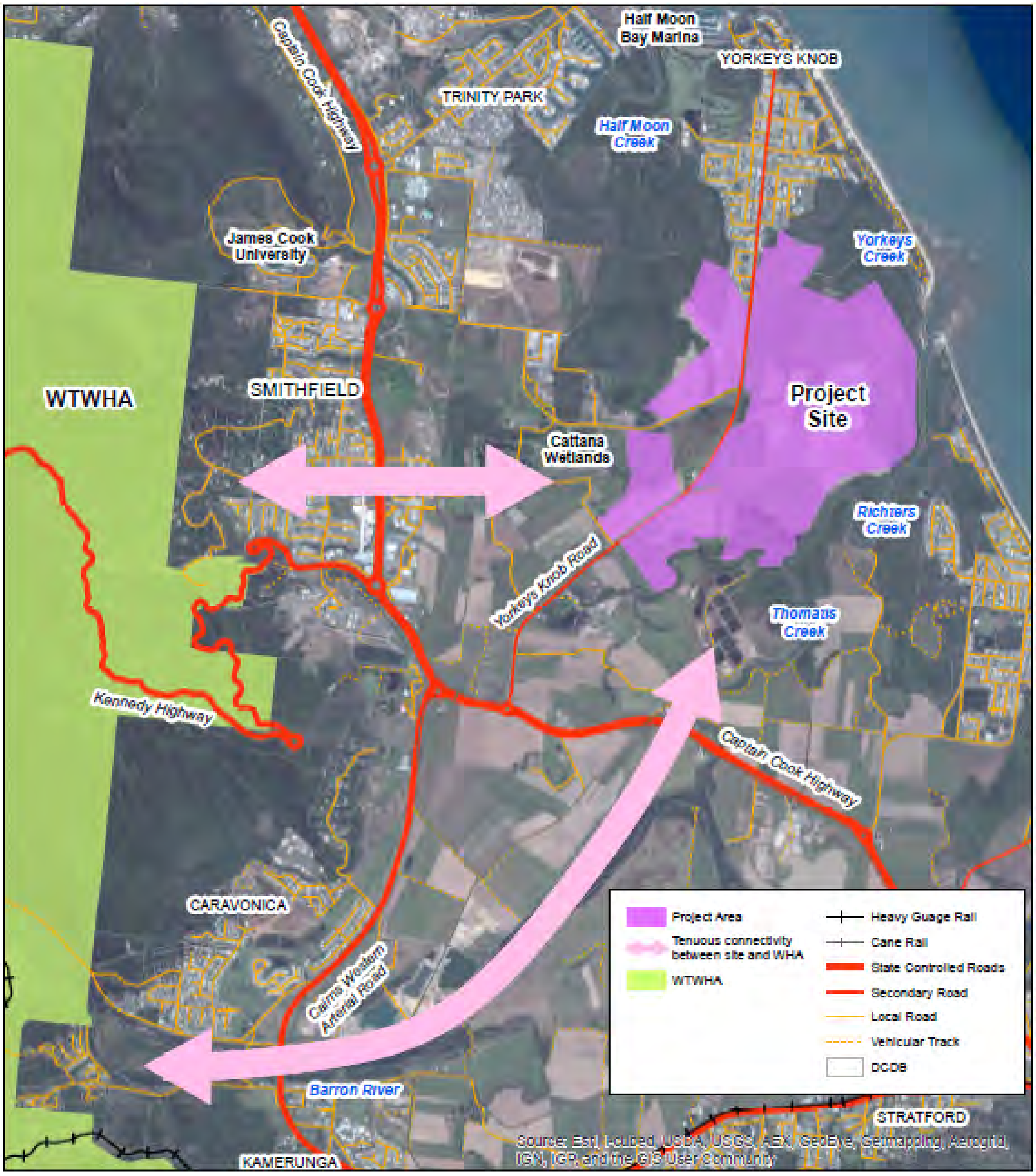


Figure 22-32 Proximity of site to WTWHA.

Arrows represent conceptual connectivity via existing watercourses, predominantly the Richters Creek / Thomatis Creek / Barron River system to the south and to a lesser extent Avondale Creek to the north via Yorkeys Creek / Half Moon Creek and the Cattana Wetlands. See end of text for a larger version of this figure.

b) *OUV and Integrity*

As for the GBRWHA, the Wet Tropics of Queensland property is recognised under the World Heritage Convention as having OUV. The Wet Tropics Management Authority (WTMA) states that in simple terms, OUV means that a place is 'exceptionally important for the whole world' (WTMA 2014). When listed, the WTWHA met the same four natural criteria as the GBRWHA. However, on 9 November 2012 the WTWHA's Indigenous heritage values were included as part of the existing Wet Tropics of Queensland National Heritage Listing. This listing recognises that Rainforest Aboriginal heritage is unique to the Wet Tropics and is a remarkable and continuous Indigenous connection with a tropical rainforest environment.

OUV is the central concept in listing under the World Heritage Convention (Article 11). The operational guidelines (paragraph 49) define outstanding universal value as 'cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole'.

The World Heritage Committee in St Petersburg 2012 adopted the following retrospective statement of outstanding universal value for the Wet Tropics of Queensland. The current criteria numbering system is used.

Brief synthesis

The following is extracted from WTMA (2014).

The Wet Tropics of Queensland, or Wet Tropics, stretches along the northeast coast of Australia for some 450 kilometres. Encompassing some 894 420 hectares of mostly tropical rainforest, this stunningly beautiful area is extremely important for its rich and unique biodiversity. It also presents an unparalleled record of the ecological and evolutionary processes that shaped the flora and fauna of Australia, containing the relicts of the great Gondwanan forest that covered Australia and part of Antarctica 50 to 100 million years ago. All of Australia's unique marsupials and most of its other animals originated in rainforest ecosystems, and their closest surviving relatives occur in the Wet Tropics. These living relicts of the Gondwanan era and their subsequent diversification provide unique insights to the process of evolution in general. They also provide important information for the interpretation of fossils of plants and animals found elsewhere in Australia, and about the evolution of Australia's sclerophyll flora and marsupial fauna in particular.

The property supports tropical rainforests at their latitudinal and climatic limits, and unlike most other seasonal tropical evergreen equatorial forests, is subject to a dry season and to frequent cyclonic events. Many of the distinct features of the Wet Tropics relate to its extremely high but seasonal rainfall, diverse terrain and steep environmental gradients. In addition to its complex array of species and life forms, the Wet Tropics is also recognised as an area possessing outstanding scenic features, natural beauty and magnificent sweeping landscapes.

Criterion (vii):– Natural Beauty and Phenomena

The Wet Tropics exhibit exceptional natural beauty, with superlative scenic features highlighted by extensive sweeping forest vistas, wild rivers, waterfalls, rugged gorges and coastal scenery. This is particularly apparent between the Daintree River and Cedar Bay, where exceptional coastal scenery combines tropical rainforest and white sandy beaches with fringing off-shore coral reefs. The winding channels of the Hinchinbrook Channel contain the most extensive mangroves in the region, providing a rich visual mosaic of rainforest and mangroves, and a terrestrial continuum with the Great Barrier Reef.

Criterion (viii) – Major Stages of the Earth's Evolutionary History

The Wet Tropics contains one of the most complete and diverse living records of the major stages in the evolution of land plants, from the very first pteridophytes more than 200 million years ago to the evolution of seed-producing plants including the cone-bearing cycads and southern conifers (gymnosperms), followed by the flowering plants (angiosperms). As the Wet Tropics is the largest part of the entire Australasian region where rainforests have persisted continuously since Gondwanan times, its living flora, with the highest concentration of primitive, archaic and relict taxa known, is the closest modern-day counterpart for Gondwanan forests. In addition, all of Australia's unique marsupials and most of its other animals originated in rainforest ecosystems, and the Wet Tropics still contains many of their closest surviving members. This makes it one of the most important living records of the history of marsupials as well as of songbirds.

Criterion (ix) – Ecological and Biological Processes

The Wet Tropics provides outstanding examples of significant ongoing ecological processes and biological evolution. As a centre of endemism for the region (second only to New Caledonia in the number of endemic genera per unit area), the Wet Tropics provides fundamental insights into evolutionary patterns both in isolation from and in interaction with other rainforests. Its tall, open forests on the drier western margins of the rainforest are also significant as part of an evolutionary continuum of rainforest and sclerophyll forests. Eucalypts, that now dominate the Australian landscape, are considered to have evolved from such rainforest stock and radiated into drier environments from the margins of closed forests.

The area supports an exceptionally high level of diversity of both flora and fauna, with over 3 000 vascular plant species in 224 families, of which 576 species and 44 genera are endemic, including two endemic plant families. Vertebrate diversity and endemism are also very high, with 107 mammal species including 11 endemic species and two monotypic endemic genera. In terms of avifauna, there are 368 bird species, of which 11 species are endemic. For reptiles, there are 113 species of which 24 species are endemic, including three monotypic endemic genera. The diversity of amphibians includes 51 species of which 22 are endemic.

Criterion (x) – Habitats for conservation of biodiversity

The Wet Tropics holds a largely intact flora and fauna with hundreds of endemic species restricted to the property, of which many are classified as threatened. The majority of plant species have restricted distributions, and many monotypic plant genera and several species of marsupials, frogs and reptiles have very restricted distributions either as isolated or disjunct populations, reflecting the refugial nature of the rainforests found in several locations. The diversity of the plant communities and animal habitats of the Wet Tropics is recognised as being the most floristically and structurally diverse in Australia and is also outstanding on a global scale. Among many emblematic species occurring in the property is the flightless Australian cassowary, one of the largest birds in the world.

In an Australian context, the Wet Tropics covers less than 0.2% of Australia, but contains 30% of the marsupial species, 60% of bat species, 25% of rodent species, 40% of bird species, 30% of frog species, 20% of reptile species, 60% of butterfly species, 65% of fern species, 21% of cycad species, 37% of conifer species, 30% of orchid species and 18% of Australia's vascular plant species. It is therefore of great scientific interest and of fundamental importance to conservation.
Although the Wet Tropics is predominantly wet tropical rainforest, it is fringed and in a few places dissected by sclerophyll forests, woodlands, swamps and mangrove forests, adding to its diversity.

Integrity

At the time of its inscription the property was identified as being an essentially intact ecosystem with the level of human impact low, especially when compared to other tropical forest regions, with 80% of the estimated cover originally present at the time of the first European settlement remaining. A substantial amount of lowland forest, however, had been cleared for agricultural purposes. A number *of human disturbances that cumulatively detracted from the overall natural integrity were scattered throughout the property and included infrastructure such as transmission lines, access roads, abandoned mine sites and more extensive areas which had been selectively logged. However the evaluation also noted that these disturbances accounted for only a small proportion of the total area of the property. In addition other local management issues that needed attention included invasions of exotic plants, animals and forest diseases.*

Since inscription, the Australian and Queensland governments have worked cooperatively to put in place a comprehensive management regime for the property, outlined in the following section. Logging has been prohibited since 1987 with the infrastructure associated with this activity removed and the impacted forests allowed to recover. Maintenance activities associated with the provision of community infrastructure are now regulated under a statutory management plan and guided by environmental codes of practice.

A number of threatening processes still impact on the overall integrity of the property including invasive species, fragmentation, and altered hydrological and fire regimes. In addition, a key emerging threat to the integrity of the property is climate change, as with even a small increase in temperature, large declines in the range size for almost every endemic vertebrate species confined to the property are predicted.

c) Property Level Values

Connectivity and Other Ecological Processes

As the Aquis site is well outside (and downstream of) the WTWHA, its contribution to World Heritage values is tenuous and indirect. The ecological analysis of the site (see **Figure 22-31**) is of some relevance to the Wet Tropics and its values, although this is diminished due to weak connectivity between the Aquis site and the WHA.

Natural habitats within the study area are internally linked through a network of watercourses/channels and associated riparian forests, and within the project area generally there is a level of habitat connectivity at aquatic and terrestrial levels. Externally, the project area is embedded within a landscape matrix of sugar cane, residential development and residual natural habitats, and its ecological relationship to the study area landscape is largely determined by the degree of continuity between and amongst residual natural habitats. This is shown schematically in **Figure 22-32** above.

Riparian vegetation dominated by mangroves is more or less continuous on the site, and in conjunction with woody vegetation in the surrounding landscape, this forms the basis of a loosely integrated local network. Vegetation and mangroves associated with the catchments of Yorkeys Creek, Half Moon Creek, and Richters Creek is of particular connectivity value. These watercourses provide some aquatic and terrestrial connectivity, and link habitats at internal and external levels. The creek-lines generally contain well-developed mangrove forests which support *Myrmecodia beccarii* and other epiphytes, although its connectivity value is somewhat diminished by tidal gates. However, the site's remnant vegetation provides connectivity that has value at the local (catchment) level.

Riparian zones provide a semblance of habitat continuity which also contributes to linking the littoral zone of the Richters Creek and Yorkeys Creek mouths (and the Great Barrier Reef lagoon) to the vine forested foothills and coastal escarpment encompassing the Wet Tropics World Heritage Area. This habitat is not continuous, with intervening cleared areas and man-made barriers such as roads and culverts being significant disruptions to aquatic and terrestrial connectivity. However, riparian zones provide a hierarchical habitat network which supports the movement of native species, particularly birds.

Connectivity may also allow the introduction of exotic flora and fauna from disturbed areas into more intact habitats. The Aquis site has been extensively surveyed to document exotic species presence. Exotic fauna is restricted to ubiquitous species; cane toads, house mice, European sparrows and the Asian house gecko, all of which are abundant across Cairns City. Weed surveys show that the exotic flora present is also ubiquitous, so that improving connectivity is unlikely to have a detrimental effect on the health of the Wet Tropics WHA.

Connectivity may also allow the introduction of exotic flora and fauna from disturbed areas into more intact habitats. The Aquis site has been extensively surveyed to document exotic species presence. Exotic fauna is restricted to ubiquitous species; cane toads, house mice, European sparrows and the Asian house gecko, all of which are abundant across Cairns City. Weed surveys show that the exotic flora present is also ubiquitous, so that improving connectivity is unlikely to have a detrimental effect on the health of the Wet Tropics WHA.

The site's existing connectivity value should be enhanced by the proposal to ecologically restore habitats on the site, including riparian habitats. Such restoration would have the benefit of providing extra habitat in areas of degraded agricultural land, providing habitat in locations and configurations that enhance landscape permeability and connectivity value, and making a contribution to improved water quality. However, such value would always be compromised by ongoing anthropogenic disturbance / barriers, and connectivity values would only be suitable for a subset of locally occurring species. Apart from its contribution to functional connectivity, wetland and riparian vegetation on the site also regulates the quality of water entering adjacent estuarine and marine systems.

This assessment concludes that connectivity between the Aquis site and the WHA is weak although there is no doubt that the restoration works will help reinforce remaining connections.

Habitats and Species

The Aquis project area supports species and habitats that also occur in the nearby Wet Tropics WHA. This includes wide ranging species such as Spectacled flying-foxes that use habitats across a variety of tenures and provide important ecosystem services including pollination and dispersal, which are essential to the long term maintenance of local and regional biodiversity within the Wet Tropics WHA. Vulnerable listed flora (e.g., *Myrmecodia beccarii*) occurring on private tenures such as the Aquis site, provide additional reservoirs of genetic diversity, and contribute to a more secure metapopulation that also crosses tenure boundaries.

The Aquis project area contains remnant vegetation in a landscape mosaic that assists in the maintenance of local biodiversity by encouraging species movements between habitats, including those contained within the Wet Tropics WHA.

However, surveys of mangrove ecosystems between Machans Beach and Trinity Beach indicate that similar habitats, resources, and species assemblages occur throughout this section of the Barron River delta (Biotropica 2014b). In this context the Aquis site does not contain habitats or species that are particularly important to preserving Wet Tropics WHA values.

This assessment concludes that while the Aquis site supports nature conservation outside the Wet Tropics WHA, the development does not contain species or habitats that are unique or significant.

Indigenous Cultural Heritage

The indigenous cultural heritage values of the site are discussed in Section **22.6.1c)** for GBRWHA Criterion (ix). This found that limited examples remain of indigenous use of land and sea resources, although some cultural material (middens and a hearth oven) may remain. These sites (four in number) lie outside the development footprint and there is an opportunity for on-site interpretation and education on indigenous culture based partly on these physical remains via the *Interpretation Strategy* (see **Table 22-50**).

Preparation of a Cultural Heritage Management Plan under the *Aboriginal Cultural Heritage Act 2003* (ACH Act) has commenced.

Presentation Values

There will be many vantage points within the Aquis site from which resort guests will be able to see the forested hillslopes of the MacAllister Range section of the WHA. The fact that one million guests per year will be able to view the WHA provides an exceptional opportunity for presenting the values of the Wet Tropics. In addition, the conservation and restoration initiatives associated with the Conservation and Environmental Management Precinct provide concrete and hands-on examples of protected area management that can be given a World Heritage flavour. These concepts will be developed further in the *Interpretation Strategy* (see **Table 22-50**).

d) Summary of Values

The property-level values are well documented in the SOUV for the WTWHA prepared by WTMA (2014). Analysis shows that some of these values are present on the Aquis Resort site:

- **Remnants of lowland rainforest communities and associated species.** The Aquis Resort project area supports species and habitats that also occur in the nearby WTWHA. This includes wide ranging species such as Spectacled flying-foxes, which use habitats across a variety of tenures and provide important ecosystem services including pollination and dispersal, which are essential to the long term maintenance of local and regional biodiversity within the WTWHA. Vulnerable listed flora (e.g., *Myrmecodia beccarii*), occurring on private tenures such as the Aquis Resort site, provide additional reservoirs of genetic diversity, and contribute to a more secure metapopulation that also crosses tenure boundaries. Further, the Aquis Resort project area contains remnant vegetation in a landscape mosaic that assists in the maintenance of local biodiversity by encouraging species movements between habitats, including those contained within the WTWHA. This assessment concludes that while the Aquis Resort site supports nature conservation outside the WTWHA, it does not contain species or habitats that are unique or significant.

Locally-significant ICH values. Limited examples remain of Indigenous use of land and sea resources, although some cultural material (middens and a hearth oven) may remain. These four sites lie outside the development footprint and there is an opportunity for on-site interpretation and education on Indigenous culture based partly on these physical remains.

- **Presentation values.** There will be many vantage points within the Aquis Resort site from which guests will be able to see the forested hillslopes of the MacAllister Range section of the WHA. The fact that one million guests per year will be able to view the WHA provides an exceptional opportunity for presenting the values of the Wet Tropics. In addition, the conservation and restoration initiatives associated with the conservation and environmental management precinct provide concrete and hands-on examples of protected area management, which can be given a World Heritage flavour.

22.7.2 Potential Impact

The WTWHA is considered to be sufficiently distant and unconnected to the site that it can be expected to be little impacted by the development. However, the following points are relevant:

- A number of threatening processes impact on the overall integrity of the WTWHA, including invasive species, fragmentation, and altered hydrological and fire regimes. Current connectivity between the Aquis Resort site and the WHA is weak and the restoration works will help reinforce remaining connections.
- A potential impact of the development is the direct use of the WTWHA by resort guests as tourists. While the principal attraction of the resort is gambling, Aquis is stressing the natural (‘clean and green’) credentials of the resort, Cairns, and Australia. A detailed assessment has yet to be made of the number of Aquis guests likely to wish to visit the WHA. However, the following points are relevant (see also **Section 22.17.8**):

- It is likely that any Aquis guests will add to already high demand for an off-site rainforest experience. Tourism can also involve a range of impacts and these are managed by the WTMA and the Queensland Parks and Wildlife Service (QPWS) through a comprehensive management system. Aquis-based tourists are most likely to experience the rainforest as commercial passengers, thereby falling under the commercial permit management system.
- While it is inevitable that Aquis will add to tourism demand, Aquis visitors on commercial tours will be subject to the laws and management arrangements in place at the time and will be part of the ultimate carrying capacity deemed suitable. This is not within Aquis' ability to influence. However, Aquis can play a significant role in educating its guests on the wise use of the WTWHA and perhaps reduce direct visitation by interpreting and presenting WTWHA (and GBR) values on-site via theming and through material used in the Interpretation Strategy (see **Table 22-50**).
- Over one million visitors per year will be able to see the WHA from Aquis Resort and this provides an exceptional opportunity for presenting the values of the Wet Tropics. In addition, the conservation and restoration initiatives associated with the conservation and environmental management precinct provide concrete and hands-on examples of protected area management that can be give a World Heritage flavour.

Indigenous cultural heritage values are essentially absent on the site, although there are records of use by Aboriginal people and some remnants of material culture (recorded but not recently discovered). These will not be affected by the development. Aquis Resort will provide a significant opportunity to present the ICH values to resort guests via material in the proposed interpretive centre. Accordingly, there are opportunities for presentation of ICH values and other associated educational aspects.

- The Aquis Resort site and its broader study area currently provide some intact and connected habitats that could be expected to indirectly benefit the WHA. These habitats are consistent with those actually represented within the WHA. While the resort site supports nature conservation outside the WHA, the site does not contain species or habitats that are particularly important to preserving WTWHA values. Proposed restoration works will help reinforce these connections and therefore help reduce fragmentation (a major threatening process).

22.7.3 Proposed Mitigation and Effectiveness

The Concept Land Use Plan includes provision for protecting almost all (99%) of the 53 ha of natural vegetation on the site (with the exception of some small infrastructure crossings) and equally importantly, the inclusion of 57 ha of new habitat and reinforcement of aquatic and terrestrial connectivity. This will strengthen important riparian corridors that ultimately connect the site with the WTWHA (i.e. via Richters Creek / Thomatis Creek and the Barron River). In addition, improved connectivity between the Coral Sea and the Cattana Wetlands will be enhanced due to improvement in the quality and robustness of the Half Moon Creek and Yorkeys Creek corridors.

In terms of presentation values, over one million visitors per year will be able to see the WHA from the Aquis Resort and this provides an exceptional opportunity for presenting the values of the Wet Tropics. In particular:

- The conservation and restoration initiatives associated with the Conservation and Environmental Management Precinct provide concrete and hands-on examples of protected area management that can be give a World Heritage flavour. These concepts will be developed further in the Aquis Resort *Interpretation Strategy*.

ICH values will be interpreted in the Cultural Heritage Centre and appropriate signage will be placed at strategic locations on the proposed walking tracks / viewing platforms. These concepts will be developed further in the Aquis Resort *Interpretation Strategy*. Preparation of a Cultural Heritage Management Plan under the *Aboriginal Cultural Heritage Act 2003* (ACH Act) has commenced.

22.7.4 Significance of Mitigated Impact

The site's existing connectivity value will be enhanced by the proposed restoration works. Such restoration will have the benefit of:

- providing extra habitat in areas of degraded agricultural land
- providing habitat in locations and configurations that enhance landscape permeability and connectivity value
- making a contribution to improved water quality.

Apart from its contribution to functional connectivity, wetland and riparian vegetation on the site also regulates the quality of water entering adjacent estuarine and marine systems.

This assessment concludes that connectivity between the site and the WHA is weak, although there is no doubt that the proposed restoration works will help reinforce remaining connections.

Presentation values (ICH and biodiversity) will be enhanced via the Aquis Resort *Interpretation Strategy*.

22.7.5 Need for Offsets

The assessment concludes that there are no significant residual adverse impacts. Accordingly, no offsets under the EPBC Act Offsets Policy (SEWPaC 2012a) are required.

22.7.6 Consistency with International Obligations

On the basis that there are likely to be no impacts of significance on the WTWHA, the development of the Aquis Resort will not be contrary to Australia discharging its responsibilities under the World Heritage Convention.

22.7.7 Consistency with Plan of Management

On the basis that there are likely to be no impacts of significance on the WTWHA, the development of the Aquis Resort will not be contrary to any plan that has been prepared for the management of declared World Heritage property under section 316 or as described in section 321 of the EPBC Act.

22.8 GREAT BARRIER REEF NATIONAL HERITAGE PLACE

22.8.1 Presence of Matter

The Great Barrier Reef is one of 15 Australian World Heritage places included in the National Heritage List on 21 May 2007 (see **Section 22.1.6f)**). The place has the same boundary as the World Heritage Area. According to GBRMPA (2013a), while there are specific criteria that apply to the listing of national heritage places, the national heritage listing of the world heritage properties was done on the basis of those values identified by the World Heritage Committee.

The national heritage criteria identified as corresponding to those for which the property was world heritage listed are:

- the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history
- the place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history
- the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history

- the place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of:
  - a class of Australia's natural or cultural places or
  - a class of Australia's natural or cultural environments
- the place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.

As was the case for the strategic environmental assessment of the GBR (GBRMPA 2013a), for the purposes of this assessment, the values of the GBR national heritage place are taken to correspond to those of the GBRWHA. As a result, these two matters of national environmental significance are addressed together under the discussion on the GBRWHA.

22.8.2 Potential Impact

As for GBRWHA.

22.8.3 Proposed Mitigation and Effectiveness

As for GBRWHA.

22.8.4 Significance of Mitigated Impact

As for GBRWHA.

22.8.5 Need for Offsets

As for GBRWHA. The assessment concludes that there are no significant residual adverse impacts. Accordingly, no offsets under the EPBC Act Offsets Policy (SEWPaC 2012a) are required.

22.8.6 Consistency with International Obligations

Not Applicable.

22.9 WET TROPICS OF QUEENSLAND NATIONAL HERITAGE PLACE

22.9.1 Presence of Matter

The Wet Tropics of Queensland is also one of 15 Australian World Heritage places included in the National Heritage List on 21 May 2007 (see **Section 22.1.6f)**).

For the purposes of this assessment the Wet Tropics of Queensland national heritage place is dealt with together with the WTWHA.

22.9.2 Potential Impact

As for WTWHA.

22.9.3 Proposed Mitigation and Effectiveness

As for WTWHA.

22.9.4 Significance of Mitigated Impact

As for WTWHA.

22.9.5 Need for Offsets

As for WTWHA.

22.9.6 Consistency with National Heritage Principles

On the basis that there are likely to be no impacts of significance on the WTWHA, the development of the Aquis Resort will not be contrary to:

a. the National Heritage management principles

b. an agreement to which the Commonwealth is party in relation to a National Heritage place

c. a plan that has been prepared for the management of a National Heritage place under section 324S or as described in section 324X of the EPBC Act.

22.10 WET TROPICS WORLD HERITAGE AREA (INDIGENOUS VALUES) NATIONAL HERITAGE PLACE

22.10.1 Presence of Matter

> On 9 November 2012 the Wet Tropics World Heritage Area's Indigenous heritage values were included as part of the existing Wet Tropics of Queensland National Heritage listing. The listing *recognises* that rainforest Aboriginal heritage is unique to the Wet Tropics and is a remarkable and continuous Indigenous connection with a tropical rainforest environment. To quote the Australian Government website (DoTE 2014a):
>
> *The Aboriginal Rainforest People of the Wet Tropics of Queensland have lived continuously in the rainforest environment for at least 5,000 years and this is the only place in Australia where Aboriginal people have permanently inhabited a tropical rainforest environment.*
>
> The Aboriginal Rainforest People developed a distinctive cultural heritage determined by their *dreamtime* and creation stories and their traditional food gathering, processing and land management techniques. Reliance on their traditions helped them survive in this at times inhospitable environment. The distinctiveness of the traditions and technical innovation and expertise needed to process and prepare toxic plants as food and their uses of fire is of outstanding heritage value to the nation and are now protected for future generations under national environmental law.

This amendment added a fifth national heritage criterion to the listing, namely:

> … the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.

As described in **Section 22.7**, the WTWHA is remote from the site and will not be affected by the development. This applies equally to Indigenous values. However, the site contains some locally-significant Indigenous cultural heritage values and these are discussed in **Section 22.6.1c) and Chapter 21** (Cultural Heritage).

22.10.2 Potential Impact

As for WTWHA.

22.10.3 Proposed Mitigation and Effectiveness

As for WTWHA.

22.10.4 Significance of Mitigated Impact

As for WTWHA.

22.10.5 Need for Offsets

As for WTWHA.

22.10.6 Consistency with International Obligations

On the basis that there are likely to be no impacts of significance on the WTWHA, the development of the Aquis Resort will not be contrary to and international obligations.

22.11 LISTED THREATENED SPECIES – FLORA

22.11.1 Presence of Matter

The protected matters report (**Appendix I**) lists 16 listed threatened flora species that could occur in the search area. Based on knowledge of the project site, and the preferred habitat of listed species, an assessment was made of their likely presence on-site as shown in **Table 22-29** below. This assessment was informed by a targeted search of the site for all listed species (see **Section 22.1.7**) in accordance with **Table 22-7**.

TABLE 22-29 LISTED THREATENED FLORA

SCIENTIFIC NAME	**COMMON NAME**	**STATUS**	**GROWTH FORM**	**SITE OCCURRENCE**
Archontophoenix myolensis	Myola palm	E	Palm	Unlikely
Cajanus mareebensis	-	E	Shrub to small tree	Unlikely
Canarium acutifolium var. acutifolium	-	V	Tree	Unlikely
Diplazium cordifolium	-	V	Fern	Unlikely
Diplazium pallidum	-	E	Fern	Unlikely
Durabaculum mirbelianum (syn Dendrobium mirbelianum)	Dark-stemmed antler orchid	E	Epiphytic or lithophytic orchid	**Likely to occur**
Myrmecodia beccarii	Ant plant	V	Epiphyte	**Confirmed**
Phaius australis	Lesser swamp-orchid	E	Orchid	Unlikely
Phalaenopsis rosenstromii (syn Phalaenopsis amabilis var. rosenstromii)	Native moth orchid	E	Orchid	Unlikely
Phlegmariurus filiformis (syn Huperzia filiformis)	Rat's tail tassel-fern	E	Fern/ Epiphyte	Unlikely
Phlegmariurus tetrastichoides (Huperzia tetrastichoides)	Square tassel fern	V	Fern/ Epiphyte	Unlikely
Polyscias bellendenkerensis	-	V	Shrub to small tree	Unlikely
Sauropus macranthus	Atherton sauropus	V	Shrub	Unlikely
Streblus pendulinus	Siah's backbone Prickly fig	E	Small tree/shrub	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS	GROWTH FORM	SITE OCCURRENCE
Vappodes phalaenopsis (syn Dendrobium bigibbum)	Cooktown orchid	V	Orchid	Unlikely
Zeuxine polygonoides	Velvet jewel orchid	V	Orchid	Unlikely

Legend:

E endangered

V vulnerable

With respect to 'further assessment' as listed in the above table, this report is based on detailed fieldwork undertaken by the Aquis study team (see **Appendix G**) in the dry season (July and October 2013) and wet season (February 2014) as well as a range of other studies undertaken by this team and others in the area.

The assessment concludes that there are 16 listed flora species in the protected matters search, of which:

- one species (*Myrmecodia beccarii* (Vulnerable (V))) was confirmed on the site
- one species (*Durabaculum mirbelianum* (Endangered (E))) is considered likely to or may possibly occur
- the remainder (14 species) are unlikely to occur, based on knowledge of the habitats present and a targeted search.

a) Confirmed Listed Species

Only one listed species (*Myrmecodia beccarii* (V)) was located on the Aquis site. Commonly known as the Ant plant because of its mutualistic relationship with ants, this epiphytic species is found throughout the Cairns City area where there are mangrove and/or Melaleuca-dominated habitats. The plant can be seen in range of age and size classes across the project area within these plant communities. It is readily seen using *Ceriops australis* and *Xylocarpus moluccensis* as hosts within mangroves, similarly on mature *Melaleuca leucadendra* and *M. quinquenervia* in wetland ecosystems. The epiphyte is also occasionally seen in the small patches of residual woodlands, hosted on *Corymbia intermedia* and *Acacia crassicarpa*. Because of its reliance on canopy level vegetation, *Myrmecodia beccarii* was not found outside well-developed forest habitats.

Photo 22-12 Ant Plant (*Myrmecodia beccarii*).

Photo 22-13 Ant Plant (*Myrmecodia beccarii*) – close-up.

b) *Listed Species with Potential to Occur On-site*

Targeted searches were conducted for the two listed orchids *Durabaculum mirbelianum* (E) and *D. nindii* (E), which were both considered to be potentially present on-site. Both species are known to occur within mangroves, coastal swamps and associated habitats. Mangrove habitats on the Aquis site provide suitable habitat for both these species. These habitats were extensively sampled during the recent surveys, and while other epiphytes and mistletoe have been recorded during various surveys, neither *D. mirbelianum* nor *D. nindii* were seen.

In addition, *Eleocharis retroflexa* (V), although not included in the protected matters search, was also considered to be potentially present. This species is known from seasonally inundated habitats around the Cairns area (Environment North 1998). The species is not known from saline habitats, but sections of Yorkeys Creek, some internal cane drains, and the aquaculture ponds do provide some suitable niches. However, targeted surveys in these areas failed to locate any individuals of *E. retroflexa*.

c) *Summary*

Based on the protected matters search, knowledge of the habitats present, and detailed, targeted fieldwork, only one listed threatened species (*Myrmecodia beccarii*) was located. This epiphytic species is found throughout the Cairns City area where there are mangrove and/or Melaleuca-dominated habitats.

While other EPBC-listed species may occur within the mangrove systems on and adjacent to the site, extra sampling directed towards mangroves failed to detect these additional (orchid) species. Detectability is relatively straightforward in this instance, so the chance of having missed species is remote. On the basis of the Ant plant population present and its habitat, the site exhibits some value, but this cannot be described as outstanding or of universal importance.

22.11.2 Potential Impact

Referring to **Table 22-12**, for this matter of NES the construction and operation of Aquis is likely to have:

- potential major regional to reef-wide beneficial operation impacts on the following impact categories (probably only locally significant):
  - modifying supporting terrestrial habitats
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off.

Under the guidelines for matters of NES, the regulator requires:

… an assessment of the relevant impacts to the listed threatened species and ecological communities and any others that are found to be or may potentially be present in areas that may be impacted by the project. Identify which component of the project is of relevance to each listed threatened species or ecological community or if the threat of impact relates to consequential actions, resulting from:

- *a decrease in the size of a population or a long-term adverse effect on an ecological community,*
- *reduction in the area of occupancy of the species or extent of occurrence of the ecological community,*
- *fragmentation of an existing population or ecological community,*
- *disturbance or destruction of habitat critical to the survival of the species or ecological community,*

- *disruption of the breeding cycle of a population,*
- *modification, destruction, removal, isolation or reduction of the availability or quality of habitat to the extent that the species is likely to decline,*
- *modification or destruction of abiotic (non-living) factors (such as water, nutrients or soil) necessary for the ecological community's survival,*
- *the introduction of invasive species that are harmful to the species or ecological community becoming established,*
- *interference with the recovery of the species or ecological community, and*
- *action that may be inconsistent with a recovery plan.*

In relation to *M. beccarii*, the following analysis is relevant.

- There will be no decrease in the size of a population or a long-term adverse effect on an ecological community given that all individuals and their habitat will be protected. All plants occur within well-developed habitats that are planned for retention.
- There will be no reduction in the area of occupancy of the species given that habitat will be protected, and expanded in the longer term. An additional 29.8 ha (plus 11.4 ha outside the project boundary) of mangrove ecosystem is proposed for restoration. The total *M. beccarii* population on-site has not been quantified but based on mangrove surveys on the site, the density is estimated at around 30 plants/ha, suggesting that an additional 40 ha of mature restored mangroves could support a large number of additional *M. beccarii*.
- Fragmentation of the existing population will not occur as habitat will be protected and existing levels of connectivity potentially enhanced through restoration. Because continuity of habitat will not be affected, existing populations should not become ecologically isolated. Moreover, attendant ants and pollinating butterflies should be similarly free of fragmentation impacts.
- No disturbance or destruction of habitat critical to the survival of the species is proposed. The mangrove and Melaleuca communities in which *M. beccarii* occurs are outside the proposed construction zone. The species occurs in similar habitats in the local area and greater Cairns City environs.
- No disruption of the breeding cycle of a population would occur and in the longer term increased habitat and enhanced connectivity may lead to population increases. As noted, there should be minimal/no disturbance to mutualistic species that are important to the long term persistence of *M. beccarii*.
- There will be no modification, destruction, removal, isolation or reduction of the availability or quality of habitat to the extent that the species is likely to decline and net habitat area is proposed to increase. The project is unlikely to exacerbate edge effects or generate other biotic/abiotic effects that may impact habitat quality or integrity.
- Modification or destruction of abiotic (non-living) factors (such as water, nutrients or soil) necessary for the ecological community's survival (Not Applicable).
- The introduction of invasive species that are harmful to the species or ecological community becoming established (Not Applicable).
- Interference with the recovery of the species or ecological community (Not Applicable).
- *Action that may be inconsistent with a recovery plan (Not Applicable – there is no recovery plan or threat abatement plan for M. beccarii).*
- The project should not adversely impact on the population of *M. beccarii* on-site and is consistent with the Conservation Advice.

Generally, the most significant impact on this species is an ongoing loss of habitat, with edge effects, loss of mutualistic relationships, and illegal collecting likely to be key secondary impacts. These threats are not impacts that are now present on the site, and the development is unlikely to give rise to such impacts.

The species and its habitat will be protected, with no clearing of its habitat as a result of the development. Additional habitat will become available as Melaleuca wetlands are restored during the habitat restoration process. The existing population will not be fragmented, and genetic exchange within the local population may be enhanced by facilitating improved habitat connectivity through riparian restoration.

22.11.3 Proposed Mitigation and Effectiveness

The species and its habitat will be protected, with no clearing of habitat as a result of the development. Additional habitat will become available as Melaleuca wetlands are restored during the habitat restoration process. The existing population will not be fragmented, and genetic exchange within the local population may be improved by facilitating improved habitat connectivity through riparian restoration.

22.11.4 Significance of Mitigated Impact

No residual adverse impact is anticipated, given that no direct impact is likely and project environmental mitigation measures will preserve and enhance native habitats.

22.11.5 Need for Offsets

The assessment concludes that there are no significant residual adverse impacts. Accordingly, no offsets under the EPBC Act Offsets Policy (SEWPaC 2012a) are required.

22.11.6 Consistency with International Obligations

Not applicable.

22.11.7 Consistency with Recovery or Threat Abatement Plans

a) Recovery Plan

Not applicable – there is no recovery plan or threat abatement plan for *M. beccarii*.

b) Threat Abatement Plan

Approved Conservation Advice for *M. beccarii* was published in December 2008 (Threatened Species Scientific Committee 2008). The main threats identified within the Conservation Advice are the clearing of lowland paperbark woodlands; localised settlement pressures, and the removal or destruction of plants by plant and butterfly collectors.

The project does not adversely impact on the population of *M. beccarii* on-site and is consistent with the Conservation Advice.

22.12 LISTED THREATENED SPECIES – FAUNA

22.12.1 Presence of Matter

The protected matters report (**Appendix I**) records those listed threatened fauna (other than migratory) that could occur in the search area. Based on knowledge of the project site, and the preferred habitat of listed species, an assessment was made of their likely presence on-site as shown in **Table 22-30** below. This assessment was informed by a targeted search of the site for all listed species (see **Section 22.1.7**) in accordance with **Table 22-7**.

With respect to ‘further assessment’ listed in **Table 22-7** above, this report is based on detailed fieldwork undertaken by the Aquis Resort study team (see **Appendix F** and **Appendix G**), in the dry season (July and October 2013) and wet season (February and March 2014) as well as a range of other studies undertaken by this team and others in the area.

TABLE 22-30 LISTED TERRESTRIAL FAUNA (OTHER THAN MIGRATORY)

SCIENTIFIC NAME	COMMON NAME	STATUS	GROWTH FORM	SITE OCCURRENCE
Casuarius casuarius johnsonii (southern population)	Southern cassowary (southern population)	E	Bird	Unlikely
Dasyurus hallucatus	Northern quoll	E	Mammal	**Likely to occur**
Dasyurus maculatus gracilis	Spotted-tailed quoll	E	Mammal	Unlikely
Erythrotriorchis radiatus	Red goshawk	V	Bird	**May overfly site**
Fregetta grallaria grallaria	White-bellied Storm-Petrel (Australasian)	V	Bird	Unlikely
Hipposideros semoni	Semon’s leaf-nosed bat	E	Mammal	Unlikely
Litoria myola	Kuranda tree frog	E	Frog	Unlikely
Litoria nannotis	Waterfall frog	E	Amphibian	Unlikely
Litoria nyakalensis	Mountain mistfrog	CE	Amphibian	Unlikely
Litoria rheocola	Common mistfrog	E	Amphibian	Unlikely
Melanotaenia eachamensis	Lake Eacham rainbowfish	E	Fish	Unlikely
Nyctimystes dayi	Australian lacelid	E	Amphibian	Unlikely
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)	Koala	V	Mammal	Unlikely
Pteropus conspicillatus	Spectacled flying-fox	V	Mammal	**Confirmed**
Rhinolophus philippinensis (large form)	Greater large-eared horseshoe bat	E	Mammal	Unlikely
Rostratula australis	Australian painted snipe	E	Bird	Unlikely
Saccolaimus saccolaimus nudicluniatus	Bare-rumped sheathtail bat	CE	Mammal	**Likely to occur**
Sternula nereis nereis	Australian Fairy Tern	V	Bird	Unlikely
Tyto novaehollandiae kimberli	Masked owl (northern subspecies)	V	Bird	Unlikely
Xeromys myoides	Water mouse	V	Mammal	Unlikely

Legend:

E endangered

V vulnerable
CE critically endangered

The above shows there were 20 listed species in the protected matters search, of which:

- one species (*Pteropus conspicillatus* (V)) was confirmed on the site
- one species (*Erythrotriorchis radiatus* (V)) may overfly the site
- two species (*Dasyurus hallucatus* (E) and *Saccolaimus saccolaimus nudicluniatus* (CE)) are likely to occur
- the remainder (16 species) are unlikely to occur, based on knowledge of the habitats present and a targeted search.

a) Confirmed Listed Species

Individuals and small groups of *Pteropus conspicillatus* (Spectacled flying-fox) were seen and heard during nocturnal surveys. This species occurs between Ingham and Cooktown, and between the McIlwraith and Iron Ranges of Cape York Peninsula. In the greater Cairns region there are known roosting colonies in Yorkeys Knob, Cairns City, Cairns Central Swamp, Anderson Park, Edmonton and Gordonvale (Freeman 2003). This species is associated primarily with rainforest and sometimes with mangroves, and large roosts are always found within 6 km of rainforests. There are no camps of *P. conspicillatus* within the Aquis site, however all the natural habitats in the area provide suitable foraging and temporary resources for this species.

b) Listed Species with Potential to Occur On-site

- *Dasyurus hallucatus* (Northern quoll) (E) is the smallest of the quoll species and the most arboreal. Although found in a variety of habitats, it is most common in rocky eucalypt woodland and open forest within 200 km of the coast. They are opportunistic omnivores feeding on invertebrates, small birds and mammals, frogs, reptiles, fruits and nectar. Northern quolls will den in tree hollows, termite mounds, fallen logs and rock crevices and will use a number of dens across their territory (Oakwood 2002). Suitable habitat on the site for this species is very limited in extent but potential prey is abundant. Nonetheless, the species has been recorded in and around the Cairns area in recent years (Wildlife Protection Society of Queensland (WPSQ) 2012) and therefore, has potential to occur in the area.
- *Erythrotriorchis radiatus* (Red goshawk) (V) occurs in woodlands and forests of tropical and warm temperate Australia. It prefers mosaic habitats that hold a large population of birds and permanent water. Riparian areas are heavily favoured and nests are restricted to trees taller than 20 metres and within one kilometre of a watercourse or wetland (Garnett and Crowley 2000). The species may occur and forage in the area, although there is no nesting habitat on the project site.
- *Saccolaimus saccolaimus nudicluniatus* (Bare-rumped sheathtail bat) (CE) is a large microbat that occurs in coastal tropical woodland/open forest from Bowen north to the Lockhart River area as well as the Top End in the Northern Territory, but is a rarely recorded species in Australia. It is known to roost in large tree hollows in a variety of *Eucalyptus* species (Dennis 2012). There is habitat on the project site including some large trees which may contain suitable roost hollows. A roost site was recently known to occur relatively nearby at Centenary Lakes in Cairns (pers. comm. T. Reis). The subspecies has potential to occur on the project site. Anabat recordings confirmed a species of *Saccolaimus* on-site however the call could only be identified to genus level so it remains conjectural as to whether *Saccolaimus saccolaimus nudicluniatus* is present on the site.

c) *Summary*

Based on the protected matters search, knowledge of the habitats present, and detailed, targeted fieldwork:

- one species (*Pteropus conspicillatus* (V)) was confirmed on the site
- one species (*Erythrotriorchis radiatus* (V)) may overfly the site
- two species (*Dasyurus hallucatus* (E) and *Saccolaimus saccolaimus nudicluniatus* (CE)) are likely to occur.

No camps of *P. conspicillatus* were found within the Aquis site, although all the natural habitats in the area provide suitable foraging and temporary resources for this species. The preferred habitats for some of the other species are present on the site and at many other locations nearby. The Aquis site is not considered critical for the survival of any of the confirmed or likely species.

Two Estuarine crocodiles have been recorded inhabiting the man-made aquaculture ponds on the southern margin of the site abutting Richters Creek. This is also a highly mobile species which is known from a variety of similar habitats in the Cairns area.

22.12.2 Potential Impact

Referring to **Table 22-12**, for this matter of NES the construction and operation of Aquis is likely to have:

- potential minor adverse construction impacts of local significance on the following impact categories:
  - light
- potential minor adverse operation impacts of local significance on the following impact categories:
  - light
- potential major regional to reef-wide beneficial operation impacts on the following impact categories (probably only locally significant):
  - modifying supporting terrestrial habitats.

In relation to *P. conspicillatus*, the following analysis is relevant to the MNES guidelines.

- There will be no habitat loss associated with the project that may lead to a decrease in the size of a population, given that all habitats will be protected. All habitat utilised by this species is marked for retention.
- There will be no reduction in the area of occupancy of the species, given that habitat will be protected and expanded in the longer term. In excess of 55 ha of degraded agricultural lands is proposed for some form of ecological restoration, and all local biota are likely to benefit from the provision of extra habitat.
- Fragmentation of the existing population will not occur, given that habitat will be protected and existing levels of connectivity enhanced. The species mobility would not be expected to decline as a direct result of the proposed development.
- No disturbance or destruction of habitat critical to the survival of the species is proposed. The species occurs in similar habitats in the local area and greater Cairns City, with a number of camps known between Yorkeys Knob and Gordonvale.
- No disruption of the breeding cycle of the population is envisaged and, in the longer term, increased habitat and enhanced connectivity may lead to population increases. The development will not impinge on any existing camp.

- There will be no modification, destruction, removal, isolation or reduction of the availability or quality of habitat, to the extent that the species is likely to decline and net habitat area is proposed to increase. The project is unlikely to impact on habitat quality or integrity.
- Modification or destruction of abiotic (non-living) factors (such as water, nutrients or soil) necessary for the ecological community's survival (not applicable).
- The introduction of invasive species that are harmful to the species or ecological community becoming established (not applicable).
- Interference with the recovery of the species or ecological community (not applicable).

In relation to the three potential species:

- *Dasyurus hallucatus* (Northern quoll): as woodland habitats are protected and not degraded, the project is likely to be neutral in terms of its effects on this species.
- *Erythrotriorchis radiatus* (Red goshawk): the project is likely to be neutral in terms of its effects on this species.
- *Saccolaimus saccolaimus nudicluniatus* (Bare-rumped sheathtail bat) (CE): as habitat suitable for this species will not be cleared, the project would not be expected to adversely affect this species.

Although listed above as a potential construction and operation phase impact, light emissions are not expected to adversely affect these species.

22.12.3 Proposed Mitigation and Effectiveness

In relation to the confirmed and potential species, none should be affected as no clearing is proposed in the Environment Conservation and Management Precinct where habitat exists. Additional habitat for some species will become available through the habitat restoration process, and the all species should derive benefit from improved habitat connectivity through the riparian restoration process.

Minor construction impacts will be effectively managed via the EMP (Construction).

22.12.4 Significance of Mitigated Impact

No residual impact is anticipated, given that no direct impact is likely and project environmental mitigation measures aim to preserve and enhance native habitats.

Minor construction impacts will be effectively managed via the EMP (Construction).

22.12.5 Need for Offsets

The assessment concludes that there are no significant residual adverse impacts. Accordingly, no offsets under the EPBC Act Offsets Policy (SEWPaC 2012a) are required.

22.12.6 Consistency with International Obligations

Action that may be inconsistent with Australia's obligations under the Biodiversity Convention, the Apia Convention or CITES: the Spectacled flying fox is listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The project does not involve trade of fauna species and is not inconsistent with the CITES convention.

The project will not significantly impact on the population of *P. conspicillatus* and is not inconsistent with the Biodiversity Convention or Apia Convention.

22.12.7 Consistency with Recovery or Threat Abatement Plans

A Recovery Plan for *P. conspicillatus* was prepared by the State of Queensland (DERM 2010c).

Known threats to the spectacled flying fox include loss of habitat, conflict with humans and/or man-made obstacles, entanglement in nets, illegal shooting, electrocution on powerlines, entanglement in barbed wire fencing and backyard drape netting, tick paralysis, genetic disorders (e.g. cleft palate syndrome), agricultural pesticide residue poisoning and vehicle-related mortality (DERM 2010c) None of these threats are significantly relevant in this instance. The species is a common sight around Cairns City and the development is likely to be neutral with respect to the listed threats. The overall recovery objectives are to secure the long-term protection of the species through a reduction in the impact of threats to species' survival and to improve the standard of information available to guide recovery. Specifically the recovery objectives include:

- research practical and cost effective flying fox deterrent systems for commercial fruit growers
- identify and protect native foraging habitat critical to the survival of the spectacled flying fox
- accurately assess the short-term and long-term population size and population trends of the spectacled flying fox
- improve the public perception of the spectacled flying-fox and the standard of information available to guide recovery
- increase knowledge of *P. conspicillatus* roosting requirements and protect important camps
- improve understanding of incidence of tick paralysis and actions to minimise paralysis mortality in flying foxes
- implement strategies to reduce incidence of electrocution and entanglement of *P. conspicillatus*
- investigate the causes of birth abnormalities such as cleft palate syndrome.

The project is not inconsistent with these recovery objectives. It should be noted that flying foxes represent an aircraft strike hazard and bat-strike management rules apply to the Aquis Resort site under CairnsPlan. These all discourage the use of the site by this species and a range of birds.

22.13 LISTED THREATENED COMMUNITIES

22.13.1 Presence of Matter

The protected matters report (**Appendix I**) addresses those listed migratory species covered by the following:

- Broad Leaf Tea Tree Woodland (E)
- Littoral Rainforest (CE).

Neither of the listed communities was found to be present on the site, despite a targeted search. Available mapping (refer **Figure 22-33**) shows the location of these communities as follows:

- the closest example of 'Broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Qld community' is 5.8 km north-west of the site
- the closest example of 'Littoral rainforest and coastal vine thickets community' occurs approximately 1.1 km south-west (cross country) of the site.

Figure 22-33 Location of listed threatened ecological communities.

A = Broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Qld; B = Littoral rainforest and coastal vine thickets of eastern Australia. See also **Figure 22-2**.

No listed threatened communities are present or near the site.

22.13.2 Potential Impact

It is not considered likely that the Aquis Resort will have any impact on these communities.

22.13.3 Proposed Mitigation and Effectiveness

Not applicable.

22.13.4 Significance of Mitigated Impact

Not applicable.

22.13.5 Need for Offsets

Not applicable.

22.13.6 Consistency with International Obligations

Not applicable.

22.14 LISTED MIGRATORY SPECIES (EXCLUDING AQUATIC SPECIES)

22.14.1 Presence of Matter

a) Database Search

The protected matters report (**Appendix I**) records those listed migratory species covered by the following:

- All species listed in the appendices to the *Convention on the Conservation of Migratory Species of Wild Animals (1979) (the 'Bonn Convention')* for which Australia is a 'Range State' under the Convention.
- All species included on the lists established under the Japan-Australia Migratory Bird Agreement (1974) ('JAMBA') and the China-Australia Migratory Bird Agreement (1986) ('CAMBA').
- All native species identified in a list established under an international agreement that has been approved by the Minister (The Minister can only approve an international agreement for these purposes if he/she is satisfied the agreement is relevant to the conservation of migratory species).

Based on knowledge of the project site, and the preferred habitat of listed species, an assessment was made of their likely presence on or near the site as shown in **Table 22-31** below. This assessment was informed by a targeted search of the site for all listed species (see **Section 22.1.7**) in accordance with **Table 22-7**.

TABLE 22-31 LISTED MIGRATORY FAUNA

SCIENTIFIC NAME	COMMON NAME	STATUS	GROWTH FORM	**SITE OCCURRENCE**
Actitis hypoleucos	Common sandpiper	MWS	Wetland bird	**Likely to occur**
Apus pacificus	Fork-tailed swift	MMB	Aerial bird	**Confirmed**
Ardea alba	Great egret / White egret	MWS	Wetland bird	**Likely to occur**
Ardea ibis	Cattle egret	MWS	Wetland bird	**Confirmed**
Arenaria interpres	Ruddy Turnstone	MWS	Wetland bird	Unlikely
Calidris acuminata	Sharp-tailed sandpiper	MWS	Wetland bird	**Confirmed**
Calidris alba	Sanderling	MWS	Wetland bird	**May overfly site**
Calidris canutus	Red knot / Knot	MWS	Wetland bird	**Likely to occur**
Calidris ferruginea	Curlew sandpiper	MWS	Wetland bird	**Likely to occur**
Calidris ruficollis	Red-necked stint	MWS	Wetland bird	**Confirmed**
Calidris tenuirostris	Great knot	MWS	Wetland bird	**Likely to occur**

SCIENTIFIC NAME	COMMON NAME	STATUS	GROWTH FORM	**SITE OCCURRENCE**
Charadrius bicinctus	Double-banded plover	MWS	Wetland bird	Unlikely
Charadrius leschenaultii	Greater sand plover / Large sand plover	MWS	Wetland bird	**Likely to occur**
Charadrius mongolus	Lesser sand plover / Mongolian plover	MWS	Wetland bird	**Likely to occur**
Charadrius veredus	Oriental dotterel	MWS	Wetland bird	**Likely to occur**
Crocodylus porosus	Estuarine crocodile	MMS	Marine reptile	**Confirmed**
Gallinago hardwickii	Latham's snipe / Japanese snipe	MWS	Wetland bird	**Likely to occur**
Haliaeetus leucogaster	White-bellied sea-eagle	MTS	Terrestrial bird	**Confirmed**
Heteroscelus brevipes	Grey-tailed tattler	MWS	Migratory wader	**May overfly site**
Hirundapus caudacutus	White-throated needle tail	MTS	Aerial bird	**Confirmed**
Hirundo rustica	Barn swallow	MTS	Terrestrial bird	**May overfly site**
Limicola falcinellus	Broad-billed sandpiper	MWS	Wetland bird	Unlikely
Limosa lapponica	Bar-tailed godwit	MWS	Wetland bird	**Likely to occur**
Limosa limosa	Black-tailed godwit	MWS	Wetland bird	**Likely to occur**
Merops ornatus	Rainbow bee-eater	MTS	Terrestrial bird	**Confirmed**
Monarcha melanopsis	Black-faced monarch	MTS	Terrestrial bird	**Confirmed**
Monarcha trivirgatus	Spectacled monarch	MTS	Terrestrial bird	**Confirmed**
Myiagra cyanoleuca	Satin flycatcher	MTS	Terrestrial bird	**Confirmed**
Numenius madagascariensis	Eastern Curlew	MWS	Wetland Bird	**Confirmed**
Numenius minutus	Little curlew / Little whimbrel	MWS	Wetland bird	**Likely to occur**
Numenius phaeopus	Whimbrel	MWS	Wetland bird	**Confirmed**
Pluvialis fulva	Pacific golden plover	MWS	Wetland bird	**Likely to occur**
Pluvialis squatarola	Grey plover	MWS	Wetland bird	**May overfly site**
Rhipidura rufifrons	Rufous fantail	MTS	Terrestrial bird	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS	GROWTH FORM	**SITE OCCURRENCE**
Rostratula australis (syn. *Rostratula benghalensis (sensu lato))*	Painted Snipe	E, MWS	Wetland bird	Unlikely
Sterna albifrons sinensis	Little Tern	MMB	Marine bird	**Likely to occur**
Tringa stagnatilis	Marsh sandpiper / Little greenshank	MWS	Wetland bird	**Likely to occur**
Xenus cinereus	Terek sandpiper	MWS	Wetland bird	**Likely to occur**

Legend:

MMB – Migratory Marine Birds

MMS – Migratory Marine Species

MTS – Migratory Terrestrial Species

MWS – Migratory Wetlands Species

E – Endangered

V – Vulnerable

S – Special Least Concern (*Nature Conservation (Protected Areas Management) Regulation 2006)*

The above table shows there were 38 relevant listed species, of which:

- 13 species were confirmed on the site
- 16 species are likely to occur
- 4 species may overfly the site
- the remainder (5 species) are unlikely to occur, based on knowledge of the habitats present and a targeted search.

b) Contribution to GBR Values

Species

The following is based on an extract of Table 4.8 of GBRMPA (2013a) dealing with listed terrestrial migratory species. As for **Table 22-28**, the following and deals with:

- the key values and attributes (Table 4.8 column 1)
- GBRMPA assessment of presence for the value at the GBR level (Table 4.8 columns 11, 16, 17, and 18) – included as columns 2, 4, 6, 8, and 10 and shaded and marked 'G' = GBR
- study team assessment of presence for the value at the Aquis site level (columns 3, 5, 7, and 9 below) – unshaded and marked 'S' = Site
- integrity (column 6 of Table 4.8) has been included in this table (columns 10 and 11) as this is relevant to the viability of habitats of listed species.

This table therefore provides a checklist of those Matters of NES (listed migratory and threatened terrestrial species) that are present at or in the immediate vicinity of the site (or are likely to be influenced in some way by the proposed development).

TABLE 22-32 KEY MATTERS OF NES (SPECIES) VALUES AND ATTRIBUTES AT GBR AND SITE LEVEL

Key values and attributes	Estuarine crocodiles		Seabirds		Shorebirds		Wetlands of international importance		Integrity	
	G	S	G	S	G	S	G	S	G	S
Biodiversity – GBR habitats										
Islands	•		•		•		•		•	
Beaches and coastlines	•	•	•		•	•	•	•	•	•
Mangrove forests	•	•	•	•	•	•	•	•	•	•
Seagrass meadows							•		•	
Coral reefs (<30 m)							•		•	
Deeper reefs (>30 m)									•	
Lagoon floor									•	
Shoals			•		•				•	
Halimeda banks									•	
Continental slope									•	
Open waters	•	•	•	•	•	•	•	•	•	•
Biodiversity – terrestrial habitats that support the GBR										
Saltmarshes	•	•	•	•	•	•	•			
Freshwater wetlands	•	•	•	•	•	•	•			
Forested floodplain							•	•		
Heath and shrublands										
Grass and sedgelands					•		•			
Woodlands							•	•		
Forests							•	•		
Rainforests										
Connecting waterbodies	•	•	•	•	•	•	•	•	•	•
Biodiversity – species										
Mangroves							•	•	•	•
Seagrasses							•		•	
Macroalgae									•	
Benthic microalgae									•	
Corals									•	

Key values and attributes	**Estuarine crocodiles**		**Seabirds**		**Shorebirds**		**Wetlands of international importance**		**Integrity**	
	G	**S**	**G**	**S**	**G**	**S**	**G**	**S**	**G**	**S**
Other invertebrates			•	•	•	•	•	•	•	•
Plankton and microbes									•	
Bony fish			•	•	•	•	•	•	•	•
Sharks and rays									•	•
Sea snakes									•	•
Marine turtles							•	•	•	•
Estuarine crocodiles	•	•							•	•
Seabirds			•	•				•	•	•
Shorebirds					•	•	•	•	•	•
Whales									•	•
Dolphins									•	•
Dugongs							•		•	
Geomorphological features										
Coral reefs									•	
Islands and shorelines			•	•	•	•	•	•	•	•
Channels and canyons									•	
River deltas									•	•
Halimeda banks									•	
Seagrass meadows							•		•	
Indigenous heritage										
Cultural practices, observances, customs and lore	•		•		•		•		•	
Sacred sites, sites of particular significance, places important for cultural tradition					•		•		•	
Stories, songlines, totems and languages	•		•		•		•		•	
Indigenous heritage (cont.)										
Indigenous structures, technology, tools and archaeology					•		•		•	•
Historic heritage										
Places of historic significance — historic shipwrecks							•			
Places of historic significance — World War II features and sites										
Places of historic significance — lightstations										
Places of historic significance — other										

Key values and attributes	Estuarine crocodiles		Seabirds		Shorebirds		Wetlands of international importance		Integrity	
	G	S	G	S	G	S	G	S	G	S
Places of scientific significance (research stations, expedition sites)										
Places of social significance — iconic sites										
Community benefits of the environment										
Income							•			
Employment							•			
Understanding										
Appreciation							•			
Enjoyment										
Access to reef resources										
Personal connection										
Community benefits of the environment (cont.)										
Health benefits										
Aesthetics	•	•	•	•	•	•	•	•	•	•

Source: Study team compilation. Key values and attributes and shaded columns (G) relate to the GBR and are extracted from GBRMPA (2013a) Table 4.8. Unshaded columns are the study team's assessments of presence.

Various attributes from this checklist were used to identify likely habitats and food sources for the target species. The following discussion aggregates all of these site values into the broader discussion of species distribution, habitat preferences, and local resources of relevance.

<u>Environmental Processes</u>

The GBR strategic assessment (GBRMPA 2013a) includes a companion table to the above that investigates key ecological processes of Matters of NES (Table 4.9). For the WHA these are based on the SOUV and cover the four listing criteria as well as integrity as above. The following table is a subset of Table 4.9 and deals with:

- the key environmental processes (Table 4.9 column 1)
- GBRMPA assessment of presence for the process at the GBR level (Table 4.8 columns 11, 16, 17, and 18) – included as columns 2, 4, 6, 8, and 10 and shaded and marked 'G' = GBR
- study team assessment of presence for the process at the Aquis site level (columns 3, 5, 7, 9, and 11) – unshaded and marked 'S' = Site
- integrity (column 6 of Table 4.9) has been included in this table (columns 10 and 11) as this is relevant to the viability of habitats of listed species.

This table therefore provides a checklist of those environmental processes that are present at or in the immediate vicinity of the site (or are likely to be influenced in some way by the proposed development).

TABLE 22-33 KEY ENVIRONMENTAL PROCESSES (SPECIES) VALUES AND ATTRIBUTES AT GBR AND SITE LEVEL

Key values and attributes	Estuarine crocodiles		Seabirds		Shorebirds		Wetlands of international importance		Integrity	
	G	S	G	S	G	S	G	S	G	S
Waves, currents and tides			•		•				•	•
Cyclones	•		•		•				•	•
Wind			•						•	
Sedimentation					•		•		•	•
Sea level	•				•		•		•	
Sea temperature	•								•	
Light									•	•
Nutrient cycling							•		•	•
Ocean acidity									•	
Freshwater inflow and salinity							•		•	•
Microbial processes									•	•
Particle feeding									•	
Primary production									•	•
Herbivory									•	
Predation	•		•		•				•	•
Symbiosis									•	
Competition	•		•		•				•	•
Connectivity	•		•		•		•		•	•
Recruitment	•		•		•		•		•	
Reef building									•	

Source: Study team compilation. Key environmental processes and shaded columns (G) relate to the GBR and are extracted from GBRMPA (2013a) Table 4.9. Unshaded columns are the study team's assessments of presence.

As for **Table 22-32**, various attributes from this environmental processes checklist aggregated into the broader discussion of species, habitats, and the processes upon which they depend.

c) Discussion

Of the 13 confirmed species:

- one (*Crocodylus porosus*) is a reptile and the remainder are birds
- five birds are considered terrestrial migrants within the Australian mainland and all are relatively common species that occur over a wide area
- two primarily aerial species (*Apus pacificus* and *Hirundapus caudacutus*) are summer migrants from the northern hemisphere (these species may forage over a wide range of natural and manmade habitats).

Estuarine Crocodiles

- One, possibly two individuals of *Crocodylus porosus* were recorded in one of the five aquaculture ponds in the project site. This species inhabits estuaries and rivers, as well as off-shore islands throughout the northern parts of Western Australia, the Northern Territory and Queensland and is known to inhabit tidal areas within Trinity Inlet and the local area. Research has shown that crocodiles are more abundant in the remote habitat regions and least abundant in the waterways along the populated east coast of Queensland (EPA 2007).
- A variety of habitats suitable for *C. porosus* such as freshwater rivers and lakes, mangroves and brackish water are available in the area surrounding the proposed development site. *C. porosus* are known to disperse from areas in search of resources such as food or habitat and the individual(s) seen within the development envelope are likely to utilise different areas depending on seasonal resource availability. It is suggested that, given current population size and distribution in Queensland, there are many suitable niche habitats available (EPA 2007). Adult *C. Porosus* do not appear highly territorial, with a number of individuals exhibiting overlapping home ranges (Kay 2004).

Seabirds and Shorebirds

Aerial birds

- Two primarily aerial species (*Apus pacificus* and *Hirundapus caudacutus*) are summer migrants from the northern hemisphere. These species may forage over a wide range of natural and manmade habitats. The Aquis project site contains habitat that is suitable for the species.
- *Sterna albifrons sinensis (Little tern [western Pacific]) (E, M) is a subspecies of Sterna albifrons (Little tern). There are three known 'populations' of the species in Australia, and locally the species may be part of a more 'sedentary' population which extends along the Queensland coast from Mackay north to Cape York (Curtis et al. 2012) or an Asian migrant. The species is considered mainly a summer visitor to northern Australia although there is a winter-breeding population in the Gulf of Carpentaria. It is possible the northern population does not migrate to Asia, however this is unconfirmed. Any Little terns recorded on-site in summer could be any of these three populations (east coast/Gulf/Asia), and similarly for early autumn and late spring records. Any records from winter would be most likely represent the eastern population, although young birds may possibly be from the winter-breeding population (pers. comm. T. Reis). The species prefers open areas for breeding sites, which are generally restricted to the Richters Creek ocean frontage and the aquaculture ponds. The species may potentially occur on-site.*

Terrestrial birds

Terrestrial birds consist of eight species, all being relatively conspicuous species within the Wet Tropics. These are detailed below (*Hirundapus caudacutus* is a summer migrant and may forage over a wide range of natural and manmade habitats and *Rhipidura rufifrons* is unlikely to occur on-site).

- *Haliaeetus leucogaster* – White bellied sea-eagle. This species is found in many coastal environments including over islands, reefs, headlands, beaches, bays, estuaries, mangroves, seasonally flooded inland swamps, lagoons and floodplains, and often far inland on large pools of major rivers. It is commonly seen perched on a high limb that provides expansive views, on rising air columns above heating islands or headlands, or above coastal ranges or cliffs where the wind is deflected upwards. Established pairs are usually sedentary, but immature individuals are dispersive. The species is common around most of the coastline of Australia (Morcombe 2000) and resident from India and Sri Lanka through Southeast Asia to Australia on coasts and major waterways. Fish form around half its diet, and as an opportunist it also consumes carrion and a wide variety of animals.
- *Hirundo rustica* – Barn swallow. The barn swallow inhabits open areas, including human settlement often near water (Morcombe 2000). Birds are often found in or over freshwater wetlands, *Melaleuca* woodlands, mesophyll shrub thickets and tussock grassland (Schodde & Mason 1999). The species is very widespread, breeding in Europe, Asia and North America. In Australia, most arrivals tend to be in north-east Queensland around Innisfail and in the far north-west along the coast from Darwin to Broome. Those reaching Australia appear to belong to the Asian race that winters on northern Australian coasts, New Guinea, Indonesia and south-east Asia, and breeds from Japan through Korea to north-eastern Burma (Morcombe 2000).
- *Merops ornatus* – Rainbow bee-eater. Rainbow bee-eaters occur in open forest and woodlands, shrub lands and various cleared or semi-cleared habitats including farmland and areas of human habitation (Higgins 1999). It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water (Storr 1985). It also occurs in coastal sand dune systems, and in mangroves in northern Australia (Higgins 1999). The movement patterns of the Rainbow bee-eater are complex, and are not fully understood. Populations that breed in southern Australia are migratory. After breeding, they move north and remain there for the duration of the Australian winter. However populations breeding in northern Australia are considered to be resident, and in many northern localities the Rainbow bee-eater is present throughout the year (Emison et al. 1987). Those that occur in coastal or sub-coastal areas in the north are present throughout the year, but may move from riparian areas where they breed, into more open habitats during the non-breeding period (Higgins 1999). During the breeding season, the species requires an open clearing or paddock with loamy soil that is pliable enough for nest tunnelling, yet firm enough to support the tunnel. A common bird, and regular summer migrants to southern Australian between September and April, they are resident in the north and remain there to breed (Morcombe 2000). Interpreting the movements of the northern populations is further complicated due to the presence of migrant birds from southern Australia which traverse northern Australia on passage to non-breeding areas (Higgins 1999). The Rainbow bee-eater is usually seen in pairs or small flocks, although when migrating it may occur in groups of up to 500 birds or more (Higgins 1999). It usually nests in loose colonies that may contain up to about 50 pairs, but some pairs nest solitarily (Boland 2004). The only actual identified threat to the Rainbow bee-eater is the introduced Cane Toad (*Bufo marinus*) (DoTE 2014e).
- *Monarcha melanopsis* – Black-faced monarch. The black-faced monarch occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll and mesophyll vine forest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket / shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest. This species occurs in 'marginal' habitats during winter or during migration (Blakers et al. 1984). The movements of the Black-faced monarch are poorly known. They exhibit migratory behaviour, spending spring, summer and autumn in eastern Australia, and wintering in southern and eastern Papua New Guinea from March to August (Schodde & Mason 1999). There are some records in Australia during the winter months (Blakers et al. 1984), but these are thought to be non-migrating immature birds (Hughes & Hughes 1980). Griffioen and Clarke (2002) describe the movement pattern of this species as an 'Intercontinental Whole Coast' pattern. Species exhibiting this pattern move north along the east coast from as far south as Victoria, and a large proportion of the population leaves Australian during winter.

- *Monarcha trivirgatus* – Spectacled Monarch. This species is generally confined to closed forest environments (e.g., rainforest, mangroves) but also occurs in moist gullies within denser wet sclerophyll forests (Morcombe 2000). It is found in Australia, Indonesia and Papua New Guinea. The species is a year-round resident in north-east Qld, and a migrant to south-east Qld and north-eastern NSW (Morcombe 2000). The Aquis project site contains some habitat that is suitable for the species, but the project is likely to be neutral in terms of its effects on migratory habits.
- *Myiagra cyanoleuca* – Satin fly-catcher. Satin fly-catchers inhabit heavily vegetated gullies in tall eucalypt woodlands, and during migration occur in coastal forests, woodlands, mangroves, drier woodlands and open forests (Blakers et al. 1984). The species is migratory, moving north in autumn to spend winter in northern Australia and New Guinea, and returning south in spring to spend summer in south-eastern Australia (Blakers et al. 1984). They are inconspicuous when on passage because movements are made singly or in pairs, or in small loose groups, and possibly at night (Blakers et al. 1984). During the non-breeding period, some individuals are known to winter in northern Queensland around Innisfail and further north around Atherton, although movements are historically described as erratic (Bravery 1970).

Other Migratory Birds

- The remaining 27 species are migratory wetland species that breed in the northern hemisphere during their summer, although some individuals (usually sub-adults) may overwinter in Australia.
- Of these, two species (*Calidris ruficollis* and *Gallinago hardwickii*) were observed on the aquaculture ponds or occasionally on ephemeral drainages across the property. These forage on a range of wetland habitats and may occur well inland of the project site. The Aquis project site contains some habitat that is suitable for these species.
- Two individuals of *Numenius madagascariensis* were observed foraging at the mouth of Richters Creek during the October survey. The species breeds in eastern Siberia during the northern hemisphere summer. Adults vacate breeding areas around June arriving in north-eastern Australia as early as late July, but most arrive in eastern Australia by late August and September. Birds begin to depart to return to breeding grounds around March and April. They occur on sheltered coasts, especially estuaries, harbours and coastal lagoons, and are often recorded in saltmarsh and on mudflats within mangroves. They mainly forage on intertidal mudflats, sand-flats and occasionally ocean beaches, and roost on sandy spits and islets, in mangroves and saltmarsh, and along the high water mark on beaches (Higgins and Davies 1996). Habitat for the species in the local area is limited and likely to be restricted to the mouth of Richters Creek.
- Two individuals of *Numenius phaeopus* were also regularly observed foraging next to mangroves at the mouth of Richters Creek in October and March. This is a largely coastal species and one of the few waders that regularly roost on the branches of mangroves (Higgins and Davies 1996). The Aquis project site contains *Numenius spp*. habitat (islands and shorelines) which is not proposed to be disturbed by the development.
- Suitable habitat for migratory waders within the project site is largely limited to the aquaculture ponds, although some species may also forage on the clay pans following tidal inundation.

Wetlands of international importance

Ramsar wetlands

The protected matters search (**Appendix I**) reveals no wetlands of international importance. The closest wetland of international importance (Ramsar wetland) to the site is Bowling Green Bay (Townsville) some 400 km to the south of the site and the next closest is the Coral Sea Reserves Ramsar wetland (approximately 500 km east on the outer reaches of the Great Barrier Reef).

Local wetlands

However, there are some small wetlands and saltpans on and near the site that have significance at the local level. The small saltpan community (1.9 ha in the north-east corner of the site) has been described in **Table 22-26**.

Figure 22-34 shows that some natural areas on the site are mapped as estuarine REs while the abandoned aquaculture ponds are mapped as a lacustrine waterbody.

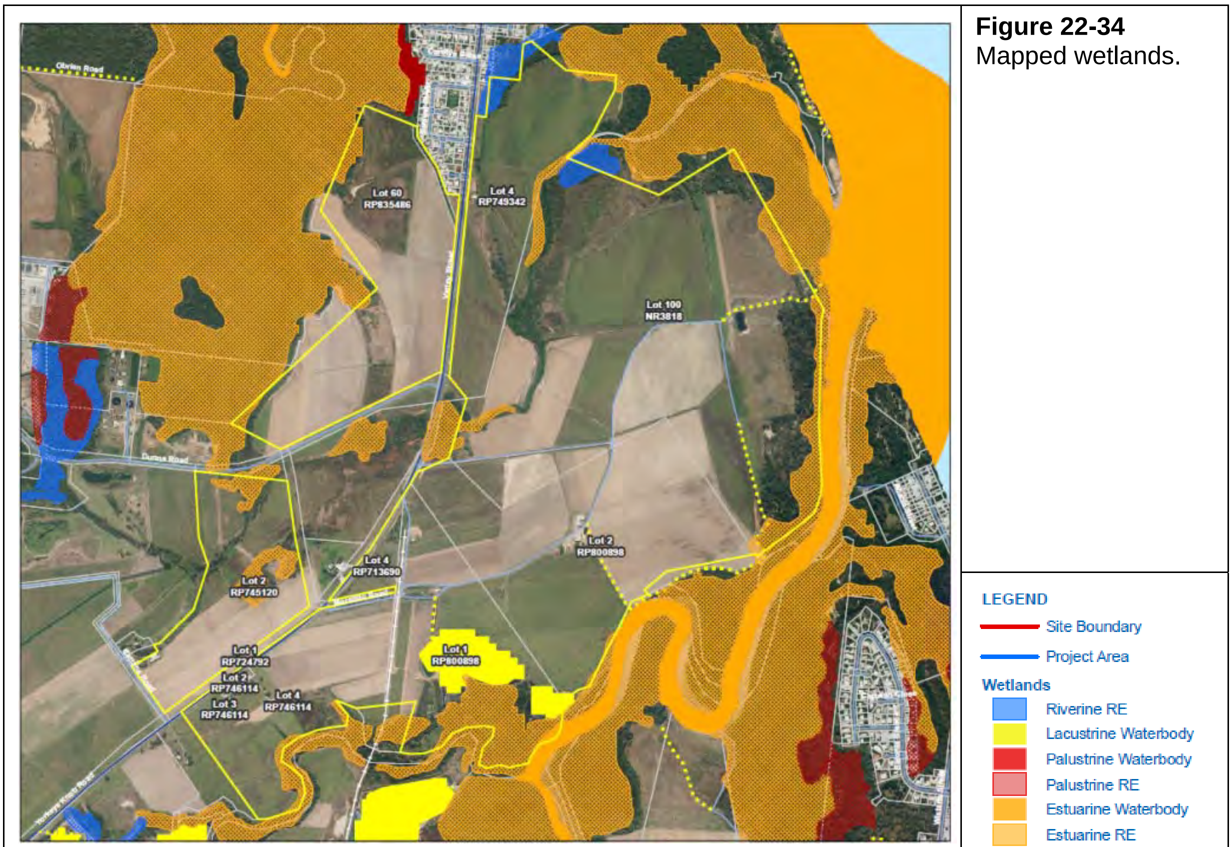


Figure 22-34
Mapped wetlands.

The ecological surveys undertaken for the project confirm that the aquaculture ponds have considerable biodiversity values, especially in the drier months. In addition, there are a number of small, locally important freshwater wetlands within various site regional ecosystems as shown below.

TABLE 22-34 LOCAL WETLANDS

TYPE	DETAILS (see Figure 22-34)
Estuarine REs	REs 7.1.1, 7.2.3b, and 7.2.4b are mapped as Estuarine REs.
Riverine REs	RE 7.3.25a on the northern boundary of Lot 100 NR3818 is mapped as a Riverine RE.
Lacustrine Waterbody	The abandoned aquaculture ponds on Lot 1 RP800898 are mapped as a Lacustrine (lake) wetland.
Palustrine REs	REs 7.3.3a, 7.3.5a, and 7.3.25a (Ecological Unit 1 - Cattana Wetlands) are mapped as Palustrine (marshy, non-tidal) wetland.

Across the site, Melaleuca forests occupy 12.4 ha. There are two Regional Ecosystems encompassing the Melaleuca wetland complexes in the study area, and both are listed as Of Concern under Queensland legislation, as follows:

- 7.3.25a: [Riverine wetland or fringing riverine wetland. *Melaleuca leucadendra* open forest and woodland. Stream levees and prior streams on well-drained sandy clay loam alluvial soils.] This RE is restricted to small patches at the northern fringe of the project area.
- 7.2.9a: [Palustrine wetland (e.g. vegetated swamp). *Melaleuca quinquenervia* open forest to woodland and shrub land. Dune swales and swampy sand plains of beach origin.] This RE is restricted to a small area directly adjacent to the patch of RE 7.3.25a on Lot 4RP749342.

See below for a photograph of this latter community.

Photo 22-14 Freshwater wetland in the *Melaleuca quinquenervia* community.

Integrity

As noted previously, despite clearing and fragmentation of habitat in the project site, biological processes in the project site are still largely intact. This area is still fringed by a band of natural vegetation and this abuts protected areas of high integrity (FHAs and QMP) to the north-east and north-west. Together these remnants maintain a high degree of biological function.

Summary

Based on the protected matters search, knowledge of the habitats present, and detailed, targeted fieldwork:

- 14 species were confirmed on the site
- 4 species may overfly the site
- 15 species are likely to occur.

Of the 14 confirmed species one (*Crocodylus porosus*) is a reptile and the remainder are birds. Five are considered terrestrial migrants within the Australian mainland and all are relatively common species that occur over a wide area.

Suitable habitat for all of these species exists within the project site, mainly is the seasonal abandoned aquaculture ponds, although some species may also forage on the clay pans following tidal inundation. Mangrove habitats are also valuable.

Migratory bird fauna contribute to OUV because of their international distribution and the need to protect habitats which support annual migration, breeding habitats, and seasonal resource utilisation. A number of migratory fauna have been recorded on-site, and both resident and 'obligate' migratory species have been encountered. Two 'obligate migratory' fauna, *Numenius phaeopus* and *N. madagascariensis,* are relatively widespread on the Australian coast-line, although they are less abundant in the south (Higgins and Davies 1996). Both migrate annually from the northern hemisphere (Higgins and Davies 1996) and on the site occupy similar habitats to the more sedentary *Esacus magnirostris.* Both *Numenius* species are mobile and likely to move in response to local resource availability. The migratory species habitat values available on-site are not unique or outstanding in a local context, nor are they proposed to be disturbed by the development.

There were three other EPBC-listed migratory wetland birds observed on the property. These species were only seen on the (man-made) aquaculture ponds and on the farms artificial drainage network. The aquaculture ponds along with adjacent permanent freshwater bodies such as the Cattana Wetlands, and ephemeral freshwater in nearby Melaleuca-dominated habitats, are a habitat resource that is used seasonally by a number of birds, including migratory shore-birds and waders. Moreover, a number of State-listed species have also been recorded within the aquaculture pond environment and the Cattana Wetlands. These species are present on a seasonal basis, and only been recorded during the dry season when water levels provide suitable wading habitat.

The site's listed migratory fauna are largely dependent on the presence of man-made habitats. Such habitat also exists adjacent to the site. Values relating to those migratory fauna which occur in natural habitats should not be affected, given that these habitats are not proposed to be disturbed.

22.14.2 Potential Impact

Referring to **Table 22-12**, for this matter of NES the construction and operation of Aquis is likely to have:

- potential minor adverse construction impacts of local significance on the following impact categories:
  - acid sulfate soil
  - dredging
  - light
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off
  - small chemical spills
  - urban discharge
- potential minor adverse operation impacts of local significance on the following impact categories:
  - light
  - small chemical spills
  - urban discharge
- potential minor beneficial operation impacts of local significance on the following impact categories:
  - artificial barriers to flow
  - increased freshwater inflow

- potential major regional to reef-wide beneficial operation impacts on the following impact categories (probably only locally significant):
  - modifying supporting terrestrial habitats
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off.

Species-specific impacts are discussed below.

Confirmed species:

- *Haliaeetus leucogaster* – White bellied sea-eagle. The Aquis Resort development is probably neutral in terms of its effect on this species, although the lake may provide a habitat resource which would benefit the species, but also increase the risk of bird-strike. Management to deter lake use by this and other identified bird species will be required in the interest of public safety.
- *Hirundo rustica* – Barn swallow. The Aquis Resort site contains habitat considered suitable for the species, but the project is likely to be neutral in terms of its effects on migratory habits.
- *Merops ornatus* – Rainbow bee-eater. This species is especially abundant in mangrove areas on the resort site where it has been recorded during all systematic and incidental surveys. Given that mangroves will be protected and in some areas expanded, the Aquis Resort development would be expected to have a neutral to beneficial effect on this species.
- *Monarcha melanopsis* – Black-faced monarch. The Aquis Resort site contains habitat that supports the species, but the project is likely to be neutral in terms of its effects on this species.
- *Myiagra cyanoleuca* – Satin fly-catcher. The resort site contains some habitat that is suitable for the species, but the project is likely to be neutral in terms of its effects on this species.

Other Migratory Birds:

- The remaining 27 species are migratory wetland species that breed in the northern hemisphere during their summer, although some individuals (usually sub-adults) may overwinter in Australia. Of these, two species (*Calidris ruficollis* and *Gallinago hardwickii*) were observed on the aquaculture ponds or occasionally on ephemeral drainages across the property. These forage on a range of wetland habitats and may occur well inland of the project site. The site contains some habitat that is suitable for these species, but the project is likely to be neutral in terms of its effects on all migratory habits.
- Two individuals of *Numenius phaeopus* were regularly observed foraging next to mangroves at the mouth of Richters Creek. This is a largely coastal species and is one of the few waders that regularly roost on the branches of mangroves. Habitat for the species in the local area is limited and likely to be restricted to the mouth of Richters Creek. The site area contains *Numenius spp*. habitat which is not proposed to be disturbed by the development. The project is likely to be neutral in terms of its effects on this species.
- Suitable habitat for migratory waders within the project site is largely limited to the aquaculture ponds, although some species may also forage on the clay pans following tidal inundation.

Filling the aquaculture ponds represents a loss of habitat for a sub-set of the migratory species recorded on the Aquis Resort site, but may reduce bird-strike once filled, given the large numbers of birds present on the ponds during the 2013 dry season. Habitats of the other migratory species confirmed on the site should not be affected by the development process. This includes the Eastern curlew which is recognised under all of the applicable conventions and agreements listed, but whose habitat (Richters Creek mouth) is unlikely to be affected by the proposed Aquis Resort development.

22.14.3 Proposed Mitigation and Effectiveness

The aquaculture ponds are used by birds mostly during the dry season when water levels are lower and habitat is more suitable. At other times of the year, there are few birds present. The adjacent Cattana Wetlands, on-site saltpans, claypans and Samphire-dominated saltpans all offer alternative habitat to most migratory species that are known from the aquaculture pond site. These other on-site habitats will be protected during and after the construction process.

22.14.4 Significance of Mitigated Impact

Bird-strike potential will remain, but reduced populations of listed waders, shore-birds and terrestrial migratory birds known to be implicated in bird-strike should reduce as a result of removing the aquaculture ponds and restoring natural mangrove habitats and mown grass (golf course) to that portion of the site.

Minor construction impacts will be effectively managed via the EMP (Construction).

22.14.5 Need for Offsets

The assessment concludes that there are no significant residual adverse impacts. Accordingly, no offsets under the EPBC Act Offsets Policy (SEWPaC 2012a) are required.

22.14.6 Consistency with International Obligations

a) Migratory Bird Agreements

As noted, the site supports a number of migratory species, principally waders, shore-birds and species typical of wetland and tidal ecosystems. A number of these species are protected under international conventions and treaties, specifically the Bonn Convention, JAMBA (Japan Australia Migratory Bird Agreement), CAMBA (China Australia Migratory Bird Agreement) and ROKAMBA (Republic of Korea Australia Migratory Bird Agreement).

These agreements list terrestrial, water and shorebird species which migrate between Australia and the respective countries. The agreements require the parties to act to protect migratory birds by:

- limiting the circumstances under which migratory birds are taken or traded
- protecting and conserving important habitats
- exchanging information
- building cooperative relationships.

The JAMBA agreement also includes provisions for cooperation on the conservation of threatened birds. As it is likely to be neutral in terms of its effects on migratory habits, the project is not inconsistent with the JAMBA, CAMBA or ROKAMBA agreements.

The Convention on the Conservation of Migratory Species of Wild Animals (1979) (the ‘Bonn Convention’) is an agreement whereby the Parties acknowledge the importance of migratory species being conserved, and of Range States agreeing to take action to this end whenever possible and appropriate. In particular the Parties;

- should promote, co-operate in and support research relating to migratory species
- shall endeavour to provide immediate protection for migratory species included in Appendix I
- shall endeavour to conclude Agreements covering the conservation and management of migratory species included in Appendix II.

As the project is likely to be neutral in terms of its effects on migratory habits and birds, it is not inconsistent with the aims of the Bonn Convention.

b) Migratory Shore-birds

In 2009 the Federal Government released the *Draft Significant Impact Guideline for 36 migratory Shore-bird Species*, which is expected to be finalised in mid-2014 with no significant changes. The policy statement is designed to assist in determining the impacts of proposed actions on migratory shore-bird species, and to provide mitigation strategies to reduce the level or extent of those impacts. It covers 36 migratory shore-bird species, 25 of which breed in the northern hemisphere and migrate to the non-breeding grounds of Australia along the East Asian – Australasian flyway (EAA flyway) (DEWHA 2009).

Under the *EPBC Act*, 'important habitat' is a key concept for migratory species. The widely accepted and applied approach to identifying internationally important shore-bird sites throughout the world has been through the use of criteria adopted under the RAMSAR Convention on Wetlands. However the international criteria are insufficient to provide protection for migratory shore-birds within Australia. The distribution of migratory shore-birds within Australia is more dispersed than in other countries, due in part to unpredictable climatic conditions and the generally lower productivity of our wetlands (DEWHA 2009c). The Guidelines identify nationally important sites for shore-birds, in addition to internationally important sites as defined under the RAMSAR Convention.

Five of the 36 migratory shore-bird species covered by the Guideline have been recorded on-site (*Calidris acuminata, Calidris ruficollis, Numenius madagascariensis, N. phaeopus and Tringa nebularia*). Information on population estimates and known internationally important sites for each of these species was referenced to determine whether the project area is internationally important.

The identification of internationally important sites was based upon Criterion 6 of the RAMSAR Convention, which states that 'a wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of water bird' (Bamford et al. 2008). Of the five species recorded on-site, only *Numenius phaeopus* has been recorded as occurring in sufficient numbers in the CRC area to trigger this criterion.

Internationally important non-breeding sites (based on the 1% criterion) for *N. phaeopus* are mainly in Australia (6), with single sites in China, Myanmar, Indonesia, and Malaysia (Bamford et al. 2008). The six important non-breeding sites in Australia are shown in **Table 22-35** and **Figure 22-35**.

TABLE 22-35 NATIONALLY IMPORTANT (NON-BREEDING) SHORE-BIRD SITES

MAP REFERENCE	DESCRIPTION	NUMBER OF BIRDS COUNTED	COUNT DATE
110	Shoalwater Bay and Broad Sound	7124	1995
107	SE Gulf of Carpentaria	3414	1999
46	Great Sandy Strait	3128	No date
28	Chambers Bay	1500	No date
84	Moreton Bay	1440	No date
20	Cairns Foreshore	1027	1995

Source: Bamford et al*.* (2008).

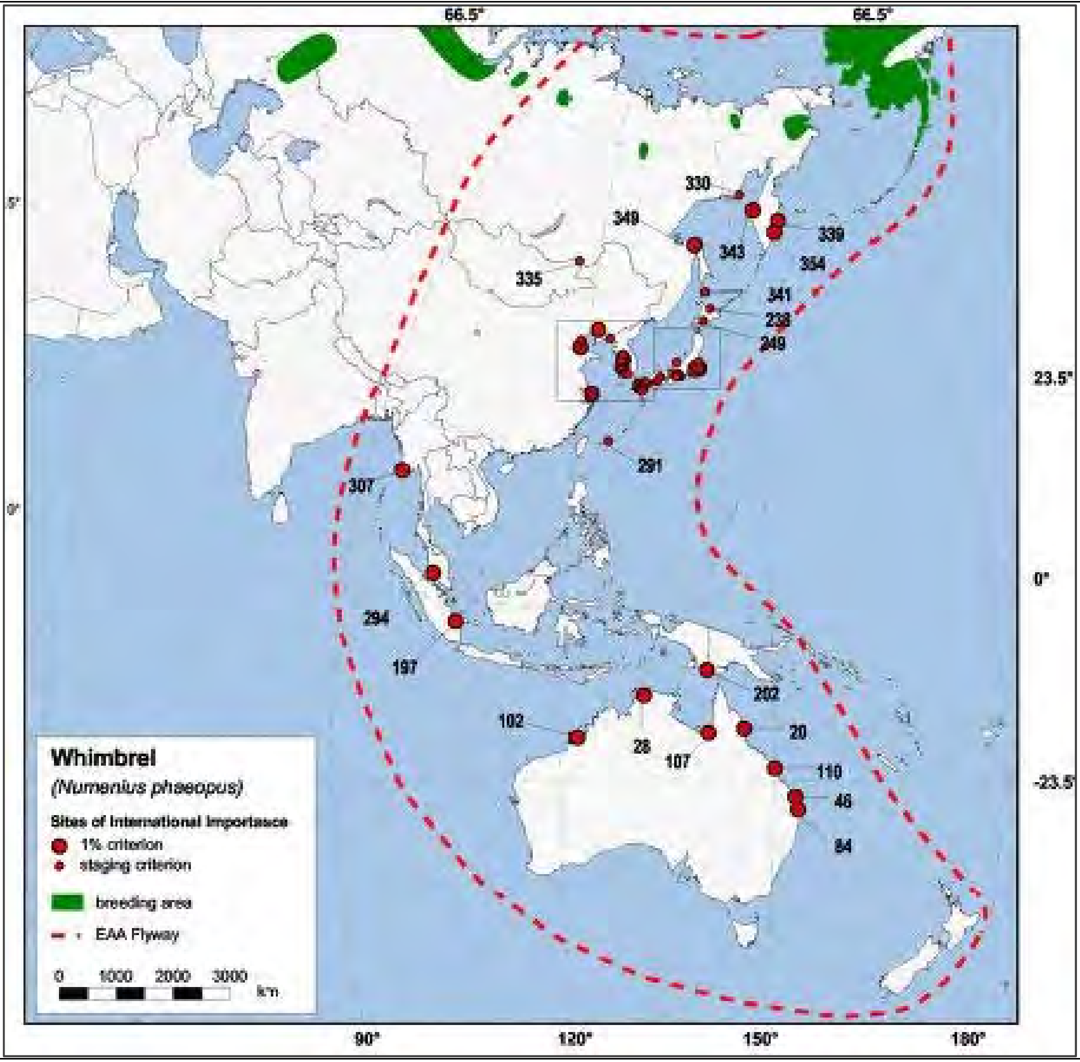


Figure 22-35 Nationally important (non-breeding) shore-bird sites.

Source: Bamford et al. (2008).

The Cairns Foreshore Is an important site for *N. phaeopus* based on a study in 2005 which recorded 1,027 birds (Bamford et al. 2008). The 1% trigger threshold for the *N. phaeopus* is 1000 based on a flyway population estimate of 100 000 individuals. The population estimate is based on counts undertaken in 1999 and 2000, however it is thought that the actual population size is larger than the count data suggests (Bamford et al. 2008). It is therefore unlikely that the Cairns Foreshore would remain an internationally important site for *N. phaeopus*, based on the count taken in 2005 which recorded only 27 individuals more than the underestimated trigger value of 1000.

During the surveys of the project area *N. phaeopus* was recorded three times, each record was of a single individual. The project area is not of international importance to *N. phaeopus* with much greater numbers utilising the more suitable habitat available at the Cairns Foreshore, approximately 10 km south of the project area.

To determine whether the project area is of national importance to migratory shorebirds, the Criteria defined in **Figure 22-36** must be addressed. The surveys undertaken on-site show that the site does not support at least 0.1% of the flyway population of a single species, or 2000 migratory shorebirds.

The final criterion is whether the site ‘supports’ at least 15 shorebird species. The EPBC Act protected matters search tool returned 18 of the 36 species as potentially occurring or having habitat suitable to support the species either within the site or within a 5 km radius of the site. The definition of 'support' in relation to this criteria is defined within the Guidelines as, 'migratory shore-birds are recorded during surveys and/or known to have occurred at the site within the previous five years'.

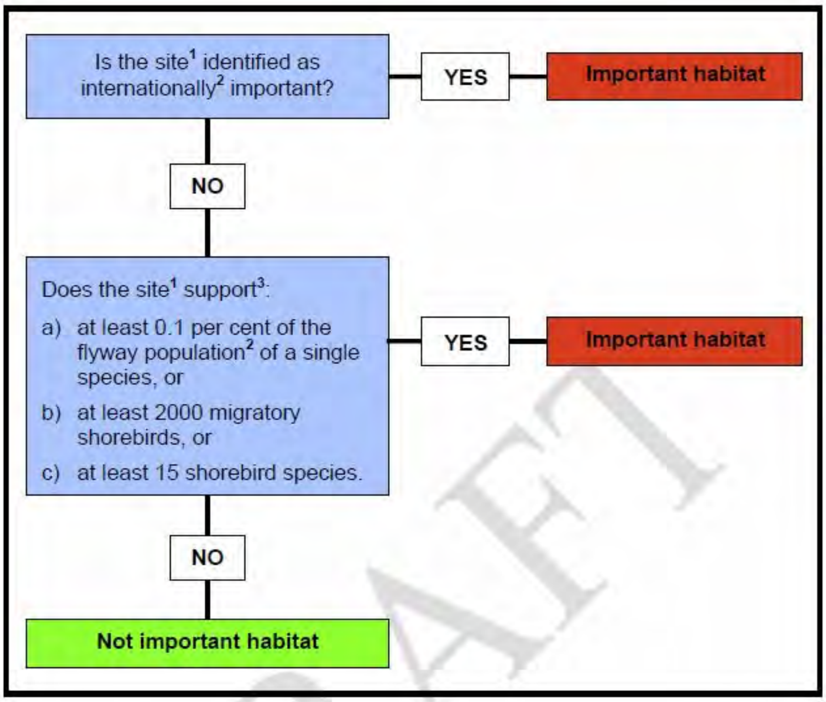


Figure 22-36 Process for identifying important habitat for migratory shorebirds under the EPBC Act.

Source: EPBC Act Significant Impact Guidelines (DoTE 2013c).

During the surveys undertaken on-site, only five of the 36 species covered by the Guideline have been recorded (*Calidris acuminata, Calidris ruficollis, Numenius madagascariensis, Numenius phaeopus and Tringa nebularia).* In the absence of records of the other 13 species from the project area being recorded within the site boundaries within the previous five years, only five migratory shorebird species are supported by the site.

In conclusion, the project area is neither an internationally, or nationally important site for the 36 migratory shorebird species covered by *EPBC Act* policy statement 3.21. The proposed development is unlikely to have a significant impact on these species.

22.14.7 Consistency with Recovery or Threat Abatement Plans

Not applicable.

22.15 LISTED AQUATIC / MARINE SPECIES

22.15.1 Presence of Matter

The protected matters report (**Appendix I**) records those listed aquatic / marine species under a number of categories that are dealt with together in this section as there is much overlap, namely:

- aquatic threatened species
- aquatic migratory species
- listed marine species
- whales and other cetaceans.

Based on knowledge of the project site and surrounds, and the preferred habitat of listed species, an assessment was made of their likely presence on or near the site as shown in the suite of tables below. This assessment was informed by a targeted search of the site and adjacent waterways (but not the open ocean) for all listed species (see **Section 22.1.7**) in accordance with **Table 22-7**.

a) Aquatic Threatened Species

Threatened species in this category include species that are extinct in the wild, critically endangered, endangered or vulnerable. Species that are listed as 'conservation-dependent' or 'extinct' are not matters of national environmental significance and do not trigger a referral under the EPBC Act.

TABLE 22-36 AQUATIC THREATENED SPECIES WITHIN 5 KM OF THE SITE

SPECIES	COMMON NAME	EPBC ACT LISTING STATUS	LIKELIHOOD OF OCCURRENCE IN ESTUARINE AREAS ADJACENT TO THE SITE	LIKELIHOOD OF OCCURRENCE OFF-SHORE, WITHIN 5 km OF THE SITE
Mammals				
Balaenoptera musculus	blue whale	E, M, C	Low	Low
Megaptera novaeangliae	humpback whale	V, M, C	Low	Moderate
Reptiles				
Caretta caretta	loggerhead turtle	E, M, O	Low	Moderate
Chelonia mydas	green turtle	V, M, O	Moderate	Moderate
Dermochelys coriacea	leatherback turtle	E, M, O	Low	Low
Eretmochelys imbricata	hawksbill turtle	V, M, O	Low	Moderate
Lepidochelys olivacea	Olive Ridley turtle	E, M, O	Low	Low
Natator depressus	flatback turtle	V, M, O	Low	Moderate
Fish				
Melanotaenia eachamensis	Lake Eacham rainbowfish	E	Low	Low
Sharks				
Carcharodon carcharias	Great white shark	V, M	low	low
Pristis clavata	dwarf sawfish	V	Low	Low
Pristis zijsron	green sawfish	V	Low	Low
Rhincodon typus	whale shark	V, M	Low	Low

Legend:

E endangered

V vulnerable

M migratory species

As shown in **Table 22-36**, 2 threatened (endangered or vulnerable) aquatic species were listed within 5 km of the project site. Of these:

- 5 are assessed as having a moderate likelihood of occurrence:
  - humpback whale (Megaptera novae-angliae)
  - loggerhead turtle (*Caretta Caretta*)
  - green turtle (*Chelonia mydas*)
  - hawksbill turtle (Eretmochelys imbricata)
  - flatback turtle (*Natator depressus*).
- 8 are assessed as having a low likelihood of occurrence.

Threatened species are a widely used indicator of the status of biodiversity. Criterion (x) (formerly (iv)) of the World Heritage Convention's natural criteria recognises threatened species as part of the GBRWHA biodiversity values. The values to be considered in regards to listed threatened species include breeding and roosting habitats of each species (DSDIP 2013c).

Sandbars at the entrance to Richters and Yorkeys creeks are likely to constrain the movement of most threatened, migratory, cetacean and marine species with the exception of turtles and sharks. There is little significant habitat or food for most marine turtles in the vicinity of the site. Nevertheless, some species, including Australian snubfin dolphins, Indo-Pacific dolphins and green turtles, may forage in these creeks, particularly near the mangrove habitats (Bunce pers. comm. 2013). The beaches of Trinity Bay are not recognised as major nesting areas for any marine turtle species (Worley Parsons 2010). Further, during discussions held in late 2013, technical staff from the Queensland Government were not aware of the results of any surveys of marine turtles nesting in the vicinity of the proposed development. However, it is likely that there is some sparse nesting of marine turtles on the beaches in the vicinity of the proposed development (Bunce pers. comm., Trenerry pers. comm.).

It has been recommended that the beaches be surveyed for use by marine turtles (frc environmental 2013) during detailed design and the results used to manage turtles.

<u>Mammals</u>

Blue Whale (*Balaenoptera musculus*)

The blue whale is listed under the 'endangered', 'migratory' and 'cetacean' schedules of the EPBC Act. Blue whale sightings in Australian waters have been widespread and it is likely that the whales occur right around the continent at various times of the year. However, much of the Australian continental shelf and coastal waters have no particular significance to the whales; these areas are typically used for migration and opportunistic feeding (DoTE 2013a). There are three known feeding areas for blue whales in Australian waters; these areas are on the southern and western coastlines of Australian and are not near the study area.

Blue whales, including calves, may migrate along the coast near the study area; however, this area is not considered to be core habitat for this species and would not be considered to support important populations or offer habitat critical to the survival of this species.

Their likelihood of occurrence in the estuaries surrounding the project site and in off-shore marine waters is low (**Table 22-36**).

Humpback Whale (*Megaptera novaeangliae*)

The humpback whale is listed under the 'vulnerable', 'migratory' and 'cetacean' schedules of the EPBC Act. Humpback whales, including calves, have been observed migrating along the coast near Cairns; however, the area is not considered to be core habitat for this species and would not be considered to support important populations or offer habitat critical to the survival of this species.

Humpback whales use habitat seasonally and are typically found along various parts of the Australian coastline for up to nine months of the year (April to December). The Australian east coast population of humpback whales migrate from summer cold-water feeding grounds in sub-Antarctic waters; to warm water winter breeding grounds in the Great Barrier Reef. They are regularly observed in Queensland waters in June and July, during the northward migration, and October and November, during the southward migration (DoTE 2013d).

Their likelihood of occurrence in the estuaries surrounding the project site is low, and in off-shore marine waters is moderate (**Table 22-36**).

Reptiles

Loggerhead Turtle (*Caretta caretta*)

The loggerhead turtle is listed under the 'endangered', 'marine' and 'migratory' schedules of the EPBC Act.

The loggerhead turtle forages in a wide range of intertidal and subtidal habitats, including coral and rocky reefs, seagrass meadows, and non-vegetated sand or mud areas (Limpus 2008c). The loggerhead turtle tends to maintain small home ranges within their foraging grounds (within approximately 10 to 15 km of coastline). Loggerhead turtles are found in the waters of coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia (Limpus et al. 1992; Prince 1994; Limpus 1995).

The three major nesting areas in Queensland are:

- the Capricorn Bunker Island Groups, especially Wreck, Tryon and Erskine islands
- Mon Repos and adjacent beaches of the Woongarra Coast and Wreck Rock Beach, together with
- the islands of the Swain Reefs, especially Pryce Island and Frigate, Bylund, Thomas and Bacchi cays.

None of these nesting areas is near the proposed development.

Loggerhead turtles may feed in, or traverse, coastal areas near Yorkeys Knob and they are moderately likely to occur waters off-shore of the study area. They are unlikely to occur in the estuaries surrounding the project site (**Table 22-36**).

Green Turtle (*Chelonia mydas*)

The green turtle is listed under the 'vulnerable', 'marine' and 'migratory' schedules of the EPBC Act.

The green turtle is globally distributed in tropical and sub-tropical waters, and is usually associated with shallow marine habitats that support seagrass and algal communities. The nearest seagrass beds to the project site are in Trinity Inlet, approximately 8.5 km south-east of the study area. Green turtles are mostly herbivorous as adults, eating algae, seagrass, mangrove fruit and jellyfish (Forbes 1994; Pendoley & Fitzpatrick 1999). Immature animals are carnivorous (Brand-Gardner et al. 1999).

In Queensland, northern green turtle populations typically nest around Raine Island and Moulter Cay (Limpus et al. 2003), but also nest on islands of the outer edge of the reef (DEWHA 2013). Mainland rookeries can occur on the mainland, and inner and outer shelf islands from Cape Grenville north to the Torres Strait (DEWHA 2013). Green turtle mating occurs in October, with nesting peaking in January until the end of March (DEWHA 2013). There are no key nesting areas near the proposed development.

Green turtles are moderately likely to occur in the estuaries surrounding the project site and off-shore (**Table 22-36**).

Leatherback Turtle (*Dermochelys coriacea*)

The leatherback turtle is listed under the 'vulnerable', 'migratory' and 'marine' schedules of the EPBC Act.

The leatherback turtle is a pelagic species known to occur in tropical, subtropical and temperate waters. Leatherback turtle foraging typically occurs in central eastern Australia from south-east Queensland to central New South Wales. As the most pelagic of all marine turtles, the leatherback turtle spends much of its time in the open ocean and may traverse thousands of kilometres over its lifetime from feeding areas to nesting beaches (Lutz & Musick 1996; Benson et al. 2007). Leatherback turtles predominantly feed on gelatinous organisms, with a preference for jellyfish (Kaplan 1995; Bjorndal 1997), their distribution reflects the distribution of their food (Leary 1957; Lazell 1980). Leatherback turtles are rarely found close to shore in Australia (GBRMPA 2011c).

There is a strong likelihood that leatherback turtles have not nested in Queensland since 1996 (Hamman et al. 2006).

The likelihood of occurrence of leatherback turtles in the estuaries surrounding the project site and off-shore is low (**Table 22-36**).

Hawksbill Turtle (*Eretmochelys imbricata*)

The hawksbill turtle is listed under the 'vulnerable', 'migratory' and 'marine' schedules of the EPBC Act.

Hawksbill turtles breed in the northern Great Barrier Reef and the Torres Strait and are heavily reliant on reef and rocky habitats, where they forage mainly on sponges but also seagrass, algae, squid, gastropods and jellyfish.

In Australia, the key nesting and inter-nesting areas (where females live between laying successive clutches in the same season) are:

- Milman Island and the inner GBR cays north from Cape Grenville Central
- Torres Strait islands
- Crab Island
- Murray Islands
- Darnley Island
- Woody Island
- Red Wallis and Woody Wallis Islands
- Bramble Cay and Johnson Islet (Torres Strait)
- Western Cape York Peninsula (DEH 2005).

Woody Island is the closest key nesting area to the proposed development area, being approximately 54 km north north-west of the site.

Hawksbill turtles may feed in, or traverse, coastal areas near Yorkeys Knob, and they are moderately likely to occur off-shore of the project site. Their likelihood of occurring in the estuaries around the project site is low (**Table 22-36**).

Olive Ridley Turtle (*Lepidochelys olivacea*)

The Olive Ridley turtle is listed under the 'endangered', 'migratory' and 'marine' schedules of the EPBC Act.

The Olive Ridley turtle has a worldwide tropical and subtropical distribution. In Australia, they occur along the coast from southern Queensland and the Great Barrier Reef, northwards to Torres Strait, and across to the Joseph Bonaparte Gulf in Western Australia. Olive Ridley turtles are uncommon in the Great Barrier Reef and have received little scientific attention (GBRMPA 2011b).

Apart from one exception, Olive Ridley turtles have not been recorded in coral reef habitat or shallow in-shore seagrass flats (Limpus 2008a).

Olive Ridley turtles forage in depths of several metres to over 100 m (Hughes 1974; Conway 1994; Whiting et al. 2005), mostly for gastropods and bivalves (Conway 1994). No large rookeries of Olive Ridley turtle have been recorded in Australia (DERM 2011).

Their likelihood of occurring in the estuaries around the project site or in the off-shore study area is low (**Table 22-36**).

Flatback Turtle (*Natator depressus*)

The flatback turtle is listed under the 'vulnerable', 'migratory' and 'marine' schedules of the EPBC Act.

The flatback turtle tends to forage in shallow continental shelf waters with soft substrates, feeding on a variety of soft-bodied animals, including soft corals, sea pens, sea cucumbers and jellyfish (Limpus 2007). Catch records from trawlers (as bycatch) indicate that the flatback turtle also feeds in turbid, shallow (depth of 10 m to 40 m) in-shore waters (Robins 1995).

Unlike other turtles, the flatback turtle lacks an oceanic phase and remains in the surface waters of the continental shelf throughout its life. Little is known about their foraging habits and habitat, although juvenile and adult turtles seem to occupy similar habitats and both forage on soft-bodied (mostly benthic) organisms (Limpus et al. 1994).

In eastern Queensland, flatback turtles nest between Bundaberg in the south to the Torres Strait in the north. The main nesting sites in the southern Great Barrier Reef are:

- Curtis Island
- Peak Island
- Facing Island
- Hummock Hill Island
- Wild Duck islands (Limpus 1971; Limpus et al. 1983).

Scattered aperiodic nesting occurs along the mainland and on in-shore islands between Townsville and the Torres Strait (Limpus et al. 1994). Nesting activity is greatest between late November and early December ceasing sometime in late January.

Flatback turtles are unlikely to occur in the estuaries surrounding the project site, and are moderately likely to occur in the off-shore study area (**Table 22-36**).

<u>Fish</u>

The Lake Eacham rainbowfish (*Melanotaenia eachamensis*) is listed under the 'endangered' schedule of the EPBC Act.

The Lake Eacham rainbowfish is found in Lake Eacham in the Atherton Tablelands and several other moderately flowing streams in the upper reaches of the Tully Catchment (Pusey et al. 1997). The rainbowfish is an opportunistic feeder and feeds on algae, aquatic invertebrates and terrestrial insects (Tappin 1991).The study area does not provide habitat for Lake Eacham rainbowfish, as it has not been found in waterways below 700 m in elevation (Pusey et al. 1997): the Lake Eacham rainbow fish is highly unlikely to be found in the study area.

Sharks

Great White Shark (*Carcharodon carcharias*)

The great white shark is listed under the 'vulnerable' and 'migratory' schedules of the EPBC Act.

Great white sharks are uncommon compared to other sharks. In Australia, great white sharks have been recorded from the central Queensland coast, around the south coast to north-west Western Australia. In Queensland, they are primarily found south of Mackay (Paterson 1990; DoTE 2013b). Great white sharks tend to move seasonally along the east Australian coast, moving northerly during autumn and winter and returning to southern Australian waters by early summer (Bruce et al. 2006). They can be found around inshore rocky reefs, surf beaches and shallow coastal bays and on the outer continental shelf and slope (DoTE 2013b). Great white sharks are often found in regions with high prey density, such as near seal colonies (DEWHA 2009).

The study area is unlikely to provide significant habitat for the great white shark. Their likelihood of occurring in the estuaries around the project site or in the off-shore study area is low (**Table 22-36**).

Dwarf Sawfish (*Pristis clavata*)

The dwarf sawfish is listed under the 'vulnerable' schedule of the EPBC Act. The study area is unlikely to provide habitat for the dwarf sawfish; there has been no record of the species from the eastern coast of the Cape York peninsula and the eastern Queensland populations of dwarf sawfish cannot be confirmed (Threatened Species Scientific Committee 2009).

The dwarf sawfish usually inhabits shallow coastal waters (2–3 m) and estuarine habitats. Estuarine habitats are used as nurseries with juveniles migrating into marine waters (Thorburn et al. 2007).

Their likelihood of occurring in the estuaries around the project site or in the off-shore study area is low (**Table 22-36**).

Green Sawfish (*Pristis zijsron*)

The green sawfish is listed under the 'vulnerable' schedule of the EPBC Act. The study area is unlikely to provide habitat for the green sawfish, as the study area is considered at the edge of the species range – there has been no record of the species south of Cairns since the 1960s (Stevens et al. 2005).

The green sawfish inhabits in-shore marine waters, estuaries and river mouths with both sandy and muddy bottom habitats (Allen 1997; Peverell et al. 2004; Stevens et al. 2005). Stead (1963) reported that this species was frequently found in shallow water.

Their likelihood of occurring in the estuaries around the project site or in the off-shore study area is low (**Table 22-36**).

Whale Shark (*Rhincodon typus*)

The whale shark is listed under the 'vulnerable' and 'migratory schedule of the EPBC Act.

The whale shark occurs in both warm-temperate and tropical waters, oceanic and in-shore, usually between latitudes 30°N and 35°S (Compagno 1984). They are often seen far off-shore, but also come close in-shore and sometime enter lagoons of coral atolls (DoTE 2013e). They are filter-feeders that are typically encountered close to the surface, either individually or occasionally in schools (Compagno 1984). Data on the life span and breeding habits of this species is largely unknown.

Their likelihood of occurrence in the estuaries surrounding the project site and off-shore is low (**Table 22-36**).

b) Listed Migratory Species

An action will require approval if the action has, will have, or is likely to have a significant impact on a listed migratory species. Fifteen migratory aquatic species were listed within 5 km of the project site using the protected matters search tool.

Of the listed migratory species, nine species are also listed as threated species.

TABLE 22-37 LISTED MIGRATORY SPECIES WITHIN 5 KM OF THE SITE

SPECIES	COMMON NAME	EPBC ACT LISTING STATUS	LIKELIHOOD OF OCCURRENCE IN ESTUARINE AREAS ADJACENT TO THE SITE	LIKELIHOOD OF OCCURRENCE OFF-SHORE OF THE SITE
Mammals				
Balaenoptera edeni	Bryde's whale	M, C	Low	Low
Balaenoptera musculus	blue whale	E, M, C	Low	Low
Dugong dugon	dugong	M, O	Low	Moderate
Megaptera novaeangliae	humpback whale	V, M, C	Low	Moderate
Orcaella brevirostris [1]	Australian snubfin dolphin	M, C	Moderate	Moderate
Orcinus orca	killer whale	M, C	Low	Low
Sousa chinensis	Indo-Pacific humpback dolphin	M, C	Moderate	Moderate
Reptiles				
Caretta caretta	loggerhead turtle	E, M, O	Low	Moderate
Chelonia mydas	green turtle	V, M, O	Moderate	Moderate
Dermochelys coriacea	leatherback turtle	E, M, O	Low	Low
Eretmochelys imbricata	hawksbill turtle	V, M, O	Low	Moderate
Lepidochelys olivacea	Olive Ridley turtle	E, M, O	Low	Low
Natator depressus	flatback turtle	V, M, O	Low	Moderate

SPECIES	COMMON NAME	EPBC ACT LISTING STATUS	LIKELIHOOD OF OCCURRENCE IN ESTUARINE AREAS ADJACENT TO THE SITE	LIKELIHOOD OF OCCURRENCE OFF-SHORE OF THE SITE
Sharks and Rays				
Carcharodon carcharias	great white shark	V, M	Low	Low
Lamna nasus	mackerel shark	M	Low	Low
Manta birostris	giant manta ray	M	Low	Low
Rhincodon typus	whale shark	V, M	Low	Low

Legend

E endangered

V vulnerable

M migratory species

O marine species

C whales and other cetaceans

[1] previously considered to be *Orcaella brevirostris* (Irrawaddy dolphin); the Australian snubfin dolphin was formally recognised as a separate species in 2005 (GBRMPA 2012).

As shown in **Table 22-37**, 17 aquatic migratory species were listed adjacent to the project site and in marine areas off-shore within 5 km of the project site. Of these:

- 8 are assessed as having a moderate likelihood of occurrence
  - dugong (Dugong dugon)
  - humpback whale (Megaptera novae-angliae)
  - Australian snubfin dolphin (Orcaella brevirostris)
  - Indo-Pacific humpback dolphin (Sousa chinensis)
  - loggerhead turtle (Caretta caretta)
  - green turtle (Chelonia mydas)
  - hawksbill turtle (Eretmochelys imbricata)
  - flatback turtle (Natator depressus)
- 9 are assessed as having a low likelihood of occurrence.

<u>Mammals</u>

Bryde's Whale (*Balaenoptera edeni*)

The Bryde's whale is listed under the 'migratory' and 'cetacean' schedules of the EPBC Act.

Bryde's whales occur in both temperate and tropical waters, oceanic and in-shore, bounded by latitudes 40°N and 40°S (Bannister et al. 1996), mostly swimming alone or in pairs. They are considered to be a fairly opportunistic feeders, readily consuming whatever shoaling prey is available (DSEWPC 2011). Future expansion of high-seas pelagic fisheries, particularly those targeting schooling pelagic fishes, may result in increased interactions with Bryde's whales, including incidental catches and injury (DSEWPC 2011).

The study area does not provide important habitat for Bryde's whales (DSEWPC 2011), and they are unlikely to occur in the vicinity of the project (**Table 22-37**).

Blue Whale (*Balaenoptera musculus*)

See **Section 22.15.1a)**.

Humpback whale (*Megaptera novaeangliae*)

See **Section 22.15.1a)**.

Killer Whale (*Orcinus orca*)

The killer whale is listed under the 'cetacean' and 'migratory' schedules under the EPBC Act. They are unlikely to occur in the areas surrounding the project site or in waters off-shore (**Table 22-37**).

Killer whales occur in all oceans and contiguous seas from equatorial regions to polar pack ice zones and may even ascend rivers. They are most numerous in coastal waters and cooler regions where productivity is high (Dalhlheim & Heyning 1999), and more commonly found around seal colonies.

Killer whale are unlikely to occur in the estuaries surrounding the project site or in waters off-shore (**Table 22-37**).

Australian Snubfin Dolphin (*Orcaella brevirostris*)

The Australian snubfin dolphin is listed under the 'migratory' and 'cetacean' schedules of the EPBC Act. The Australian snubfin dolphin is Australia's only endemic dolphin and was described as a separate species from the Irrawaddy dolphin (*Orcaella brevirostris*) in 2005 (Beasley et al. 2005).

The Australian snubfin dolphin is an opportunistic-generalist feeder, taking food from the bottom and water column within coastal and estuarine waters. Its diet consists primarily of fish, but includes cephalopods (squid and octopus) and crustaceans (prawns and crabs).

The Australian snubfin dolphin appears to be the rarest dolphin in Queensland (Parra et al. 2002). Little is known about the ecology and population status of this species throughout its range and this species is considered a high priority research species (Parra et al. 2006; Ross 2006). Coastal, estuarine and riverine areas are important for *Orcaella* species in other regions; however, only marine populations are evident in Australia. They appear to inhabit shallow waters <15 m deep within 10 km of the coast and 20 km of a river mouth. Their association with near-shore and estuarine tropical waters is likely related to the productivity of these waters and their diet consisting of a wide variety of coastal, estuarine and near-shore fishes (Parra et al. 2006).

Australian snubfin dolphin are moderately likely to occur in the estuarine areas adjacent to the project site and in areas off-shore of the project site (**Table 22-37**).

Indo-Pacific Humpback Dolphin (*Sousa chinensis*)

The Indo-Pacific humpback dolphin is listed under the 'migratory' and 'cetacean' schedules of the EPBC Act.

The distribution of Indo-Pacific humpback dolphins appears to be continuous along the east coast of Queensland (Corkeron et al. 1997). The Indo-Pacific humpback dolphin usually inhabits shallow coastal waters in association with rivers or creeks, estuaries, enclosed bays and coastal lagoons (Hale et al. 1998; Parra 2006). It mostly occurs in protected shallow waters (less than 15 m deep) that are close to the coast (within 10 km of the coast) and river and creek mouths (within 20 km of a river or creek) (Parra 2006).

The Indo-Pacific humpback dolphin is an opportunist-generalist feeder. It consumes a wide variety of coastal and estuarine fishes, but also reef, littoral and demersal fishes, and some cephalopods and crustaceans. It generally eats fish associated with mangrove habitats and is consequently affected by disturbances to these habitats (Parra 2005).

The Indo-Pacific humpback dolphin is moderately likely to occur in the estuarine areas adjacent to the project site and in areas off-shore of the project site (**Table 22-37**).

Dugong (Dugong dugon)

The dugong is listed under the 'migratory' and 'marine' schedules of the EPBC Act.

Dugongs feed almost exclusively on seagrass, particularly *H. uninervis, H. ovalis* and *H. spinulosa*, and principally inhabit seagrass meadows (Preen 1992; Preen et al. 1995; Lanyon & Morris 1997). Their dependence on seagrass for food generally limits them to waters within 20 km of the coast, although individuals have been sighted further from the coast during aerial surveys (e.g. Marsh & Lawler 2002) and they have been observed feeding in deep-water (water depth of more than 20 m) seagrass (Lee Long et al. 1997). Given the absence of seagrass in areas off-shore of Yorkeys Knob, dugong are unlikely to feed in areas close to the proposed development.

Dugongs prefer shallow and protected areas with seagrass meadows, however they can be highly migratory due to their search for suitable seagrass or warmer waters (Marsh et al. 2002) and are known to travel several hundreds of kilometres. Dugongs have evolved to cope with the inherently unpredictable and patchy nature of seagrass meadows by moving to alternative areas known to support seagrass in the past.

Dugong are moderately likely to occur in areas off-shore of the project site, and have a low likelihood of occurring in the estuaries surrounding the project site (**Table 22-37**).

<u>Reptiles</u>

Loggerhead Turtle (*Caretta caretta*)

See **Section 22.15.1a)**.

Green Turtle (*Chelonia mydas*)

See **Section 22.15.1a)**.

Leatherback Turtle (*Dermochelys coriacea*)

See **Section 22.15.1a)**.

Hawksbill Turtle (*Eretmochelys imbricata*)

See **Section 22.15.1a)**.

Olive Ridley Turtle (*Lepidochelys olivacea*)

See **Section 22.15.1a)**.

Flatback Turtle (*Natator depressus*)

See **Section 22.15.1a)**.

Sharks and Rays

Great White Shark (*Carcharodon carcharias*)

See **Section 22.15.1a)**.

Mackerel Shark (*Lamna nasus*)

The mackerel shark is listed under the 'migratory' schedule of the EPBC Act.

The mackerel shark is a wide ranging coastal and oceanic species found in temperate and cold-temperate waters worldwide, preferring water temperatures below 18°C (Stevens et al. 2006). The mackerel shark feeds on pelagic fish and cephalopods. Future expansion of high-seas pelagic fisheries, particularly those targeting schooling pelagic fishes, may result in increased interactions with killer whales, including incidental catches and injury.

Mackerel shark are unlikely to occur in the estuaries surrounding the project site or in waters off-shore (**Table 22-37**).

Giant Manta Ray (*Manta birostris*)

The giant manta ray is listed under the 'migratory' schedule of the EPBC Act. The *Manta* genus was recently re-evaluated and split into two species based on genetic evidence; the reef manta ray (*Manta alfredi*) and the giant manta ray (*Manta birostris*) (Kashiwagi et al. 2008; Marshall et al. 2009; Ito & Kashiwagi 2010).

The giant manta ray has a widespread distribution, being found in both tropical and temperate waters of the Atlantic, Pacific and Indian Oceans. The giant manta ray is likely to be a more oceanic and more migratory species than the reef manta ray (A. Marshall et al. unpubl. data from IUCN 2013).

The giant manta ray is not regularly encountered in large numbers, but is generally sighted along productive coastlines with regular upwelling, oceanic island groups and particularly off-shore pinnacles and seamounts. They can also be encountered on shallow reefs while being cleaned or feeding at the surface inshore and off-shore. In inshore areas, they can occasionally be observed in sandy bottom areas and seagrass beds.

The study area is unlikely to provide significant habitat for the giant manta ray. Giant manta rays are unlikely to occur in the estuaries surrounding the project site or in waters off-shore (**Table 22-37**).

Whale Shark (*Rhincodon typus*)

See **Section 22.15.1a)**.

c) Listed Marine Species

Listed marine species are protected in Commonwealth Marine Areas under the EPBC Act.

TABLE 22-38 MARINE SPECIES IN THE COMMONWEALTH MARINE AREA

SPECIES	COMMON NAME	EPBC ACT LISTING STATUS	LIKELIHOOD OF OCCURRENCE OFF-SHORE IN THE COMMONWEALTH MARINE AREA OFF-SHORE OF THE SITE
Mammals			
Dugong dugon	dugong	M, O	Moderate
Reptiles			
Acalyptophis peroneii	horned seasnake	O	Moderate
Aipysurus duboisii	Dubois' seasnake	O	Moderate
Aipysurus eydouxii	spine-tailed seasnake	O	Moderate
Aipysurus laevis	olive seasnake	O	Moderate
Astrotia stokesii	Stoke's seasnake	O	Moderate
Caretta caretta	loggerhead turtle	E, M, O	Moderate
Chelonia mydas	green turtle	V, M, O	Moderate
Dermochelys coriacea	leatherback turtle	E, M, O	Low
Disteira kingii	spectacled seasnake	O	Moderate
Disteira major	olive-headed seasnake	O	Moderate
Enhydrina schistosa	beaked seasnake	O	Moderate
Eretmochelys imbricata	hawksbill turtle	V, M, O	Moderate
Hydrophis elegans	elegant seasnake	O	Moderate
Hydrophis mcdowelli	small-headed seasnake	O	Moderate
Hydrophis ornatus	– (a seasnake)	O	Moderate
Lapemis hardwickii	spine-bellied seasnake	O	Moderate
Laticauda colubrina	– (a sea krait)	O	Moderate
Lepidochelys olivacea	Olive Ridley turtle	E, M, O	Low
Natator depressus	flatback turtle	V, M, O	Moderate
Fish			
Halicampus nitidus	glittering pipefish	O	Low
Halicampus spinirostris	spiny-snout pipefish	O	Low
Hippichthys cyanospilos	blue-speckled pipefish	O	Low
Hippichthys heptagonus	Madura pipefish	O	Low
Hippichthys penicillus	beady pipefish	O	Low
Hippichthys spicifer	belly-barred pipefish	O	Low
Hippocampus bargibanti	pygmy seahorse	O	Low

SPECIES	COMMON NAME	EPBC ACT LISTING STATUS	LIKELIHOOD OF OCCURRENCE OFF-SHORE IN THE COMMONWEALTH MARINE AREA OFF-SHORE OF THE SITE
Hippocampus histrix	spiny seahorse	O	Low
Hippocampus kuda	spotted seahorse	O	Low
Hippocampus planifrons	flat-faced seahorse	O	Low
Hippocampus zebra	zebra seahorse	O	Low
Micrognathus andersonii	Anderson's pipefish	O	Low
Micrognathus brevirostris	thorntail pipefish	O	Low
Microphis brachyurus	short-tail pipefish	O	Low
Nannocampus pictus	painted pipefish	O	Low
Phoxocampus diacanthus	pale-blotched pipefish	O	Low
Siokunichthys breviceps	softcoral pipefish	O	Low
Solegnathus hardwickii	pallid pipehorse	O	Low
Solenostomus cyanopterus	robust ghost pipefish	O	Low
Solenostomus paegnius [1]	rough-snout ghost pipefish	O	Low
Solenostomus paradoxus	ornate ghost pipefish	O	Low
Syngnathoides biaculeatus	double-end pipehorse	O	Low
Trachyrhamphus bicoarctatus	bentstick pipefish	O	Low
Trachyrhamphus longirostris	straightstick pipefish	O	Low

Legend

E endangered

V vulnerable

M migratory species

O marine species

C whales and other cetaceans

– no common name

[1] listed under *Solenostomus cyanopterus* in Species Profile and Threats (SPRAT) Database

As shown in **Table 22-38**, 65 marine species (excluding birds) were listed adjacent to the project site and in marine areas off-shore within 5 km of the project site. This includes:

- 45 fish species
- one mammal species that was also listed as migratory
- 19 reptile species, including:
  - six species that were listed as migratory
  - six species that were listed as threatened (either endangered or vulnerable).

Of these:

- 18 are assessed as having a moderate likelihood of occurrence
- 27 are assessed as having a low likelihood of occurrence.

Species listed as marine under the EPBC Act are protected within Commonwealth Marine Areas (i.e. 3–200 nm from the Queensland coastline).

<u>Mammals</u>

The dugong (*Dugong dugon*) is a listed marine species, and is moderately likely to occur in Commonwealth Marine Areas off-shore of the project site (**Table 22-38**).

Reptiles

Nineteen species of reptile were listed within 5 km of the project site, including:

- six species of marine turtle (described in **Section 22.15.1a)**).
- 13 species of seasnake or sea krait.

Sea snakes and sea kraits are predatory marine reptiles that inhabit shallow, tropical waters over reef, inter-reef or sandy habitats throughout the Indo-Pacific region (Stokes 2004). The highest diversity occurs in northern Australia and south-east Asia. There are approximately 54 species within approximately 13 genera, and each genus is represented by both widespread and endemic species. The two largest genera, *Aipysurus* and *Hydrophis*, account for more than half of all species. Six of the seven *Aipysurus* species are restricted to Australasian waters. By contrast, species diversity of the genus *Hydrophis* is highest in southeast Asia, with up to eight species reported from Australian waters, and five of these appearing to be Australasian endemics (Lukoschek 2008 and references cited within).

Basic biological, distributional, and ecological information is limited for most seasnakes (Lukoschek 2008); the olive seasnake is one of the most studies species. The olive seasnake typically occurs at discrete reefs, with habitat preference related to reef location, exposure and area; distribution did not appear to be related to the protection status of reefs (GBRMP zoning). Factors driving spatial and temporal changes are poorly understood (Lukoschek 2008 and references cited within). Studies of the olive seasnake in the Keppel Island region found that this species maintains small home ranges over short time periods, and that females have larger home ranges than males (Burns & Heatwole 1998; Lynch 2000). Males also appear to move off reefs in the summer, returning to the same or a nearby reef to mate in winter (Lynch 2000). Despite their ability to expand into new marine habitats, local populations appear to be relatively isolated and, if subject to extinction, are unlikely to re- establish by dispersal (Lukoschek 2008 and references cited within).

Seasnakes are moderately likely to occur in the Commonwealth Marine Area off-shore of the project site.

Fish

Forty species of pipefish / pipehorse and five species of seahorse were listed within 5 km of the project site.

Very little is known about the biology of pipefish, pipehorse and seahorse species in Queensland waters. About half of the world's Syngnathids species live in Australian waters, and there are approximately 49 species of pipefish / pipehorse, and nine seahorse species known from the GBRWHA (Stokes et al. 2004). Species from the families Syngnathidae and Solenostomidae have been found attached to seagrass, gorgonians, drifting debris (after storms or floods), live coral, mangrove roots, floating *Sargassum*, or swimming freely in mid-water (Lightowler 1998 and Vincent 1996 from Stokes et al. 2004). Foster and Vincent (2013) found that the most commonly reported seahorse habitat was seagrass, while mangroves were the least reported. Tropical species are primarily found among coral reefs (Scales 2010; Foster & Vincent 2013).

Syngnathids have low mobility, and small home ranges, and are typically found in water 1–15 m deep; however, some species occur at 45–60 m depth (Stokes et al. 2004). Some seahorse species change habitat and depth choice as they grow (Foster and Vincent 2004). Several characteristics of their life history, including low fecundity, lengthy parental care and mate fidelity, render the Syngnathids vulnerable to overfishing and habitat damage (Foster and Vincent 2013).

Given the likely absence of seagrass beds in the off-shore study area, pipefish, pipehorse and seahorse are unlikely to be common in Commonwealth Marine Areas within 5 km of the project site.

d) Whales and Other Cetaceans

All cetaceans are protected in Commonwealth Marine Areas under the EPBC Act. The Australian Whale Sanctuary includes all Commonwealth waters from the three nautical mile state waters limit out to the boundary of the Exclusive Economic Zone (i.e. out to 200 nautical miles and further in some places) (DoTE 2014c). Cetacean species that are listed as migratory or threated under the EPBC Act are also protected in state waters (i.e. coastal waters to three nautical miles and other waters under Queensland jurisdiction).

TABLE 22-39 WHALES AND OTHER CETACEANS

SPECIES	COMMON NAME	EPBC ACT LISTING STATUS	LIKELIHOOD OF OCCURRENCE OFF-SHORE IN THE COMMONWEALTH MARINE AREA OFF-SHORE OF THE PROJECT SITE
Balaenoptera acutorostrata	minke whale	C	Moderate
Balaenoptera edeni	Bryde's whale	M, C	Low
Balaenoptera musculus	blue whale	E, M, C	Low
Delphinus delphis	common dolphin	C	Moderate
Grampus griseus	Risso's dolphin	C	Moderate
Megaptera novaeangliae	humpback whale	V, M, C	Moderate
Orcaella brevirostris [1]	Australian snubfin dolphin	M, C	Moderate
Orcinus orca	killer whale	M, C	Low

SPECIES	COMMON NAME	EPBC ACT LISTING STATUS	LIKELIHOOD OF OCCURRENCE OFF-SHORE IN THE COMMONWEALTH MARINE AREA OFF-SHORE OF THE PROJECT SITE
Sousa chinensis	Indo-Pacific humpback dolphin	M, C	Moderate
Stenella attenuata	spotted dolphin	C	Moderate
Tursiops aduncus	Indian Ocean bottlenose dolphin	C	Moderate
Tursiops truncatus	bottlenose dolphin	C	Moderate

Legend:

E endangered

V vulnerable

M migratory species

O marine species

C whales and other cetaceans

[1] previously considered to be *Orcaella brevirostris* (Irrawaddy dolphin); the Australian snubfin dolphin was formally recognised as a separate species in 2005 (GBRMPA 2012)

As shown in **Table 22-39**, 12 whales and other cetaceans were listed in the Commonwealth Marine Area off-shore of the proposed development. Of these:

- 9 are assessed as having a moderate likelihood of occurrence
- 3 are assessed as having a low likelihood of occurrence.

Of the species listed:

- six species were also listed as migratory
- two species were also listed as threatened (one as vulnerable and one as endangered).

All cetaceans are protected in Commonwealth Marine Areas under the EPBC Act.

<u>Whales</u>

Minke Whale (*Balaenoptera acutorostrata*)

The study area is unlikely to be an important habitat for minke whales and they are unlikely to feed in the area, however they may traverse open waters off-shore of the project site during their annual migration.

This species undertakes extensive migrations between cold water feeding grounds and warmer water breeding grounds. Migration paths are presumably widespread (approximately 12 to 65°S), although they are less predictable than most other Balaenopterids, such as the humpback whale, and the exact location of breeding grounds is not known. Minke whales feed predominantly on *Euphausia superba* (Antarctic krill) and smaller krill (Bannister et al. 1996).

Minke whales are moderately likely to occur in Commonwealth Marine Areas off-shore of the project site (**Table 22-39**).

Bryde's Whale (*Balaenoptera edeni*)

See **Section 22.15.1a)**.

Blue Whale (*Balaenoptera musculus*)

See **Section 22.15.1a)**.

Humpback Whale (*Megaptera novaeangliae*)

See **Section 22.15.1a)**.

Killer Whale (*Orcinus orca*)

See **Section 22.15.1a)**.

<u>Other Cetaceans</u>

Common Dolphin (*Delphinus delphis*)

Common dolphins are very gregarious species, typically observed in Australian waters in large groups. The species is not known to be migratory (Bannister et al. 1996) although they are highly mobile and capable of moving long distances (Ross 2006). The common dolphin is an opportunistic feeder that may move in-shore or off-shore following food (Ross 2006). It is known to feed on mesopelagic fish and cephalopods (Bannister et al. 1996) to a depth of 280 m but also at the surface and in association with tuna (Ross 2006).

Common dolphins are moderately likely to occur in Commonwealth Marine Areas off-shore of the project site (**Table 22-39**).

Risso's Dolphin (*Grampus griseus*)

Risso's dolphins are considered to be pelagic and oceanic species to latitudes of ~55° (Ross 2006). They inhabit both in-shore and off-shore waters and are most frequently seen over the continental slope. Off-shore waters of Fraser Island have the only known 'resident' population in Australia (Bannister et al. 1996). Risso's dolphins feed primarily on squid, some octopus and possibly fish (Bannister et al. 1996).

Risso's dolphins are moderately likely to occur in Commonwealth Marine Areas off-shore of the project site (**Table 22-39**).

Australian Snubfin Dolphin (*Orcaella brevirostris*)

See **Section 22.15.1a)**.

Indo-Pacific Humpback Dolphin (*Sousa chinensis*)

See **Section 22.15.1a)**.

Spotted Dolphin (*Stenella attenuata*)

Spotted dolphins are mostly found in oceanic tropical zones between about 40°N and 40°S, inhabiting both near-shore and oceanic habitats. Although no population size is known for spotted dolphins in Australia, they are not thought to be rare (DoTE 2013f). Spotted dolphins feed mainly on small epipelagic and mesopelagic fish, and squids. Nemertean worms and crab larvae are also consumed on occasion (Sekiguchi et al. 1992; Würtz et al. 1992).

Spotted dolphins are moderately likely to occur in Commonwealth Marine Areas off-shore of the project site (**Table 22-39**).

Indian Ocean Bottlenose Dolphin (*Tursiops aduncus*)

The taxonomy of the genus *Tursiops* is controversial. *Tursiops aduncus*, the current taxon of the Indian Ocean bottlenose dolphin, occurs widely around Australia in large groups (Hale et al. 2000 in Ross 2006). The species is highly visible and relatively common in coastal, estuarine, pelagic and oceanic waters between about 65°N and 55°S; it is found slightly further off-shore where sympatric with the Indo-Pacific humpbacked dolphin (Bannister et al. 1996).

This species is generally considered an opportunistic feeder on items such as fish, cephalopods and crustaceans (DoTE 1997) and often feeds in association with trawlers (Bannister et al. 1996).

Indian Ocean bottlenose dolphins are moderately likely to occur in Commonwealth Marine Areas off-shore of the project site (**Table 22-39**).

Bottlenose Dolphin (*Tursiops truncatus*)

Tursiops truncatus is currently considered the more poorly known species of the *Tursiops* genus in Australian waters. They are usually found off-shore in waters deeper than 30 m (Hale et al. 2000; Ross 2006) but also appear be found in some coastal waters (Hale et al. 2000; Kemper 2004). The bottlenose dolphin tends to inhabit cooler, deeper off-shore waters than the Indo-Pacific bottlenose dolphin (Bannister et al. 1996).

No information is available on their biology in Australian waters but studies in South Africa suggest they feed on squid and fish from deep, cool waters (Ross 1984 in Ross 2006).

Bottlenose dolphins are moderately likely to occur in Commonwealth Marine Areas off-shore of the project site (**Table 22-39**).

e) Critical Habitats and Commonwealth Marine Reserves

There are no critical habitats or Commonwealth marine reserves listed within 5 km of the project site.

f) Contribution to GBR Values and Processes

<u>Values</u>

The following is based on an extract of Table 4.8 of GBRMPA (2013a) dealing with listed terrestrial migratory species. As for **Table 22-20**, the following deals with:

- the key values and attributes (Table 4.8 column 1)
- GBRMPA assessment of presence for the value at the GBR level (Table 4.8 columns 11, 16, 17, and 18) – columns 2, 4, 6, and 8 below shaded and marked 'G' = GBR
- study team assessment of presence for the process at the Aquis site level (columns 3, 5, 7, and 9 below) – unshaded and marked 'S' = Site
- integrity (column 6 of Table 4.9) has been included in this table (columns 10 and 11) as this is relevant to the viability of habitats of listed species.

This table therefore provides a checklist of those Matters of NES values (listed migratory and threatened marine species) that are present at or in the immediate vicinity of the site (or are likely to be influenced in some way by the proposed development).

TABLE 22-40 KEY MATTERS OF NES VALUES AND ATTRIBUTES AT GBR AND SITE LEVEL

Key values and attributes	Marine turtles		Whales		Dolphins		Dugong		Sharks and rays	
	G	S	G	S	G	S	G	S	G	S
Biodiversity – GBR habitats										
Islands	•									
Beaches and coastlines	•	•								
Mangrove forests	•	•								
Seagrass meadows	•				•		•		•	
Coral reefs (<30 m)	•								•	
Deeper reefs (>30 m)	•								•	
Lagoon floor					•		•		•	
Shoals					•				•	
Halimeda banks	•									
Continental slope										
Open waters	•	•	•	•	•	•	•	•	•	•
Biodiversity – terrestrial habitats that support the GBR										
Saltmarshes										
Freshwater wetlands										
Forested floodplain										
Biodiversity – terrestrial habitats that support the GBR (cont.)										
Heath and shrublands										
Grass and sedgelands										
Woodlands										
Forests										
Rainforests										
Connecting waterbodies	•	•	•	•	•	•	•	•	•	•
Biodiversity – species										
Mangroves										
Seagrasses	•						•			
Macroalgae	•	•								
Benthic microalgae										
Corals										
Other invertebrates	•	•	•	•	•	•			•	•

Key values and attributes	Marine turtles		Whales		Dolphins		Dugong		Sharks and rays	
	G	S	G	S	G	S	G	S	G	S
Plankton and microbes			•							
Bony fish			•	•	•	•			•	•
Sharks and rays									•	
Sea snakes										
Marine turtles	•	•								
Estuarine crocodiles										
Seabirds										
Shorebirds										
Whales			•							
Dolphins					•					
Dugongs							•			
Geomorphological features										
Coral reefs										
Islands and shorelines	•									
Channels and canyons										
River deltas										
Halimeda banks										
Geomorphological features (cont.)										
Seagrass meadows	•									
Indigenous heritage										
Cultural practices, observances, customs and lore	•		•		•		•		•	
Sacred sites, sites of particular significance, places important for cultural tradition										
Stories, songlines, totems and languages	•		•		•		•		•	
Indigenous structures, technology, tools and archaeology										
Historic heritage										
Places of historic significance — historic shipwrecks										
Places of historic significance — World War II features and sites										
Places of historic significance — lightstations										
Places of historic significance — other										
Places of scientific significance (research stations, expedition sites)										
Places of social significance — iconic sites										

Key values and attributes	Marine turtles		Whales		Dolphins		Dugong		Sharks and rays	
	G	S	G	S	G	S	G	S	G	S
Community benefits of the environment										
Income										
Employment										
Understanding										
Appreciation										
Enjoyment										
Access to reef resources										
Personal connection										
Health benefits										
Aesthetics	•	•	•	•	•	•	•	•	•	•

Source: Study team compilation. Key values and attributes and shaded columns (G) relate to the GBR and are extracted from GBRMPA (2013a) Table 4.8. Unshaded columns are the study team's assessments of presence.

Various attributes from this checklist are used to identify likely habitats and food sources for the target species. The following discussion aggregates all of these site values into the broader discussion of species distribution, habitat preferences, and local resources of relevance.

Environmental Processes

The following is based on an extract of Table 4.9 of GBRMPA (2013a) dealing with listed marine migratory species. As for Table 22-21, the following deals with:

- the key process (Table 4.9 column 1)
- GBRMPA assessment of presence for the process at the GBR level (Table 4.9 columns 10, 12, 13, 14, and 15) – columns 2, 4, 6, 8, and 10 below shaded and marked 'G' = GBR
- study team assessment of presence for the process at the Aquis site level (columns 3, 5, 7, 9, and 11 below) – unshaded and marked 'S' = Site.

This table therefore provides a checklist of those Matters of NES values (listed migratory and threatened marine species) that are present at or in the immediate vicinity of the site (or are likely to be influenced in some way by the proposed development).

TABLE 22-41 KEY WHA ENVIRONMENTAL PROCESSES AT GBR AND SITE LEVEL

Key values and attributes	Marine turtles		Whales		Dolphins		Dugong		Sharks and rays	
	G	S	G	S	G	S	G	S	G	S
Waves, currents and tides	•									
Cyclones	•				•		•		•	
Wind										
Sedimentation							•			
Sea level	•									
Sea temperature	•									
Light	•	•					•	•		
Nutrient cycling										
Ocean acidity										
Freshwater inflow and salinity										
Microbial processes										
Particle feeding	•						•			
Primary production										
Herbivory										
Predation	•		•		•				•	
Symbiosis										
Competition	•		•		•		•		•	
Connectivity	•	•	•	•	•	•	•	•	•	•
Recruitment	•		•		•		•		•	
Reef building										

Source: Study team compilation. Key environmental processes and shaded columns (G) relate to the GBR and are extracted from GBRMPA (2013a) Table 4.9. Unshaded columns are the study team's assessments of presence.

As for **Table 22-46**, various attributes from this environmental processes checklist aggregated into the broader discussion of species, habitats, and the processes upon which they depend.

<u>Discussion</u>

Twenty-four threatened aquatic fauna species are listed as occurring within 5 km of the site. With the exception of the estuarine or saltwater crocodile (*Crocodylus porosus*), none of these species were recorded in the field surveys (frc environmental 2013). Some key findings are as follows (frc environmental 2013).

Marine Mammals

Seven dolphin species have been recorded from coastal waters downstream of the proposed development site:

- In-shore bottlenose dolphins (*Tursiops truncatus*)
- Common dolphin (*Delphinus delphis*)
- Risso's dolphin (*Grampus griseus*)
- Irrawaddy dolphin (Orcaella brevirostris)
- Indo-Pacific humpback dolphin (*Sousa chinensis*)
- Spotted dolphin (*Stenella attenuata*)
- Indian Ocean bottlenose dolphin (*Tursiops aduncus*).

The habitats adjacent to the proposed development site are unlikely to provide significant habitat for any of these species, due to the shallow waters and high potential for the creeks to be cut off from the ocean at low tide.

Dugongs are most often seen amongst or above seagrass beds. Given that there is no seagrass adjacent to the subject land (see **Section 22.6.1c)**), dugong are unlikely to occur in the vicinity of the site (the nearest mapped seagrass is at Ellie Point (near the Cairns International Airport). Although unlikely, seagrass may exist beyond the extent of the water surveyed in the subtidal zone. There are no Dugong Protection Areas in the vicinity of the proposed site and dugongs are unlikely to occur within 5 km of the proposed site.

Whales have been recorded off-shore of Cairns, with five species recorded as likely to occur downstream of the proposed development site on the online protected matters search tool for Commonwealth protected species:

- humpback whale (Megaptera novaeangliae)
- minke whale (Balaenoptera acutorostrata)
- Bryde's whale (Balaenoptera edeni)
- blue whale (Balaenoptera musculus)
- killer whale (*Orcinus orca*).

The small creeks surrounding the site of the proposed development do not provide habitat for any whale species.

Marine Reptiles

Six species of marine turtles have been recorded from estuarine waters adjacent to and downstream of the proposed development site. There is little significant habitat or food for marine turtles in the vicinity of the proposed development site. Nevertheless, some species, including green turtles, may forage in these creeks, particularly in the mangrove habitats (Bunce pers. comm. 2013). The beaches of Trinity Bay are not recognised as major nesting areas for any marine turtle species (Worley Parsons 2010). Further, technical staff from the EHP are not aware of the results of any surveys of marine turtles nesting in the vicinity of the proposed development. However, it is likely that there is some sparse nesting of marine turtles on the beaches in the vicinity of the proposed development (Bunce pers. comm. 2013, Trenerry 2013 pers. comm.).

TABLE 22-42 MARINE TURTLES AND LIKELIHOOD OF OCCURRENCE NEAR THE PROJECT SITE

SPECIES	COMMON NAME	PREFERRED HABITAT	LIKELIHOOD OF OCCURRENCE
Caretta caretta	Loggerhead turtle	This species has a tropical and subtropical distribution and inhabit subtidal and intertidal coral and rocky reefs and seagrass meadows as well as deeper soft-bottomed habitats of the continental shelf. In Queensland, breeding and nesting is mainly in the southern Great Barrier Reef (Capricorn/Bunker group) and adjacent coastal areas near Bundaberg (e.g. Mon Repos, Wreck Rock and Tryon Island).	Possible, but not likely to be common
Chelonia mydas	Green turtle	This species has a tropical and subtropical distribution in seaweed rich coral reefs and in-shore seagrass beds. Eastern Australian populations nest around the Capricorn Bunker Group of the southern Great Barrier Reef. Northern Great Barrier Reef populations nest on islands of the outer edge of the reef (e.g. Raine Island).	Possible, but not likely to be common
Dermochelys coriacea	Leatherback turtle	Leatherback turtles are found in all oceans of the world. Their feeding grounds are mainly in temperate waters but they breed in tropical areas. Leatherback turtles are most commonly found in temperate waters feeding primarily on macroplankton (jellyfish, salps). Leatherback turtles are oceanic and are rarely found close to shore in Australia. Leatherback turtles feed and occasionally nest within the Great Barrier Reef Marine Park with nesting recorded at Wreck Rock and adjacent beaches near Bundaberg. There is sporadic nesting at other widely scattered sites in Queensland.	Highly unlikely
Eretmochelys imbricate	Hawksbill turtle	This species has a tropical and temperate distribution, typically found in tidal or subtidal coral and rocky reefs. In Australia, hawksbills feed in rocky areas and on coral reefs. They are commonly seen around the Great Barrier Reef including Torres Strait islands. There are three main breeding areas in Australia: the far northern section of the Great barrier Reef Marine Park and the Torres Strait region, north eastern Arnhem land and Western Australia.	Possible, but not likely to be common

SPECIES	COMMON NAME	PREFERRED HABITAT	LIKELIHOOD OF OCCURRENCE
Lepidochelys olivacea	Olive ridley turtle	This species has a tropical and subtropical distribution, and is found in shallow soft-bottomed habitats in protected waters. These turtles are solitary, preferring the open ocean. The olive ridley is mostly carnivorous, feeding on jellyfish, snails, crabs, and shrimp. They are found from southern Queensland and the Great Barrier Reef to Torres Strait. There are two main breeding areas for olive ridley turtles in Australia, one in the Northern Territory with about 1000 nesting females per year, and the other in the Gulf of Carpentaria with less than 100 nesting females per year. No nesting by the species has been recorded in the Great Barrier Reef World Heritage Area.	Unlikely
Natator depressus	Flatback turtle	Flatback turtles are only found on the continental shelf of Australia. Although they feed around Papua New Guinea and Indonesia as well as within the Great Barrier Reef Marine Park, they nest only in Australia. Breeding is centred in the southern Great Barrier Reef around Peak, Wild Duck, Curtis and Facing Islands. However, there is low density nesting on many mainland beaches and off-shore islands north of Gladstone. Most nesting occurs on Crab Island in western Torres Strait.	Unlikely

There are several species of seasnake in the coastal waters downstream of the proposed development site. This includes the olive seasnake (*Aipsurus laevis)* and yellow-bellied seasnake (*Pelamis platurus).* The creeks surrounding the proposed development site are unlikely to provide significant habitat for these species.

Other Species

The Lake Eacham Rainbowfish (*Melanotaenia eachamensis*), a freshwater fish, is listed as occurring in the area, but is highly unlikely to occur near the site.

The opal cling goby (*Stiphodon semoni*), is listed as critically endangered under the EPBC Act, and has been recorded both to the north and south of the site. While larvae migrate to the ocean through small coastal streams, adults are usually found in pristine rainforest streams, consequently the waters surrounding the site are unlikely to provide significant habitat for this species.

There are several species, mainly syngnathids (seahorses and pipefish) and seasnakes that are protected under the syngnathids schedule of the EPBC Act as listed marine species and are considered moderately or highly likely to use habitat in the study area. These are protected only if found in Commonwealth marine waters.

Seagrass Habitat

According to frc environmental (2013), most of the seabed habitats within and surrounding the Port of Cairns, including the habitats off-shore of the proposed development site, are within a narrow strip of the Great Barrier Reef's High Nutrient Coastal Strip, which is characterised by muddy sediment and elevated nutrients (GBRMPA 2001). In 2007, frc environmental surveyed Half Moon Creek and did not find any seagrass in or adjacent to the creek mouth (frc environmental 2007). There are no other known records of seagrass in Half Moon, Yorkeys or Thomatis / Richters Creek, nor in the waters off-shore of these creeks.

The closest recorded seagrass bed is at the mouth of Trinity Inlet, approximately 8 km south-east of the proposed development site (DAFF 2013). The seagrass beds in Trinity Inlet are a small portion of the total area of seagrass along the tropical Queensland coast and their limited distribution, and localised relative abundance, provides a disproportionately important nursery ground for prawns and other commercially and recreationally important species (Lee Long et al. 1993; Rasheed et al. 2013). However, in the past four years rainfall in the wet season has been above average, which, combined with the 2010/11 La Niña and tropical cyclone Yasi, have resulted in major decreases in the distribution and abundance of seagrass along the north-eastern coast of Queensland, including the seagrass beds in Trinity Inlet. Seagrass density in Trinity Inlet are currently the lowest since monitoring began in 2001 (Rasheed et al. 2013). Thirteen seagrass species are recorded from the region, with seagrass meadows around Cairns Harbour usually dominated by *Zostera muelleri* subsp. *capricorni*. Seagrass meadows typically have a greater distribution and are denser in the dry season (October to November) when light and temperature conditions are most favourable.

Light

The project area does not currently contain any significant light sources and in any event is well-screened from the GBRWHA by dense fringing vegetation.

Connectivity

Connectivity of terrestrial habitats plays an important role in maintain ecosystem services that help sustain the GBR this has been discussed extensively in relation to terrestrial ecology.

g) Summary

Matters of national environmental significance that may be affected by the Aquis development with respect to aquatic ecology include:

- world heritage properties – GBRWHA
- national heritage places – GBR national heritage place
- Commonwealth heritage places – GBR region
- GBRMP – see below
- Commonwealth Marine Areas
- 13 nationally threatened aquatic species (5 are assessed as having a moderate likelihood of occurrence, 8 are assessed as having a low likelihood of occurrence)
- 17 nationally migratory species (8 are assessed as having a moderate likelihood of occurrence, 9 are assessed as having a low likelihood of occurrence)
- 65 listed marine species (including fish, sharks, mammals and reptiles) (18 are assessed as having a moderate likelihood of occurrence, 29 are assessed as having a low likelihood of occurrence)
- 12 whales and other cetaceans (9 are assessed as having a moderate likelihood of occurrence, 3 are assessed as having a low likelihood of occurrence).

There are no critical habitats or Commonwealth marine reserves listed under the EPBC Act within 5 km of the project site.

22.15.2 Potential Impact

Referring to **Table 22-12**, for this matter of NES the construction and operation of Aquis is likely to have:

- potential minor adverse construction impacts of local significance on the following impact categories:
  - acid sulfate soil
  - dredging
  - light
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off
  - small chemical spills
  - urban discharge
- potential minor adverse operation impacts of local significance on the following impact categories:
  - light
  - small chemical spills
  - urban discharge
- potential minor beneficial operation impacts of local significance on the following impact categories:
  - artificial barriers to flow
  - increased freshwater inflow
- potential major regional to reef-wide beneficial operation impacts on the following impact categories (probably only locally significant):
  - modifying supporting terrestrial habitats
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off.

See **Section 22.15.4** below.

22.15.3 Proposed Mitigation and Effectiveness

See **Section 22.15.4** below.

22.15.4 Significance of Mitigated Impact

The *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoTE 2013c) indicate that an action will require approval if the action has, will have, or is likely to have a significant impact on a listed species.

a) Critically Endangered or Endangered Species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of a population*
- *reduce the area of occupancy of the species*
- *fragment an existing population into two or more populations*
- *adversely affect habitat critical to the survival of a species*
- *disrupt the breeding cycle of a population*
- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*
- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*
- *introduce disease that may cause the species to decline, or*
- *interfere with the recovery of the species.*

Five of the 13 aquatic threatened species listed within 5 km of the project site are listed as endangered under the EPBC Act. Of these species, the loggerhead turtle is considered moderately likely to occur off-shore of the project site. No endangered aquatic species are considered likely to occur in the estuaries surrounding the project site. The significant impact assessment for these species is presented below.

TABLE 22-43 SIGNIFICANT IMPACT ASSESSMENT FOR LISTED ENDANGERED SPECIES

SIGNIFICANCE CRITERION	**LOGGERHEAD TURTLE (*CARETTA CARETTA*)**
Lead to a long-term decrease in the size of a population	Populations of loggerhead turtles in the region are low are likely to represent only migratory and foraging individuals along the coast.
Reduce the area of occupancy of the species	The area downstream of the project site is not a known breeding or aggregating area for loggerhead turtles.
Fragment an existing population into two or more populations	Loggerhead turtles of the study area are likely to be transient. The project will not fragment habitat for this species.
Adversely affect habitat critical to the survival of a species	The study area is not considered to be near any habitat recognised as critical to loggerhead turtle populations.
Disrupt the breeding cycle of a population	The study area is not a known loggerhead turtle breeding ground and should not impact on the breeding cycle.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Direct disturbance to bare (non-vegetated) substrates will occur at the mouth of Richters Creek and off-shore, along the inlet pipeline footprint. This habitat is not essential to the survival or reproduction of loggerhead turtles and thus no long-term impacts to the species are predicted to occur.
Result in invasive species that are harmful to a critically endangered or endangered species Becoming established in the endangered or critically endangered species' habitat	It is unlikely that a harmful invasive species will be introduced during any stage of the project.
Introduce disease that may cause the species to decline	There is limited potential for disease to be introduced to loggerhead turtle populations, through introduced pests or other means.

SIGNIFICANCE CRITERION	LOGGERHEAD TURTLE (*CARETTA CARETTA*)
Interfere with the recovery of the species	The project is not located near breeding or nesting sites. Low numbers of loggerhead turtles may forage in Trinity Inlet south of the project site, but they are unlikely to occur in sufficient numbers immediately downstream of the project site. The project is not expected to interfere with the recovery of this species.
Overall impact assessment result	The study area does not support an important population of loggerhead turtles and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on loggerhead turtles

Overall conclusion: The study area does not support an important population of loggerhead turtles and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on loggerhead turtles.

b) Vulnerable Species

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of an important population of a species*
- *reduce the area of occupancy of an important population*
- *fragment an existing important population into two or more populations*
- *adversely affect habitat critical to the survival of a species*
- *disrupt the breeding cycle of an important population*
- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*
- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*
- *introduce disease that may cause the species to decline, or*
- *interfere substantially with the recovery of the species.*

Seven of the 13 aquatic threatened species listed within 5 km of the project site are listed as vulnerable under the EPBC Act. Of these species, three species – the green turtle, hawksbill turtle, and humpback whale – are moderately likely to occur off-shore of the project site. The green turtle is also moderately likely to occur in the estuaries surrounding the project site.

The significant impact assessment for these species is presented in **Table 22-44**.

TABLE 22-44 SIGNIFICANT IMPACT ASSESSMENT FOR LISTED VULNERABLE SPECIES

SIGNIFICANCE CRITERION	**ASSESSMENT**			
	GREEN TURTLE (*CHELONIA MYDAS*)	**HAWKSBILL TURTLE (*ERETMOCHELYS IMBRICATA*)**	**HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*)**	**FLATBACK TURTLE (*NATATOR DEPRESSUS*)**
Lead to a long-term decrease in the size of an important population of a species	The project site does not represent a unique habitat type that the green turtle would depend on. No significant impacts to green turtle populations are expected to occur.	The presence of hawksbill turtles in the region is not known, but there are only likely to be migratory populations along the coast near the proposed development.	The presence of humpback whales in the region is seasonal, with the migration period occurring from June/July to October/November. The potential for interaction with migrating humpback whales is minimal and no long-term effects are predicted to significantly impact the east Australian humpback whale population from the project.	The presence of flatback turtles in the region is not known, but there are only likely to be migratory populations along the coast near the proposed development.
Reduce the area of occupancy of an important population	The area downstream of the project site is not a known breeding or aggregating area for green turtles.	The area downstream of the project site is not a known breeding or aggregating area for hawksbill turtles.	The Great Barrier Reef is a known breeding and aggregating area for humpback whales. However, the project will not have an impact on the habitat of this species.	The area downstream of the project site is not a known breeding or aggregating area for flatback turtles.
Fragment an existing important population into two or more populations	The occurrence of green turtles downstream of the project site is transient. The project will not fragment any marine habitats.	The occurrence of hawksbill turtles downstream of the project site is transient and most likely seasonal. The project will not fragment any marine habitats.	The occurrence of humpback whales downstream of the project site is seasonal. The project will not fragment any marine habitats.	The occurrence of flatback turtles downstream of the project site is transient and most likely seasonal. The project will not fragment any marine habitats.
Adversely affect habitat critical to the survival of a species	The project site is not considered to be near any habitat recognised as critical to green turtle populations.	The project site is not considered to be near any habitat recognised as critical to hawksbill turtle populations.	The project site is not considered to be near any habitat recognised as critical to the humpback whale population.	The project site is not considered to be near any habitat recognised as critical to flatback turtle populations.

(Continued over)

SIGNIFICANCE CRITERION	ASSESSMENT			
	GREEN TURTLE (*CHELONIA MYDAS*)	**HAWKSBILL TURTLE (*ERETMOCHELYS IMBRICATA*)**	**HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*)**	**FLATBACK TURTLE (*NATATOR DEPRESSUS*)**
Disrupt the breeding cycle of an important population	The project site is not a known green turtle breeding ground and should not impact on the breeding cycle.	The project site is not a known hawksbill turtle breeding ground and should not impact on the breeding cycle.	No impact to the breeding cycle of the humpback whale is expected to result from the project.	The project site is not a known flatback turtle breeding ground and should not impact on the breeding cycle.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Direct disturbance to bare (non-vegetated) substrates will occur at the mouth of Richters Creek and off-shore, along the inlet pipeline footprint. This habitat is not essential to the survival or reproduction of the green turtle and thus no long-term impacts to the species are predicted to occur.	Direct disturbance to bare (non-vegetated) substrates will occur at the mouth of Richters Creek and off-shore, along the inlet pipeline footprint. This habitat is not essential to the survival or reproduction of the hawksbill turtle and thus no long-term impacts to the species are predicted to occur.	Direct disturbance to bare (non-vegetated) substrates will occur at the mouth of Richters Creek and off-shore, along the inlet pipeline footprint. This habitat is not essential to the survival or reproduction of the humpback whale and thus no long-term impacts to the species are predicted to occur.	Direct disturbance to bare (non-vegetated) substrates will occur at the mouth of Richters Creek and off-shore, along the inlet pipeline footprint. This habitat is not essential to the survival or reproduction of the flatback turtle and thus no long-term impacts to the species are predicted to occur.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	It is unlikely that invasive species may be introduced during any stages of the project.	It is unlikely that invasive species may be introduced during any stages of the project.	It is unlikely that invasive species may be introduced during any stages of the project.	It is unlikely that invasive species may be introduced during any stages of the project.
Introduce disease that may cause the species to decline	There is limited potential for disease to be introduced to green turtle populations, through introduced pests or other means.	There is limited potential for disease to be introduced to hawksbill turtle populations, through introduced pests or other means.	There is limited potential for disease to be introduced to the humpback whale populations, through introduced pests or other means.	There is limited potential for disease to be introduced to flatback turtle populations, through introduced pests or other means.

SIGNIFICANCE CRITERION	ASSESSMENT			
	GREEN TURTLE (*CHELONIA MYDAS*)	**HAWKSBILL TURTLE (*ERETMOCHELYS IMBRICATA*)**	**HUMPBACK WHALE (*MEGAPTERA NOVAEANGLIAE*)**	**FLATBACK TURTLE (*NATATOR DEPRESSUS*)**
Interfere substantially with the recovery of the species	The project is not located near breeding or nesting sites. Low numbers of green turtles may forage in Trinity Inlet south of the project site, but they are unlikely to occur in marine areas directly off-shore of the project site. The project is not expected to interfere with the recovery of this species.	The project is not located near breeding or nesting sites. Low numbers of hawksbill turtles may forage in Trinity Inlet south of the project site, but they are unlikely to occur in marine areas directly off-shore of the project site. The project is not expected to interfere with the recovery of this species.	Humpback whale populations are currently recovering at a rate of 10 to 11% per annum. A significant impact on breeding individuals would interfere with this growth, which is highly unlikely as a result of the project.	The project is not located near breeding or nesting sites. Low numbers of green turtles may forage in Trinity Inlet south of the project site, or other nearby rocky reefs. The project is not expected to interfere with the recovery of this species.
Overall impact assessment result	The project site does not support an important population of green turtles and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on green turtles.	The project site does not support an important population of hawksbill turtles and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on hawksbill turtles.	The project site does not support an important population of humpback whales and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on humpback whales.	The project site does not support an important population of flatback turtles and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on flatback turtles.

Overall conclusion: The study area does not support an important population of any vulnerable species and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on vulnerable species.

c) Listed Migratory Species

The *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoTE 2013c) indicate that an action will require approval if the action has, will have, or is likely to have a significant impact on a migratory species. An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- *substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*
- *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or*
- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

Seventeen migratory aquatic species (other than the crocodile which has already been discussed) were listed within 5 km of the Project Site. Of these, eight are assessed as having a moderate likelihood of occurrence:

- dugong (Dugong dugon)
- humpback whale (Megaptera novae-angliae)
- Australian snubfin dolphin (*Orcaella brevirostris*)
- Indo-Pacific humpback dolphin (*Sousa chinensis*)
- loggerhead turtle (*Caretta caretta*)
- green turtle (*Chelonia mydas*)
- hawksbill turtle (Eretmochelys imbricata)
- flatback turtle (*Natator depressus*).

Nine are assessed as having a low likelihood of occurrence.

Impacts on the likely species are assessed below.

TABLE 22-45 SIGNIFICANT IMPACT ASSESSMENT FOR LISTED MIGRATORY AQUATIC SPECIES

SIGNIFICANCE CRITERION	**LOGGERHEAD TURTLE (*Caretta caretta*)**	**GREEN TURTLE (*Chelonia mydas*)**	**DUGONG (*Dugong dugon)***	**HAWKSBILL TURTLE (*Eretmochelys imbricata)***	**HUMPBACK WHALE (*Megaptera novaeangliae*)**	**FLATBACK TURTLE (*Natator depressus*)**	**AUSTRALIAN SNUBFIN DOLPHIN (*Orcaella brevirostris*)**	**INDO-PACIFIC HUMPBACK DOLPHIN (*Sousa chinensis*)**
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Populations of loggerhead turtles in the region are low are likely to represent migratory populations only. There are no seagrass beds being disturbed during construction or operations. Loggerhead turtle populations are highly unlikely to be modified, destroyed or isolated.	Populations of green turtles in the region are moderate and are likely to represent resident and migratory populations. There are no seagrass beds being disturbed during construction or operations. Green turtle populations are highly unlikely to be modified, destroyed or isolated.	Populations of dugongs in the region are likely to be low. There are no seagrass beds being disturbed during construction or operations. Dugong populations are highly unlikely to be modified, destroyed or isolated.	Populations of hawksbill turtles in the region are low are likely to represent migratory populations only. Coral reefs or seagrass beds are not likely to be disturbed during construction or during operations. Hawksbill turtle populations are highly unlikely to be modified, destroyed or isolated.	The presence of humpback whales in the region is seasonal, with the migration period occurring from June/July to October/November. The potential for interaction with migrating humpback whales is minimal and the project is unlikely to modify, destroy or isolate important habitat for this species.	Populations of flatback turtles in the region are low are likely to represent migratory populations only. Coral reefs or seagrass beds are not likely to be disturbed during construction or during operations. Hawksbill turtle populations are highly unlikely to be modified, destroyed or isolated.	Although Australian snubfin dolphins are known to occur along the shores near the project area, they are not likely to be present in substantial numbers. The project is unlikely to modify, destroy or isolate important habitat for this species.	Although Indo-Pacific humpback dolphins are known to occur along the shores near the project area, they are not likely to be present in substantial numbers. The project is unlikely to modify, destroy or isolate important habitat for this species.

(Continued over)

SIGNIFICANCE CRITERION	**LOGGERHEAD TURTLE (*Caretta caretta*)**	**GREEN TURTLE (*Chelonia mydas*)**	**DUGONG (*Dugong dugon)***	**HAWKSBILL TURTLE (*Eretmochelys imbricata)***	**HUMPBACK WHALE (*Megaptera novaeangliae*)**	**FLATBACK TURTLE (*Natator depressus*)**	**AUSTRALIAN SNUBFIN DOLPHIN (*Orcaella brevirostris*)**	**INDO-PACIFIC HUMPBACK DOLPHIN (*Sousa chinensis*)**
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	It is highly unlikely that invasive species will be introduced during any stage of the project.	It is highly unlikely that invasive species will be introduced during any stage of the project.	It is highly unlikely that invasive species will be introduced during any stage of the project.	It is highly unlikely that invasive species will be introduced during any stage of the project.	It is highly unlikely that invasive species will be introduced during any stage of the project.	It is highly unlikely that invasive species will be introduced during any stage of the project.	It is highly unlikely that invasive species will be introduced during any stage of the project.	It is highly unlikely that invasive species will be introduced during any stage of the project.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The study area is not a known key Loggerhead turtle breeding ground and the project is unlikely to affect the breeding cycles of any populations.	The study area is not a known key green turtle breeding ground and the project is unlikely to affect the breeding cycles of any populations.	The study area is not a known key dugong breeding ground and the project is unlikely to affect the breeding cycles of any populations.	The study area is not a known key hawksbill turtle breeding ground and the project is unlikely to affect the breeding cycles of any populations.	The study area is not a known humpback whale breeding ground, but migratory humpback whales are known to travel along the coast. The project is highly unlikely to affect the breeding cycles of humpback whales or their migration route.	The study area is not a known key flatback turtle breeding ground and the project is unlikely to affect the breeding cycles of any populations.	Important breeding, feeding, migration and resting habitats of this species do not occur within or downstream of the project site, and only a few individuals have been recorded within the study area. The project area is not considered to support an ecologically significant population.	Important breeding, feeding, migration and resting habitats of this species do not occur within or downstream of the project site, and only a few individuals have been recorded within the study area. The project area is not considered to support an ecologically significant population.

SIGNIFICANCE CRITERION	LOGGERHEAD TURTLE (*Caretta caretta*)	GREEN TURTLE (*Chelonia mydas*)	DUGONG (*Dugong dugon)*	HAWKSBILL TURTLE (*Eretmochelys imbricata)*	HUMPBACK WHALE (*Megaptera novaeangliae*)	FLATBACK TURTLE (*Natator depressus*)	AUSTRALIAN SNUBFIN DOLPHIN (*Orcaella brevirostris*)	INDO-PACIFIC HUMPBACK DOLPHIN (*Sousa chinensis*)
Overall impact assessment result	The study area does not support an important population of Loggerhead turtles and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on Loggerhead turtles.	The study area does not support an important population of green turtles and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on green turtles.	The study area does not support an important population of dugongs and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on dugongs.	The study area does not support an important population of hawksbill turtles and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on hawksbill turtles.	The study area does not support an important population of humpback whales and does not provide habitat critical to the survival of the species. As long as water quality is protected, there will be no significant impact on this species.	The study area does not support an important population of flatback turtles and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on flatback turtles.	The study area does not support an ecologically significant population of Australian snubfin dolphins and does not provide important habitat for this species. The project will not result in a significant impact on Australian snubfin dolphins.	The study area does not support an ecologically significant population of Indo-Pacific humpback dolphins and does not provide important habitat for this species. The project will not result in a significant impact on Indo-Pacific humpback dolphins.

d) Listed Marine Species

As long as water quality is protected, there will be no significant impact on listed marine species within Commonwealth Marine Area due to the distance of this area from the site and the already described low level of impacts.

e) Whales and Other Cetaceans

All cetaceans are protected in Commonwealth Marine Areas under the EPBC Act. Cetacean species that are listed as migratory or threated under the EPBC Act are also protected in state waters (i.e. coastal waters to three nautical miles and other waters under Queensland jurisdiction). These species have all been addressed above (i.e. as migratory or threatened). In summary, the study area does not support an important population of humpback whales and does not provide habitat critical to the survival of the species. As long as water quality is protected, there will be no significant impact on whales and other cetaceans.

f) Summary

The *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoTE 2013) indicate that an action will require approval if the action has, will have, or is likely to have a significant impact on a listed species. Different criteria apply for different conservation categories.

<u>Critically Endangered or Endangered Species</u>

The study area does not support an important population of loggerhead turtles and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on loggerhead turtles.

<u>Vulnerable Species</u>

The study area does not support an important population of any vulnerable species and does not provide habitat critical to the survival of the species. The project will not result in a significant impact on vulnerable species.

<u>Listed migratory species</u>

As long as water quality is protected, there will be no significant impact on listed migratory species due to the distance of this area from the site and the already described low level of impacts.

<u>Listed Marine Species</u>

As long as water quality is protected, there will be no significant impact on listed marine species within Commonwealth marine area due to the distance of this area from the site, and the already described low level of impacts.

<u>Whales and Other Cetaceans</u>

As long as water quality is protected, there will be no significant impact on whales and other cetaceans.

The protection of water quality was seen as the major mitigation need and this is proposed to be addressed during construction by a suite of construction safeguards and during operation by the integrated water management strategy. Essentially this latter strategy (discussed in more detail in **Table 22-50**) involves design innovations to reduce the export of sediments and nutrients from the site.

There is the chance that minor impacts may occur due to resort lighting. However, most light spill will be able to be screened by appropriate plantings seaward of the development area.

Minor construction impacts will be effectively managed via the EMP (Construction).

22.15.5 Need for Offsets

The assessment concludes that there are no significant residual adverse impacts. Accordingly, no offsets under the EPBC Act Offsets Policy (SEWPaC 2012a) are required.

22.15.6 Consistency with International Obligations

On the basis that there are likely to be no impacts of significance on any marine species, the development of the Aquis Resort will not be contrary to Australia discharging its responsibilities under the World Heritage Convention and associated treaties and commitments.

22.16 GREAT BARRIER REEF MARINE PARK

22.16.1 Presence of Matter

a) Overview

The protected matters report (**Appendix I**) lists two zoned areas of the GBRMP, namely:

- General Use GU-16-6004 VI
- Habitat Protection HP-16-5130 VI.

Although in general the GBRMP lies seaward of low water between Bundaberg and Cape York, for parts of the Port of Cairns (south of Taylor Point and north of False Cape) the boundary is off-shore as shown on **Figure 22-37**. Adjacent to the project site the boundary is approximately 3.5 km off-shore (1.9 km off-shore of the lake inlet point). Seaward to this line the GBRMP zoning is *General Use*, while the *Habitat Protection* zone lies north of Taylor Point.

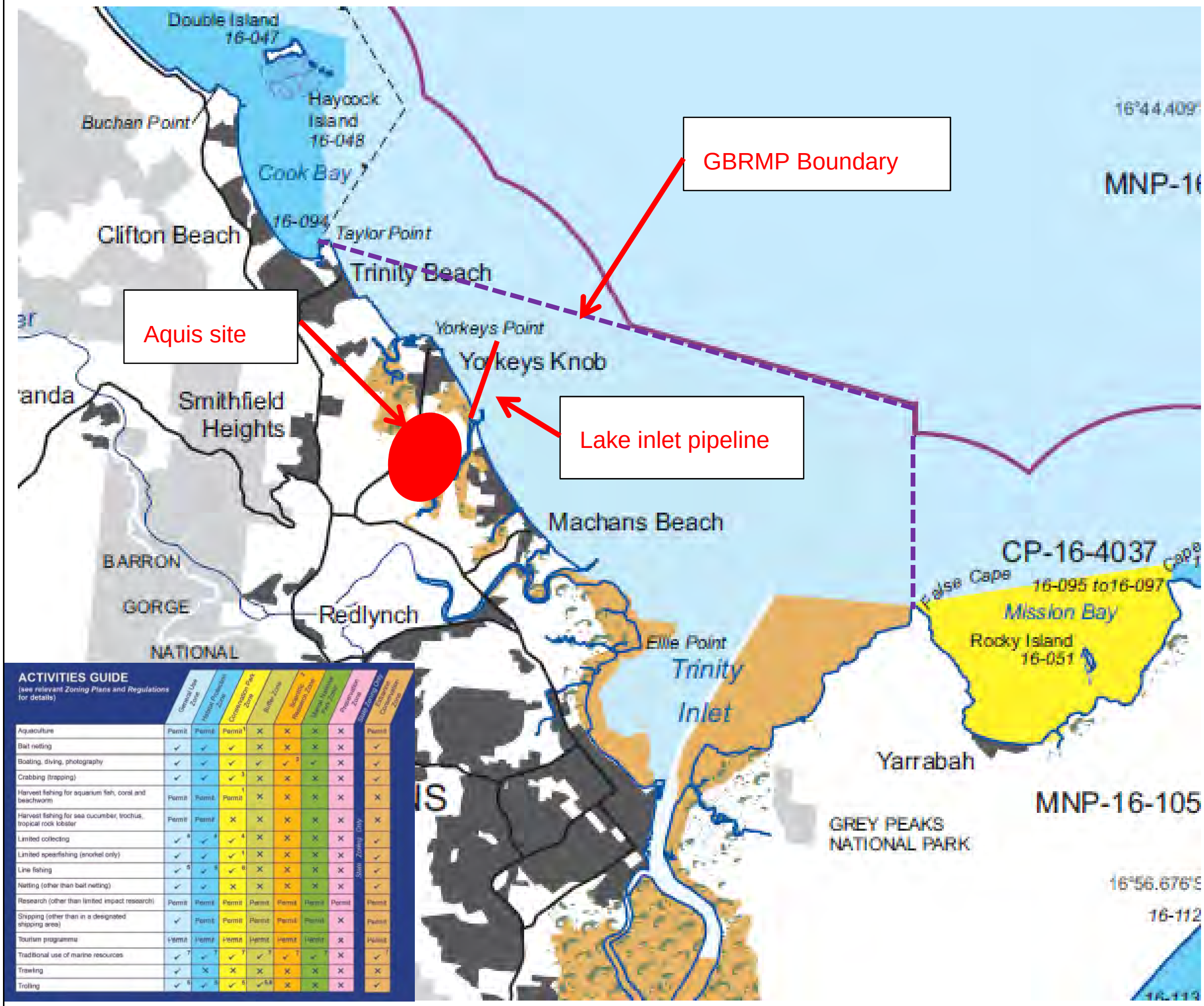


Figure 22-37 GBRMP Zoning Plan extract with Cairns exclusion area shown.

See also **Figure 22-4**.

The Aquis site is hydrologically linked to the GBRMP via Richters Creek, Yorkeys Creek, and Half Moon Creek, all of which flow into the Coal Sea and then to the Park. Therefore, water quality issues are important. In addition, the proposed seawater inlet is to be located within 1.9 km of the GBRMP boundary and works are required to construct this infrastructure.

The GBR Region and the GBR Marine Park cover the same area, with the exception of 13 coastal exclusion areas that are not within the Marine Park. Cairns is one such exclusion area (see **Figure 22-4** and **Figure 22-37**). Adjacent to the Aquis site the landward boundary of the GBRMP is some 3.5 km seaward of the coast.

The Marine Park covers 344 400 square kilometres and includes the subsoil beneath the seabed extending to a depth of 1000 metres and the airspace above extending to a height of 915 metres.

In accordance with the *Great Barrier Reef Marine Park Act 1975*, the Marine Park is managed to protect and conserve the biodiversity, heritage values and environment of the Region. The Marine Park is a multiple-use area allowing ecologically sustainable use and its values are grouped into four categories:

- biodiversity, including habitats and species
- geomorphological features
- indigenous and historic heritage
- community benefits of the environment, comprising the cultural, social and economic benefits derived from the Region's environment.

As no works are proposed within the GBRMPA, it is considered that the discussion above regarding the natural values and environmental processes of the GBRWHA is sufficiently detailed to include the Park.

Of particular relevance to Aquis are the cultural values of the Park and the fact that the development has taken its full name (Aquis Resort at The Great Barrier Reef) from what to international visitors is one of the most recognisable features of Australia. The Great Barrier Reef (the distinction between the WHA, the national heritage place, and the Marine Park is most likely lost on most potential visitors) is clearly an essential product brand. According to the project rationale documented in the draft state EIS:

> The key feature of Aquis Resort is its association with—and its proximity to—Australia's iconic World Heritage listed Great Barrier Reef. This natural wonder, and its close proximity to the World Heritage listed Wet Tropics rainforests, provides a unique opportunity that does not exist in competing Asian markets for spectacular natural features to attract international tourists from around the world.
>
> The provision of high quality international standard accommodation and entertainment facilities in close proximity to these two natural World Heritage listed icons, presents an opportunity to enhance the Cairns and Tropical North Queensland brands in the international marketplace. It provides an opportunity to establish Cairns as an international destination, which can confidently compete in the Asian tourism market. The project's rationale relies on the provision of a fully integrated resort and gambling experience targeted at the international (particularly Asian) tourism market.

b) Overall Assessment

Values

The methodology adopted for WHA values (**Section 22.6.1c)** is repeated here for GBRMP values. The following table is a subset of Table 4.8 and deals with:

- the key values and attributes (Table 4.8 column 1)
- GBRMPA assessment of presence for the value at the GBR level (Table 4.8 column 7) – column 2 below shaded and marked 'G' = GBR
- study team assessment of presence for the value at the Aquis site level (column 3 below) – unshaded and marked 'S' = Site.

This table therefore provides a checklist of those GBRMP values that are present at or in the immediate vicinity of the site (or are likely to be influenced in some way by the proposed development).

TABLE 22-46 KEY GBRMP VALUES AND ATTRIBUTES AT GBR AND SITE LEVEL

Key values and attributes	Great Barrier Reef Marine Park	
	G	S
Biodiversity – GBR habitats		
Islands	•	
Beaches and coastlines	•	
Mangrove forests	•	
Seagrass meadows	•	
Coral reefs (<30 m)	•	
Deeper reefs (>30 m)	•	
Lagoon floor	•	
Shoals	•	
Halimeda banks	•	
Continental slope	•	
Open waters	•	•
Biodiversity – terrestrial habitats that support the GBR		
Saltmarshes	•	•
Freshwater wetlands	•	•
Forested floodplain	•	•
Heath and shrublands	•	
Biodiversity – terrestrial habitats that support the GBR (cont.)		
Grass and sedgelands	•	
Woodlands	•	•
Forests	•	•
Rainforests	•	•
Connecting waterbodies	•	•
Biodiversity – species		
Mangroves	•	•
Seagrasses	•	
Macroalgae	•	•
Benthic microalgae	•	•
Corals	•	
Other invertebrates	•	•
Plankton and microbes	•	
Bony fish	•	•
Sharks and rays	•	•

Key values and attributes	Great Barrier Reef Marine Park	
	G	S
Sea snakes	•	•
Marine turtles	•	•
Estuarine crocodiles	•	•
Seabirds	•	•
Shorebirds	•	•
Whales	•	•
Dolphins	•	•
Dugongs	•	
Geomorphological features		
Coral reefs	•	
Islands and shorelines	•	
Channels and canyons	•	
River deltas	•	•
Halimeda banks	•	
Seagrass meadows	•	
Indigenous heritage		
Cultural practices, observances, customs and lore	•	
Sacred sites, sites of particular significance, places important for cultural tradition	•	
Stories, songlines, totems and languages	•	
Indigenous structures, technology, tools and archaeology	•	•
Historic heritage		
Places of historic significance — historic shipwrecks	•	
Places of historic significance — World War II features and sites	•	
Places of historic significance — lightstations	•	
Places of historic significance — other	•	
Places of scientific significance (research stations, expedition sites)	•	
Places of social significance — iconic sites	•	
Community benefits of the environment		
Income	•	
Employment	•	
Understanding	•	
Appreciation	•	•
Enjoyment	•	•

Key values and attributes	Great Barrier Reef Marine Park	
	G	S
Access to reef resources	•	
Personal connection	•	
Health benefits	•	
Aesthetics	•	•

Source: Study team compilation. Key values and attributes and shaded column (G) relate to the GBR and are extracted from GBRMPA (2013a) Table 4.8. Unshaded columns are the study team's assessments of presence.

All of the above attributes of site relevance have been covered in the discussion of GBRWHA values and Matters of NES species. These are assumed to apply equally to the GBRWHA and the GBRMP. Technically, the GBRMP boundary is some 3.8 km further seaward than that of the WHA and therefore the effect of the development could be expected to be somewhat attenuated by that point.

Environmental Processes

The GBR strategic assessment (GBRMPA 2013a) includes a companion table to the above that investigates key ecological processes of Matters of NES (Table 4.9). The following table is a subset of Table 4.9 and deals with:

- the key environmental processes (Table 4.9 column 1)
- GBRMPA assessment of presence of the process at the GBR level (Table 4.9 column 7) – column 2 below shaded and marked 'G' = GBR
- study team assessment of presence for the value at the Aquis site level (column 3 below) – unshaded and marked 'S' = Site.

This table therefore provides a checklist of those environmental processes that are present at or in the immediate vicinity of the site (or are likely to be influenced in some way by the proposed development).

TABLE 22-47 KEY GBRMP ENVIRONMENTAL PROCESSES AT GBR AND SITE LEVEL

Key values and attributes	**Great Barrier Reef Marine Park**	
	G	**S**
Biodiversity – GBR habitats		
Waves, currents and tides	•	•
Cyclones	•	•
Wind	•	
Sedimentation	•	•
Sea level	•	
Sea temperature	•	
Light	•	•
Nutrient cycling	•	•
Ocean acidity	•	
Freshwater inflow and salinity	•	•
Microbial processes	•	•
Particle feeding	•	
Primary production	•	•
Herbivory	•	
Predation	•	•
Symbiosis	•	
Competition	•	•
Connectivity	•	•
Recruitment	•	
Reef building	•	

Source: Study team compilation. Key environmental processes and shaded columns (G) relate to the GBR and are extracted from GBRMPA (2013a) Table 4.9. Unshaded columns are the study team's assessments of presence.

All of the above values and processes have been covered in the discussion of GBRWHA values and Matters of NES species.

Community benefits of the environment

Although remote from the reef itself, the project aims to interpret GBRMP values in a number of ways, including:

- theming (see below) and architecture
- design of the large seawater aquarium (where GBR values can be presented and interpreted to all resort users)
- material used in the *Interpretation Strategy* (see **Table 22-50**).

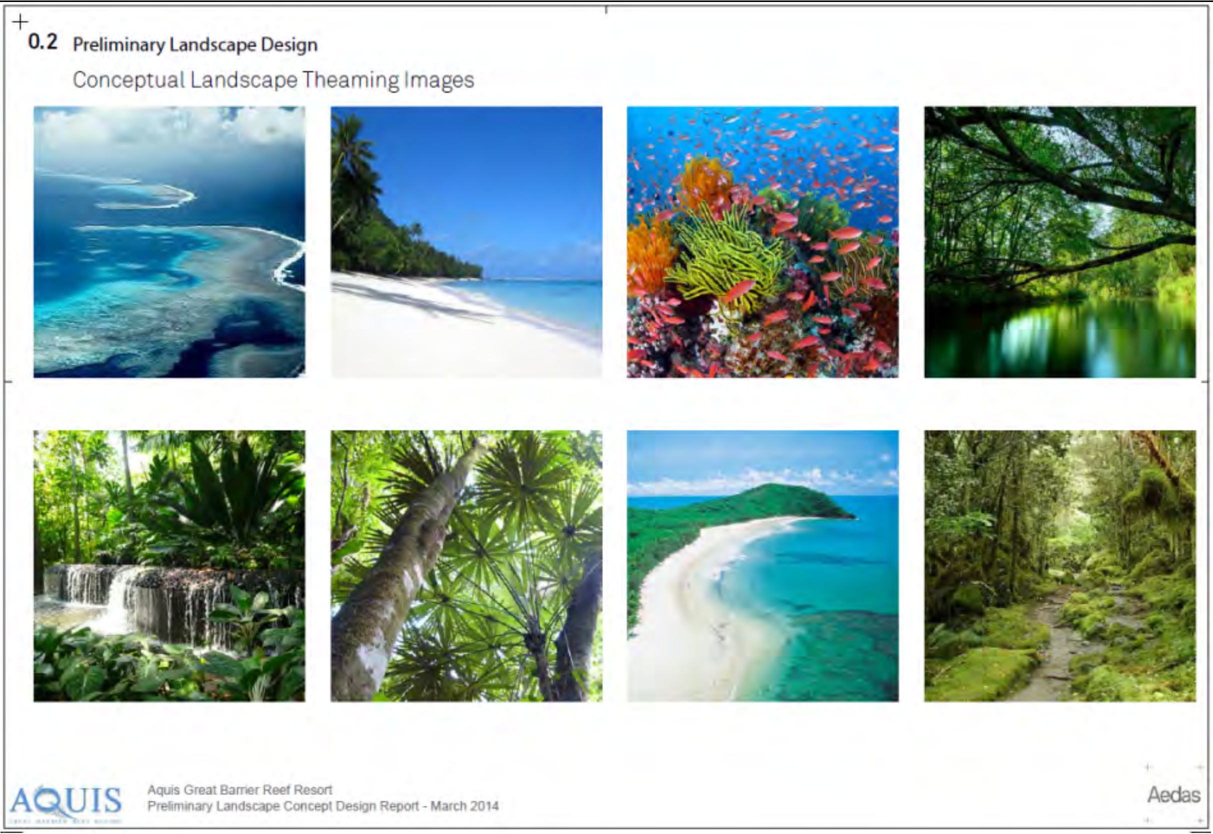


Figure 22-38 Preliminary landscape design themes.

These images are being used to develop the Aquis concept and brand and show how GBR images play an important role in the overall theming.

22.16.2 Potential Impacts

Referring to **Table 22-12**, for this matter of NES the construction and operation of Aquis is likely to have:

- no major adverse impacts (construction and operation)
- potential minor adverse construction impacts of local significance on the following impact categories:
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off
  - small chemical spills
  - urban discharge

- potential minor adverse operation impacts of local significance on the following impact categories:
  - small chemical spills
  - urban discharge
- potential minor beneficial operation impacts of local significance on the following impact categories:
  - artificial barriers to flow
  - increased freshwater inflow
  - outbreak of crown-of-thorns starfish
- potential major regional to reef-wide beneficial operation impacts on the following impact categories (probably only locally significant):
  - modifying supporting terrestrial habitats
  - nutrients from catchment run-off
  - pesticides from catchment run-off
  - sediments from catchment run-off.

Many of the potential impacts on the GBRWHA are not considered to apply to the GBRMP on the basis that they are of local scale and are not expected to apply 3.5 km off-shore. Most impacts could be expected to be somewhat attenuated by that point. This is particularly true of water quality (where dilution and dispersion is significant over such a distance), light impacts (light intensity follows an inverse square law), and visual impacts (the site would be barely visible from such a distance).

As noted previously, modelling shows that at the boundary of the GBRMP (3.5 km north-east of the lake discharge in Richters Creek), median tracer concentrations are 0.1% (i.e. dilution of 99.9%). This result in indistinguishable from that at the inlet.

However, as noted in GBRMPA (2013a), land-based activities have the potential to cumulatively impact on the GBRMP and principal among these is water quality and specifically sediment and nutrient flux. The Aquis Resort stormwater drainage strategy has been shown to provide beneficial impacts in this regard.

a) Blue Maps

The impact (adverse and beneficial) of land-based activities on the GBRMP is recently being assessed using GBRMPA's Blue Maps project. As discussed in **Section 22.6.1c)**, the maps model three situations:

- Case 1: pre-colonisation conditions
- Case 2: current conditions and management priorities
- Case 3: future conditions following development / management.

Cases 1 and 2 have already been discussed. Of particular relevance is Case 2 as it includes essentially pre-Aquis condition, values, and protection/management priorities. Reiterating, Case 2 shows that (see **Figure 22-39**):

- the existing mangrove forests to the north-east and north-west of the site as well as the Richters Creek corridor are in need of critical protection
- the Aquis site itself is recommended for restoration.

These actions are required to improve ecosystem services as previously defined.

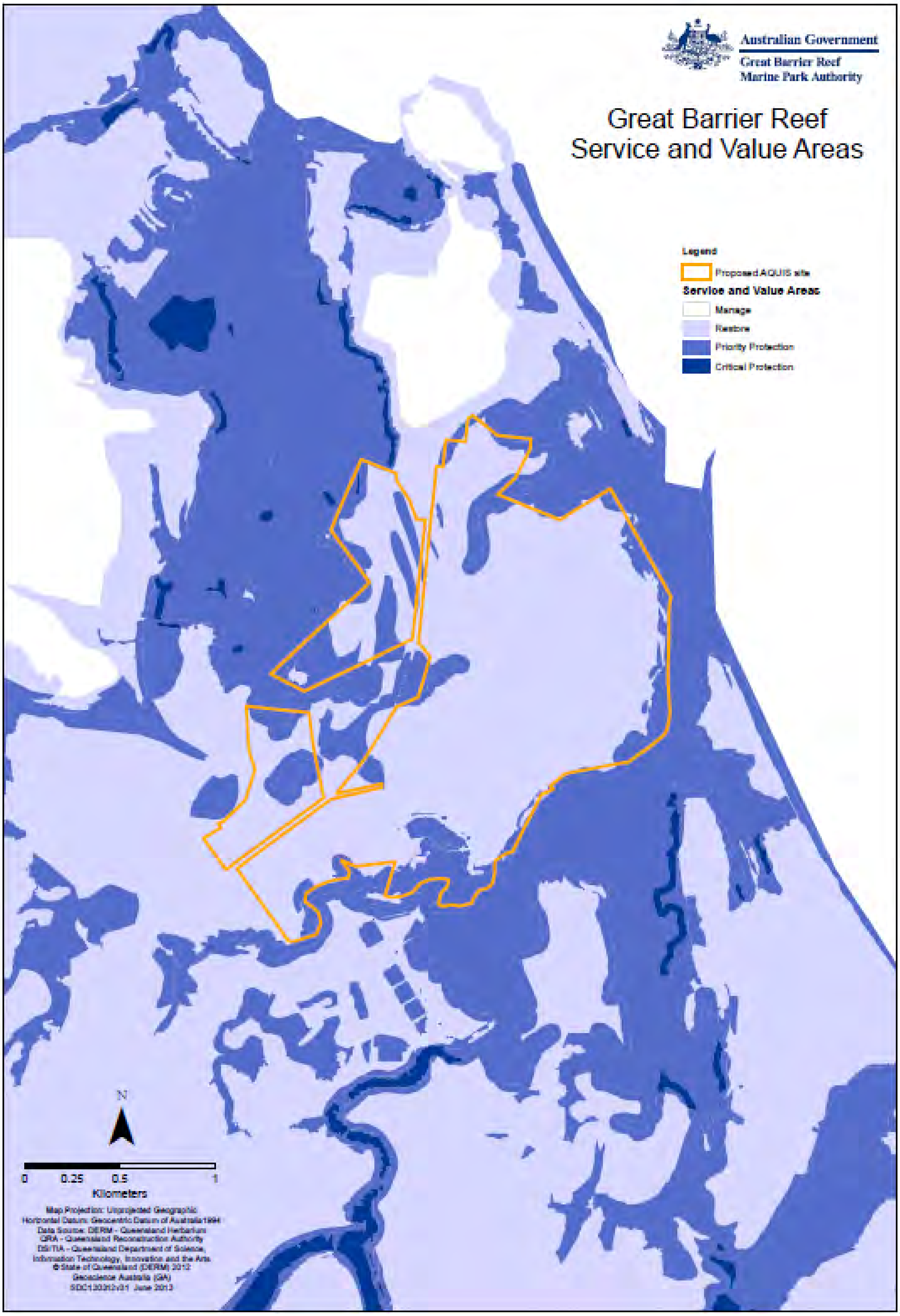


Figure 22-39 Draft Blue Map of Aquis site and surrounds (values and services).

Source: GBRMPA (D Audas pers. comm. 31 March 2014).

With the exception of the degraded cane land upon which the development precincts are to be constructed, the Aquis Resort concept aligns very closely with the GBRMPA recommendations. As described in **Section 22.4.2**:

- the wooded fringes of the site are to be protected and restored
- Yorkeys Creek is to be retained and riparian vegetation extended (this will go beyond the GBRMPA recommendations)
- waterway barriers (tide gates and undersized culverts) are to be removed.

The Aquis team is working with GBRMPA to quantify the benefits that these initiatives to the ecosystem services provided by the site. Although this work is still in preparation, it is likely that it will show a locally significant contribution when compared with the current situation.

b) Tourism

Section 22.4.1c) includes a brief assessment of tourism impacts. These are dealt with as a special case of consequential / facilitated impact in **Section 22.17.8**, along with an assessment of management arrangements and likely implications.

22.16.3 Proposed Mitigation and Effectiveness

All project specific mitigation is as specified for the GBRWHA (**Section 22.6.3**) with the exception of tourism which is addressed in **Section 22.17.8**. This concludes that Aquis Resort visitors (all of whom will who access the reef on commercial tours) will be subject to the laws and management arrangements in place at the time, and will be part of the ultimate carrying capacity deemed suitable. This is not within Aquis Resort's ability to influence. However, Aquis Resort can play a significant role in educating its guests on the wise use of the GBR and perhaps reduce direct visitation by interpreting and presenting GBR values on-site via theming, its aquarium, and through material used in the *Interpretation Strategy* (see **Table 22-50**).

22.16.4 Significance of Mitigated Impact

The *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoTE 2013c) indicate that an action will require approval if the action has, will have, or is likely to have a significant impact on the Great Barrier Reef Marine Park. An action is likely to have a significant impact on the environment of the Great Barrier Reef Marine Park if there is a real chance or possibility that the action will:

- *modify, destroy, fragment, isolate or disturb an important, substantial, sensitive or vulnerable area of habitat or ecosystem component such that an adverse impact on marine ecosystem health, functioning or integrity in the Great Barrier Reef Marine Park results*
- *have a substantial adverse effect on a population of a species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution*
- *result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological health or integrity or social amenity or human health*
- *result in a known or potential pest species being introduced or becoming established in the Great Barrier Reef Marine Park*
- *result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, or social amenity or human health may be adversely affected, or*
- *have a substantial adverse impact on heritage values of the Great Barrier Reef Marine Park, including damage or destruction of an historic shipwreck.*

TABLE 22-48 SIGNIFICANT IMPACT ASSESSMENT FOR THE GREAT BARRIER REEF MARINE PARK

SIGNIFICANCE CRITERION	ASSESSMENT
Modify, destroy, fragment, isolate or disturb an important, substantial, sensitive or vulnerable area of habitat or ecosystem component such that an adverse impact on marine ecosystem health, functioning or integrity in the Great Barrier Reef Marine Park results	The boundary of the GBRMP is approximately 3.5 km off-shore of the project site, and 1.9 km from the seaward end of the seawater inlet pipe – no direct disturbance to aquatic habitats within the GBRMP is proposed. Impacts associated with turbidity and potential run-off of contaminants would be temporary during construction. During operations, a Stormwater Management Plan would minimise the risk of run-off; however, in periods of flooding any contaminants may reach the GBRMP. Estuarine waters monitored around the project site (see **Chapter 11** – Water Quality) do not meet the QWQG for various nutrients and turbidity. Contaminants introduced from the project site would be diluted by flood flows, which would be expected to have nutrient concentrations and turbidity levels similar to or greater than those measured during non-flood periods. No marine habitats within the GBRMP will be modified or destroyed at any phase of the project. Adverse impacts to ecosystem health, functioning or integrity of the GBRMP is not expected.
Have a substantial adverse effect on a population of a species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution	No substantial cetacean populations are known to occur off-shore of the proposed development. The cetacean species that may occur within or downstream of the Resort area are highly unlikely to be permanent residents and would unlikely be affected by construction and operations. Potential impacts to cetaceans would be limited to minor impacts associated with sediment plumes and run-off of contaminants. Such impacts are likely to be minimal as marine vertebrates tend to avoid unfavourable areas.
Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological health or integrity or social amenity or human health	Water quality data collected to date indicate that the waters within Richters Creek and downstream experience natural fluctuations in turbidity and total suspended solids. Modelling of potential impacts of water quality from the proposed lake conclude that the water quality will be in similar or better condition than the receiving environment.
Result in a known or potential pest species being introduced or becoming established in the Great Barrier Reef Marine Park	It is highly unlikely that there is potential for an aquatic invasive species to be introduced to the GBRMP as a result of construction and operation of the proposed development. Introduced species such as Tilapia, which may colonise the lake, are unlikely to establish in the GBRMP. Populations of Tilapia around the Cairns region occur mainly in freshwater habitats, and intensive surveys of open estuaries of coastal foreshores have failed to detect any individuals (Russell 2012). Preparation of a Tilapia Management Plan is a project commitment (see **Chapter 19** – Biosecurity).
Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, or social amenity or human health may be adversely affected	In the absence of mitigation, spillage of contaminants and mobilisation of contaminated marine sediments during construction of the off-shore inlet pipeline may contaminate the marine environment. However, implementation of appropriate management measures will greatly reduce this risk. In addition, the EMP (Construction) includes specific measures for management of soil and water and this will reduce the potential contamination from runoff from the project site. In any case, runoff from the project site is not expected to reach the GBRMP. No high value marine habitats occur in the GBRMPA in the vicinity of the project site; no impacts to existing biological process or aquatic habitats within the GBRMP are predicted to occur.

SIGNIFICANCE CRITERION	ASSESSMENT
Have a substantial adverse impact on heritage values of the Great Barrier Reef Marine Park, including damage or destruction of an historic shipwreck.	The project is unlikely to directly or indirectly impact upon the GBRMP heritage values. There are no historic shipwrecks within the vicinity of the project site.

Overall conclusion: The project is unlikely to significantly impact the Great Barrier Reef Marine Park.

Minor construction impacts will be effectively managed via the EMP (Construction).

The Aquis Resort will contribute a very small proportion (0.14%) of the total sediment load entering the receiving environment of the Barron River catchment. Even if all of the proposed pollutant load reduction strategies for the site were to fail for whatever reason, the risk of the development having a significant and adverse impact on the water quality of the receiving environment is extremely low.

22.16.5 Need for Offsets

The assessment concludes that there are no significant residual adverse impacts. Accordingly, no offsets under the EPBC Act Offsets Policy (SEWPaC 2012a) are required.

22.16.6 Consistency with International Obligations

a) Overview

The *Great Barrier Reef Marine Park Act 1975* (Cwlth) requires the Great Barrier Reef Marine Park Authority to have regard to, and seek to act in a way that is consistent with, the objects of the Act, the protection of the world heritage values of the Great Barrier Reef World Heritage Area, and the principles of ecologically sustainable use.

b) Objects of the GBRMP Act

According to the *Great Barrier Reef Marine Park Act 1975* (Cwlth):

1. The main object of this Act is to provide for the long term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region.
2. The other objects of this Act are to do the following, so far as is consistent with the main object:
   a) allow ecologically sustainable use of the Great Barrier Reef Region for purposes including the following:
      (i) public enjoyment and appreciation;
      (ii) public education about and understanding of the Region;
      (iii) recreational, economic and cultural activities;
      (iv) research in relation to the natural, social, economic and cultural systems and value of the Great Barrier Reef Region;
   b) encourage engagement in the protection and management of the Great Barrier Reef Region by interested persons and groups, including Queensland and local governments, communities, Indigenous persons, business and industry;
   c) assist in meeting Australia's international responsibilities in relation to the environment and protection of world heritage (especially Australia's responsibilities under the World Heritage Convention).

The GBRMPA's management focus is the protection and conservation of the GBRMP and to assist in meeting Australia's international responsibilities in relation to the environment and protection of world heritage.

On the basis that there are no works proposed within the GBRMP and that there are unlikely to be any impacts of significance on the GBRMP, the development of the Aquis Resort will not be contrary to the Act and to Australia discharging its responsibilities under the World Heritage Convention.

c) Objects of the GBRMP Regulations

The *Great Barrier Reef Marine Park Regulations 1983* (Cwlth) do not have a specific object. However, subsection 7(3) of the *Great Barrier Reef Marine Park Act 1975* provides that the Authority must, in managing the Marine Park and performing its other functions, have regard to, and seek to act in a way that is consistent with, the objects of the Act, the principles of ecologically sustainable use and the protection of the world heritage values of the Great Barrier Reef World Heritage Area.

The Regulations therefore are required to support the objects of the Act.

On the basis that there are no works proposed within the GBRMP and that there are unlikely to be any impacts of significance on the GBRMP, the development of the Aquis Resort will not be contrary to the Regulations and by implication, to Australia discharging its responsibilities under the World Heritage Convention.

22.17 IMPACTS AND MANAGEMENT

22.17.1 Summary of Impacts and Management Needs

This assessment is concerned with impacts on matters of NES and in so doing has focused on those aspects of the development most likely to affect these matters. The main values / impacts have been found to be biodiversity / ecological integrity and water quality. Both of these impacts are expected to be beneficial due to improvements in condition.

In order to provide context for the assessment of impacts on matters of NES, the following summary includes all impacts from the state EIS process documented in the balance of this EIS. These impacts are broken down into the following types (see also **Section 22.4.1a)**):

- adverse and beneficial
- consequential / facilitated and cumulative
- short term and long term
- reversible and irreversible
- predictable and unpredictable.

A summary of key impacts of all these types is provided in **Table 22-49** below. This is a copy of **Table 23-1**. A more detailed assessment of impacts on matters of NES is provided in **Section 22.17.7** to **Section 22.17.9**.

TABLE 22-49 SUMMARY OF IMPACTS AND MANAGEMENT NEEDS

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
3 RP Details, Tenure and Easements	Permit to occupy will be required to construct and operate the lake water exchange infrastructure in Richters Creek and off-shore, a crossing of Lot 139 NR3819, and a lake overflow channel and associated bank protection works on the banks for Richters Creek adjacent to Lot 2 RP8000898. In both areas the land is within the GBR Coast Marine Park (Queensland) and the Yorkeys Creek FHA (FHA-034) – Area B. Impacts associated with the construction and operation of this infrastructure are assessed elsewhere.	Nil.	Minor impacts on naturalness of Richters Creek estuary and minor navigation restrictions on public use of creek.	Very minor additional private use of public land.		✓	✓		✓	
4 Native Title	Construction of lake water exchange infrastructure will constitute a 'future act' in terms of native title legislation and therefore compliance with the appropriate provisions of the NTA. This is an administrative process.	Nil.	Nil.	Minor additional extinguishment of some native title interests in adjacent protected areas for water exchange infrastructure.		✓	✓		✓	

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
5 Strategic Cropping Land	Loss of mapped SCL (303 ha), 201 ha of which is in current production (13,000 t/a). This loss is unavoidable and mitigation will be required under the *Strategic Cropping Land Act (Qld)* 2011 (Chapter 5) for the area of SCL as validated under the Regulations.	Payment of mitigation fees (up to $6 million) will benefit state revenue.	Nil.	Loss of a further 15% of the delta section of the Mulgrave Mill cane supply. Impact is not critical as assignments have been transferred from the closed Babinda Mill.		✓		✓	✓	
6 Landscape and Visual Amenity	Site will be transformed from a rural setting to a highly developed urban setting with a consequential change of existing amenity. Large buildings will be visible from a number of current vantage points around the city. There will be some reduction in naturalness of the area near the Richters Creek mouth from where parts of the development will be visible. This is of local significance only and the development will not detract from the World Heritage experience.	Some observers may find the resort (and in particular the restoration and rehabilitation) attractive although this has not been evaluated.	Nil.	Further transformation of Barron River delta from rural to urban landscape.	✓	✓		✓	✓	

(Continued over)

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
7 Flora and fauna	Minor (6 ha) clearing (mainly abandoned aquaculture ponds). Little to no impact on Matters of NES and Matters of SES. Very minor impacts on state marine park and FHA due to lake infrastructure on / in Richters Creek. Requires management via EMP (Construction). Additional baseline survey underway.	Additional habitat (56 ha) and reinforcement of waterway connectivity, removal of waterway barriers. Overall enhancement of habitat and ecological values. Net reduction in export of pollutants (due to WSUD features and use of WWTP water) compared with cane farm (see Surface Water and Water Quality). Net improvement of FHA values due to restoration works and removal of waterway barriers. Interpretive values will be enhanced via the Interpretation Strategy.	Nil. A range of indirect impacts associated with increased population and visitation of protected areas.	Net beneficial impact due to creation of 61 ha of additional habitat and reinforcement of waterway connectivity, removal of waterway barriers. Beneficial impact on habitat, connectivity, and ecological processes and flow-on effect to most indicators of matters of NES/SES. Further transformation of Cairns backdrop from a rural to urban setting. Increased population and visitation of protected areas will add to existing impacts on these areas.		✓	✓		✓	

(Continued over)

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
8 Coastal Processes	The development can be secured against all coastal processes threats (coastal erosion, river migration, storm tide and associated cyclone-induced elevated water levels, and tsunami). Safe refuge can be provided for resort guests and staff above the 0.01% storm tide using a shelter-in-place strategy. Aquis Resort mitigation of coastal threats will have no adverse impact on surrounding land.	Subject to future planning, residents from external areas may be able to access the Aquis Resort safe refuge facilities. Possible joint Aquis Resort / Queensland Government protection works at the Barron River / Thomatis Creek bifurcation (if adopted) would reduce likelihood of river migration and this would be of public benefit.				✓		✓	✓	
9 Flooding	The development can be secured against Barron River flooding with floor levels set above the PMF event. Safe refuge can be provided for resort guests and staff above the PMF level using a shelter-in-place strategy. Aquis Resort flood mitigation works will have no adverse impact on surrounding land in accordance with CRC's flooding and earthworks codes.	Lowering of flood levels for locations south of the lake, especially at Holloways Beach. Raising Yorkeys Knob Road to 2% AEP will provide a high level evacuation route for Yorkeys Knob residents. Subject to future planning, residents from external areas may be able to access the Aquis Resort safe refuge facilities.	Beneficial impact on flooding of upstream areas (especially Holloways Beach).	Minor lowering of a Barron River flood (beneficial).	✓		✓		✓	

(Continued over)

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
10 Surface Water and Water Quality	Low risk of export of pollutants during construction (to be covered by an element of the EMP (Construction) – site-specific discharge criteria to be developed). Low risk of impacts due to operation of lake (site-specific discharge criteria to be developed). Comprehensive Lake Management Plans required for managing lake water quality and ecology (including management of pest fish, crocodiles, insect vectors, aquatic weeds, and wading birds). Requires management via EMP (Construction). Additional baseline survey underway.	Reduction of 132.1 t/a (46%) of TSS, 0.24 t/a TP (28%) and 0.7 t/a (12%) TN compared with cane farm (this is total export and allows for Aquis Resort sewage production and re-use of treated effluent on-site). Removal of tide gates and culverts will improve tidal flushing and water quality of Half Moon Creek and Yorkeys Creek. Rehabilitation of Half Moon Creek will improve water quality in that system.	Nil.	Net beneficial cumulative impact on pollutant export to the GBR lagoon (WSUD and re-use of treated effluent). Net beneficial cumulative impact on Half Moon Creek due to removal of tide gates.	✓	✓	✓		✓	

(Continued over)

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
10 Ground-water and Ground-water Quality	Lake water will be quarantined from groundwater and will therefore not affect groundwater level or salinity. No extraction of groundwater is proposed although groundwater from the shallow aquifer within the lake footprint will be lost through dewatering for construction. This is a one-off event that will not affect other groundwater users. Requires management via EMP (Construction). Additional baseline survey underway.	Nil.	Nil.	Nil.	✓			✓	✓	
12 Hazards	Nil. The site is exposed to many hazards (especially coastal processes and flooding) but these are accommodated in the concept design.	Removal of 6 ha of abandoned aquaculture ponds will reduce river migration risk. Possible use of Aquis Resort as a safe refuge for local residents. Raising Yorkeys Knob road to improve flood immunity which will benefit the Yorkeys Knob community.			✓	✓		✓	✓	✓

(Continued over)

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
13 Economic			A range of flow-on effects as expenditure works its way through the local, regional, and state economy. These will be both beneficial and adverse.	Major beneficial impact on all sectors of the economy due to direct and indirect influences. However, there could also be adverse impacts arising from the same forces.	✓	✓		✓	✓	
14 Social			There will be a range of beneficial and adverse consequential impacts that are too detailed to summarise. Without appropriate mitigation there could be competition for employees and this could lead to shortages in other businesses.	Employment opportunities will be enhanced and this will have far-reaching implications for social and economic indicators. These will be adverse and beneficial. Current growth-related social issues (e.g. cost of living, rate of change, lifestyle changes, law and order) that will be exacerbated.	✓	✓		✓	✓	
15 Soils: general	Minor construction impacts (e.g. erosion and sedimentation). Construction methodology involves using the lake excavation to trap all runoff from major earthworks and this will prevent export.Both eastern and western parcels require management via EMP.	Nil.	Nil.	Nil.	✓		✓		✓	

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
15 Soils: Contamin-ated Land	Remediation of small areas of contaminated land will be required. Agrichemicals present in soils do not pose a risk to health or biological systems. Requires management via EMP (Construction).	Remediation of contaminated land will remove this small current threat to environmental values.	Further degradation of aquatic habitat (amenable to mitigation by management).	Possible addition of contaminated sediments in adjacent watercourses (amenable to mitigation by management).	✓		✓		✓	
15 Soils: Acid Sulfate Soil / Potential Acid Sulfate Soil (PASS)	Management of extensive ASS/PASS on-site is feasible and a strategy has been prepared based on proven techniques. This will either quarantine or treat all soils during earthworks based on a continuous monitoring, treatment, and validation program. A detailed ASSMP prepared in accordance with QASSIT guidelines will be required to supplement the EMP (Construction).	Remediation of ASS/PASS will remove this major current threat to environmental values. Treated soils will be a valuable community resource and public beneficial uses for several million m^3 of clean sand have been identified. Removal of tide gates and reintroduction of saline water can be expected to reduce current acid drainage that is affecting fisheries values of Half Moon Creek in particular.			✓		✓		✓	

(Continued over)

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
16 Air and Greenhouse	17 kilotonnes of CO_2-e per annum during construction and 63.5 kilotonnes of CO_2-e per annum during operation (with recommended mitigation). Vegetated buffers included to reduce export of air emissions to adjacent properties. Other operation phase emissions able to be mitigated and managed. Likely air emissions from construction but substantial buffers exist. Requires management via EMP (Construction).	Nil. The net greenhouse gas emissions of the cane farm are essentially zero. External sequestration of CO_2 could arranged to produce nil or beneficial net emissions (to be investigated).	Addition of 17 kilotonnes of CO_2-e per annum during construction and 51.5 kilotonnes of CO_2-e per annum during operation (with recommended mitigation).	Minimal adverse impact on local airshed. Of little consequence as current impacts are minor.	✓	✓	✓		✓	
17 Noise and Vibration	Likely noise emissions from construction but substantial buffers exist. Requires management via EMP (Construction).	Nil.	Nil.	Nil.	✓		✓		✓	
19 Biosecurity	Very minor potential for weed transport to and from the site. Electric ants are present and will need management. Requires management via EMP (Construction) and ongoing weed and pest management.	Management of existing weeds and pest animals (including electric ants).	Nil.	Net beneficial impact on weeds and pest animals due to enhanced management.	✓	✓	✓		✓	

(Continued over)

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
20 Health and Safety	There is some risk from crocodiles and insect vectors but these can be mitigated by management. Requires management via EMP (Construction) and specific management plans for crocodiles and insect vectors.	Nil.	Beneficial impact to residents of Yorkeys Knob due to enhanced flood immunity of Yorkeys Knob Road. Possible beneficial impacts if Aquis Resort is used as a local evacuation centre in an emergency.	Additional demands will be placed on regional health and safety services purely by virtue of population growth. This will be offset to a large degree by Aquis Resort infrastructure and planning.		✓		✓	✓	
21 Indigenous Cultural Heritage	Nil.	Production of CHMP will formalise relations with relevant Indigenous people and protect existing sites (outside development footprint). Interpretive values will be enhanced via the Interpretation Strategy.	Nil.	Minor beneficial impact due to conservation and interpretation of identified sites.		✓	✓		✓	
21 Non-Indigenous Cultural Heritage (NICH)	Minor. All existing (but not registered) NICH sites will be lost but these have minimal value.	Opportunity to salvage / archive NICH values. Interpretive values will be enhanced via the Interpretation Strategy.	Nil.	Minor beneficial impact due to conservation and interpretation of identified sites.		✓		✓	✓	
22 Matters of NES	See **Section 22.18.4**.	See **Section 22.18.4**.	See **Section 22.18.4**.	See **Section 22.18.4**.	✓	✓	✓		✓	

(Continued over)

CHAPTER / ELEMENT	ADVERSE IMPACT	BENEFICIAL IMPACT	CONSEQUENTIAL IMPACT	CUMULATIVE IMPACT	SHORT-TERM	LONG TERM	REVERSIBLE	IRREVERSIBLE	PREDICTABLE	UNPREDICTABLE
24 Infra-structure – general			Various potential impacts associated with upgrading infrastructure (e.g. discharge of treated sewage effluent). However, the Aquis Resort will re-use 80% of its own treated effluent on a long-term basis.	The Aquis Resort development will bring forward the need to expand regional infrastructure (especially water, sewerage, power, and communications) although growth has already been factored into regional planning.	✓	✓		✓	✓	
24 Infra-structure - Cairns International Airport Operations	Nil. All compliance criteria are, or can be, met (further attention is required regarding radar shadow). Bird and bat strike risk is recognised and considered in design. Requires management via EMP (Construction) and specific management plans for mitigating bird and bat strike risk.	Removal of 6 ha of existing water bird habitat (abandoned aquaculture ponds) will reduce birdstrike risk.	Nil.	Minor increase in airport movements (beneficial for economy, adverse in terms of congestion and noise).	✓	✓	✓	✓	✓	

Source: Study team compilation.

22.17.2 Discussion – Adverse Impacts

The principal direct and indirect adverse impacts (following mitigation and assuming recommended management) are considered to be:

- Loss of 303 ha of mapped SCL:
  - Land suitable for agriculture is a finite resource and the Aquis Resort site currently produces about 13 000 tonnes of sugar cane per year from approximately 190 ha of farmed land. The balance of the mapped SCL is not farmed for a number of reasons.
  - The 211 ha loss of area harvested for Mulgrave Mill as a result of the Aquis project represents 1.3% of 2012 total area harvested for Mulgrave Mill and 0.53% of the total area harvested by Mitr Phol's Mulgrave and South Johnstone Mills. Given the recent closure of the Babinda Mill and the reassignment of some of this land to the Mulgrave Mill, coupled by the potential ability of South Johnstone to draw cane from expanded production on the Atherton Tableland, the impact on the viability of the Mulgrave Mill is likely to be marginal.
  - The main impacts of the loss of this cane land would be on transport infrastructure, as the cost of operating the line to Edmonton north relies on being spread across a 90 000 tonne production. In this context the percentage lost is 14% and this would reduce transport efficiency in terms of contributions to the maintenance of the line. The transport task would also be less efficient as the same number of train trips per day would be required and the length of season would be the same, however the yield per trip would be lower. Generally the economics of the cane transport would be adversely impacted by the loss of production.
  - It is not possible to avoid or minimise this lost agricultural production on the Aquis Resort site. Mitigation is limited to a financial payment as allowed for under the *Strategic Cropping Land Act 2011* (Qld) for the area of SCL as validated under the Regulations.
- Change in landscape character:
  - The site will be transformed from a rural setting to a highly developed urban setting with a consequential change of existing amenity.
  - Tall buildings on the site will be able to be seen from off-shore, from some elevated houses at Yorkeys Knob and Smithfield, and will be glimpsed above the mangroves as seen from the Cairns Esplanade; but will not be seen from Green Island, Fitzroy Island, Palm Cove, Redlynch or Redlynch Valley Road. The site will be clearly visible from arriving and departing aircraft.
  - The existing quiet beach at the mouth of Richters Creek will lose its perceived naturalness and seclusion.
  - The lighting associated with this major complex will be noticeable over a wide distance, either directly or as night-time glow, and from a distance may appear to be similar to or compatible with airport lighting.
  - There are unlikely to be any visual impacts on the GBRWHA, its OUV and associated aesthetic attributes, or on intangible perceptions or responses, as the built form will be no more visible from off-shore than Cairns CBD buildings.
  - In general it is not possible to mitigate this impact due to the intensity of the proposed development and the height of the current building envelopes. The project will be very visually prominent when viewed from Yorkeys Knob Road although screening will partially hide more distant structures. Screening will be effective to some extent, especially where there is a large distance between the viewer and the structures and the screening vegetation is close to the viewer (e.g. along Yorkeys Knob Road and Yorkeys Knob Beach).
- Infrastructure
  - The development will result in increased demand on existing infrastructure that will need to be met through infrastructure upgrades/augmentation.

- Economic and social:
  - The development will result in demand for goods, services and labour in excess of existing supply / capacity in the region which may lead to upward pressure on prices in absence of increase supply / capacity in the short-term.
  - Consequential population increases will result in increased demand for housing and social services which may put upward pressure on cost of rental accommodation / housing and shortages in services delivery. See also **Section 22.17.9**.

22.17.3 Discussion – Beneficial Impacts

The principal direct and indirect beneficial impacts (following mitigation and assuming recommended management) are considered to be:

- Water quality of the GBR lagoon:
  - The adoption of WSUD principles and the re-use of 1430 ML/a of treated effluent from the Marlin Coast WWTP means that, compared with current farming activity, there will be a net reduction of pollutants exported to the GBR, even allowing for the sewage production of the development. This reduction is estimated to involve a total of over 133 t/a and can be expected to have a beneficial effect on the water quality of the GBR lagoon.
  - The removal of tide gates and undersized culverts on-site will improve tidal flushing and thereby enhance water quality in Half Moon and Yorkeys Creek.
  - Proposed rehabilitation of the Half Moon Creek and Yorkeys Creek corridors within the site will improve water quality in that system.
- Biodiversity (habitat, species, and ecological processes):
  - With the exception of minor clearing for infrastructure corridors and the removal of the disused aquaculture ponds for safety and environmental reasons, very little natural vegetation is to be cleared. Inclusion of this land in an area to be protected by town planning approvals will remove current threatening processes and lack of protection.
  - An additional 56 ha of native vegetation will be planted and this will provide habitat for listed plants and animals as well as reinforcing ecological connectivity through the site, to the benefit of upstream areas (e.g. Cattana Wetlands) and downstream areas (e.g. the two FHAs and the state and Commonwealth marine parks).
  - Removal of existing waterway barriers (tide gates and undersized culverts) will enhance aquatic and terrestrial connectivity.
  - The development of Aquis Resort will bring forward planning and implementation of bulk water supply, treatment and distribution upgrades as well as increased wastewater treatment capacity at the Marlin Coast WWTP, and upgrades to the Cairns Western Arterial Road and the proposed Smithfield Bypass for which warrants currently exist.
  - The infrastructure upgrades are not solely required as a direct consequence of the proposed development, but also cater for future population growth which will be brought forward as a consequence of the employment opportunities created by Aquis Resort.
- Economic and social:
  - Aquis Resort will provide a massive stimulus to the local economy with substantial increases in employment opportunities both directly and indirectly in the regional economy.
  - The development will bring forward planned population increases and it is anticipated that levels of service and standards of services provision will be maintained and enhanced as a consequence of the increased population base.

22.17.4 Discussion – Consequential Impacts

Consequential impacts involve the raft of adverse and beneficial effects of the construction and operation of the project that arise from an action made possible by an initial direct impact (see also **Section 22.4.1a)**). These are expected to include the following:

- The direct need to bring forward expansions of infrastructure (especially power, water, sewerage, communications, and solid waste handling facilities, and to a lesser extent roads). The impacts will be both adverse and beneficial. For example, the need to upgrade infrastructure to service the resort will require expansion of the basic plants, involving off-site impacts associated with clearing, water extraction, disposal of treated effluent, and the upgrading of pipelines, transmission lines, pumping stations, and generation facilities. These are all the impacts associated with basic infrastructure and would occur for any growth in demand – as noted previously, this growth has been planned for and is simply being brought forward. The beneficial impacts arise because the upgrading of infrastructure inevitably leads to better quality of services for existing users in the area to be upgraded. This is especially true for electricity and communications. See also **Section 22.17.9**.
- The impact of providing and transporting construction materials to the site, especially raw materials such as sand and gravel, as well as manufactured products including cement, steelwork and a large range of plant and equipment to be used in the project. The supply of these materials will impact on the environment of the sites from which they are derived (for example quarries and factories) and transport by all modes.
- The indirect demand for a range of community services arising from workers employed during construction and operation, and their families, including housing, education, police, medical, and a range of social services associated with the growth of the population at large. The provision of these services will consume resources (such as available land supply) and require additional employment and investment in support infrastructure. See **Section 22.17.9**.
- The beneficial impacts of all of the economic ‘multipliers’ identified in the economic impact study. As money circulates in the economy there will be a growth in employment and business opportunities. This growth has obvious beneficial impacts but also will put a strain on current resources such as food, non-renewable energy, and non-renewable materials.
- International air transport. An obvious consequential impact is the growth in international air transport required to convey resort guests to and from the site. This has been allowed for in the greenhouse gas calculations but this is just one aspect of the impact. Cairns Airport Pty Ltd has confirmed, however, there is sufficient runway capacity for all Aquis Resort demands, so there will be no need to contemplate a second runway.
- Provision for hazards. While in most respects the Aquis Resort will be ‘self-sufficient’ in terms of coping with hazards, there is no doubt that the extra guest and staff population could require community services following an extreme event. These include medical, police, and infrastructure providers.
- Tourism use of the GBRWHA and WTWHA. It is expected that some Aquis Resort guests will want to visit the attractions of the region as part of their stay in Cairns. This has the potential to add to visitation impacts of these protected areas. See **Section 22.17.8**.

The above is just an overview of likely consequential impacts. The expenditure of $8.15 billion in construction and the annual revenue stream of $11 billion cannot take place without major changes to the local, regional, and state economies. It is considered that CRC and state agencies would be best-placed to examine the implications for specific infrastructure and services for which they are responsible and use this information to modify current planning to accommodate the Aquis Resort.

22.17.5 Discussion – Cumulative Impacts

Cumulative impacts are the successive and combined effects of impacts on the environment, taking into account direct, indirect, and consequential impacts and the incremental and compounding effects of these impacts over time. These have been addressed in GBRMPA (2013a) and included in the discussion in **Table 22-12**. The principal cumulative impacts (following mitigation and assuming recommended management) are considered to be:

- Adverse cumulative impacts:
  - Increasing urbanisation of the Barron River delta and the loss of rural landscape values. This is unavoidable and largely un-mitigatable if Aquis Resort is to proceed.
  - Loss of currently productive cane land / potential SCL and further reduction of the assigned land for the Mulgrave Mill. This loss can be mitigated by a financial contribution under the *Strategic Cropping Land Act* (2011) if Aquis Resort is to proceed.
  - A range of flow-on effects arising from the growth of population (tourist and staff) and the impacts of normal daily life. These effects will be felt in all sectors of the economy, and especially for service providers.
  - There will be many growth-related social issues (e.g. cost of living, rate of change, lifestyle changes, law and order).
- Beneficial cumulative impacts:
  - Reduction in export of suspended solids and nutrients to the GBR lagoon due to the WSUD features and the re-use of at least 80% of the sewage produced by Aquis Resort after treatment in the CRC's Marlin Coast WWTP. The export of these pollutants is a known chronic impact arising from agricultural and urban land use in the GBR catchment.
  - Enhancement of habitat and habitat connectivity around and through the site. Loss of riparian function is also a known threat to GBR values and the Aquis initiatives will assist in the reinforcement of the Richters Creek, Yorkeys Creek, and Half Moon Creek systems. This will also enhance the ecological function of the adjacent Cattana Wetlands.
  - Employment opportunities will be enhanced and this will have far-reaching implications for social and economic indicators. However, this class of impacts could be both beneficial and adverse.

The strategic assessment of the GBR Program Report (GBRMPA 2013b) includes a draft Cumulative Impact Assessment Policy (s5.2.4). This was developed because the strategic assessment found that:

> …impacts — whether the result of human activities or natural forces — affecting the Region's values do not operate in isolation but overlap and interact with each other and that their accumulation through time and over an ever-increasing area is diminishing the ecosystem's ability to recover from disturbances.
>
> The declining health of the Great Barrier Reef indicates the need to not only protect and restore the condition of values and processes but to improve our management of high risk and cumulative impacts. This will be vital to improving the Reef's health and resilience and safeguarding its heritage values and community benefits. (p 26)

The purpose of the policy is 'to inform development of a transparent, consistent and systematic approach to the assessment of cumulative impacts across jurisdictions from activities within and adjacent to the Great Barrier Reef Region'. The focus of this policy is on developing processes to improve the way in which cumulative impacts are assessed and considered in planning and assessment decision making.

This policy is aimed at better considering cumulative impacts in decision-making and provides little guidance for this current assessment. However, the strategic assessment document contains many instances where cumulative impacts are discussed in detail (water quality is the most common theme) and this has been considered in this EIS. As noted above, it is expected that the direct contribution to cumulative impacts on the GBR is beneficial (due to the reduction in export of pollutants). However, when the consequential / facilitated impacts on the Cairns region are considered (e.g. those arising from population growth and expanded economic activity), there is no doubt that the human footprint will grow. This is a matter addressed by the FNQ Regional Plan 2009-2031 as further discussed in – see **Section 22.17.9**.

22.17.6 Discussion – Duration and Nature of Impacts

a) Short-term Impacts

Short term impacts are generally associated with construction (e.g. erosion and sedimentation, contaminated land, ASS/PASS issues, noise and air emissions, groundwater impacts, weeds, and construction-associated aspects of visual amenity and Cairns airport impacts) as well as episodic hazards associated with short term aspects of floods and coastal processes.

These construction impacts are all amenable to environmental management and are all expected to be minor in nature.

Impacts associated with flooding, storm tide, and tsunami are all able to be mitigated by design responses (generally by setting sufficiently high floor levels, providing safe refuge, ensuring that structures are adequately designed, and making sure that appropriate emergency responses are in place).

b) Long-term Impacts

The likely significant long term impacts (most of which are also irreversible) are considered to be changes to the landscape character of the area and the suite of economic and social changes that are variously adverse and beneficial. Associated with these are the inevitable expansions of the infrastructure network.

As a trend, impacts on biodiversity and water quality are expected to be long term and largely beneficial. Any adverse impacts are considered to be associated with extreme events and are reversible.

Coastal erosion and river migration have been shown to be unlikely but are nonetheless dealt with by design initiatives.

Loss of SCL has been shown to be largely related to reduced efficiency of the cane tram network in the Barron River delta group of farms. Mitigation is required under the *Strategic Cropping Land Act 2011* (Qld) but this is financial in nature and is not directed to actually offsetting the impacts.

Greenhouse gas emissions, even with proposed on-site mitigation, remain a significant long term impact. Off-site mitigation by sequestration remains a possibility and would have a beneficial impact if adopted at any time in the future as the operational impact is on-going.

Lesser long-term impacts include tenure-related and native title-related changes, along with minor Indigenous and non-Indigenous cultural heritage matters.

c) Reversible Impacts

All of the construction-related impacts are reversible, as are episodic impacts on water quality and biodiversity and the effects of flooding, storm tide, and tsunami.

Operational impacts arising from noise and air emissions (other than greenhouse) disappear practically as soon as the source of noise or emission ceases, while biosecurity impacts generally can be reversed.

Technically, impacts on Tenure and Easements can be reversed.

d) Irreversible Impacts

Irreversible impacts already discussed as 'long-term impacts' are SCL, landscape and visual amenity, coastal erosion and river migration, and a range of economic and social impacts. Also in this category are native title and NICH, the effects on both of which cannot be undone.

Groundwater is listed in this category as the volume of the surface aquifer within the lake footprint will be 'consumed' by the lake dewatering process. However, this is of negligible impact.

e) Predictable (Knowable) Impacts

With the exception of those described as 'unpredictable', all of the impacts are considered to be predictable, either based on current knowledge, well-established modelling techniques, expert opinion, or through the application of risk assessment techniques.

f) Unpredictable (Unknowable) Impacts

Of all of the predicted impacts, perhaps the only ones that are 'unknowable' are coastal erosion and river migration as these involve natural processes that are too complex to predict and that are not amenable to normal risk assessment. It is this class of impacts that warrants a serious 'defence' strategy that deals with consequence without being able to influence likelihood. Works are proposed for both of these impacts in the form of buffers and on-site structural works.

22.17.7 Matters of NES Summary – Direct Impacts

The site's natural values, framed in terms of OUV and indigenous flora and fauna, are unlikely to be lost, degraded or damaged, or notably altered, modified, obscured or diminished by the proposed development.

The site exhibits local value in terms of providing habitat for EPBC migratory and listed threatened species. Habitats present are not unique, but contribute to the local persistence of these species and form part of a habitat mosaic which supports EPBC-listed flora and fauna, including migratory species. This habitat mosaic provides ecological connectivity at a local level but has limited value beyond this dimension.

The development area sits (broadly) between two World Heritage areas, and in this context the site could potentially enhance the connectivity values of the landscape intervening between these two areas. Planned restoration would enhance landscape connectivity and surrounding aesthetic values.

22.17.8 Consequential Impacts – Tourism

a) Regional Demand

Although the Aquis Resort is primarily an integrated destination in its own right and will provide substantial on-site tourism features (for example, the aquarium, cultural centre, and boundary boardwalks), it is likely that some guests will want to visit the attractions of the region as part of their stay in Cairns. Aquis Resort is emphasising its '… at The Great Barrier Reef' brand as a major attractor. A detailed assessment has yet to be made of the likely number of resort guests to visit the GBR and WTWHA. However, it is known that 85% of all reef tourism takes place from locations in the Cairns / Port Douglas area and therefore any Aquis Resort guests will add to the existing demand for a reef experience. Various attractions in the WTWHA are also popular for Cairns-based tourists.

Some relevant points are:

- GBRWHA:
  - The Great Barrier Reef is a well-known Australian destination for international visitors and advice from Tourism Tropical North Queensland (TTNQ) is that practically 100% of Chinese visitors travel to the GBRMP (V Tan pers. comm. 27 May 2014).
  - Tourism is the most significant direct use of the GBR, both in terms of economic value and employment, with tourism in the GBR catchment and WHA in 2012 generating approximately $6.4 billion in direct in direct expenditure, $5.2 billion value-added, and an equivalent of more than 64 000 full time jobs (GBRMPA 2013a).
- WTWHA:
  - Similarly, advice from TTNQ is that most Chinese visitors also take trips to various destinations within the WTWHA (V Tan pers. comm. 27 May 2014). The types of trips are discussed later.
  - Tourism is an important direct use of the WTWHA, both in terms of economic value and employment. Recent work by Prideaux and Falco-Mammone (2007) estimates that the gross economic value of tourism directly generated by the WTWHA was $426 million. This is likely to be greater now and increasing annually.

b) Trip Preferences

These trip-preference observations are supported by exit surveys at the Cairns International Airport that are regularly conducted by JCU. While these are not targeted at Chinese visitors in particular, they do indicate preferences of international visitors to the region that can be expected to be typical. For example, an exit survey undertaken by Prideaux and Sibtain (2010) reveals the following during the 2007-2009 survey period:

- GBRWHA:
  - 74.2% (79.0% in 2009) of respondents visited the Great Barrier Reef, with the majority of respondents departing from Cairns.
  - The key reasons given by respondents for not visiting the Great Barrier Reef were ‘lack of time’ (13.5%) and ‘because they had been before’ (8.5%).
- WTWHA:
  - 76.1% of respondents reported visiting the Wet Tropics World Heritage rainforests. The key ‘hotspots’ for experiencing the rainforest include:
    - Kuranda (51.3% in the 2007-2009 survey period)
    - Daintree (35.7% in the 2007-2009 survey period)
    - Mossman Gorge (32.5% in the 2007-2009 survey period).
  - The reasons given by respondents for not visiting the rainforest (23.9%) were ‘not enough time’, followed by ‘not interested’ and that ‘activities they wished to participate in were not available’.

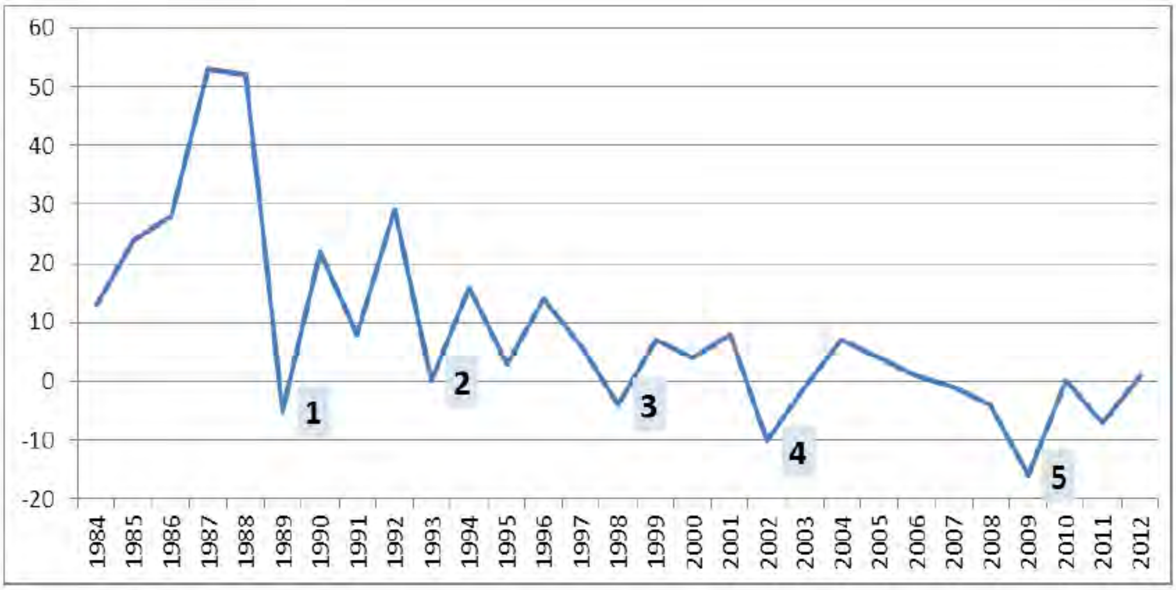
TTNQ also advise (V Tan pers. comm. 27 May 2014) that although Asia in general and China in particular has many different tourism markets, and that the gaming market is in some ways unique, Aquis Resort guests from these areas can be expected to follow the general pattern of arrivals from these areas and will wish to visit the natural attractions of the region. These comments are supported by recent experience in Singapore. Some particular distinctives can be expected to apply to the likely Aquis Resort guest profile (V Tan pers. comm. 27 May 2014):

- GBRWHA:
  - a strong desire to visit the GBRMP (this is necessarily via commercial tours)
  - a preference for destinations that involve an island or pontoon and a high level of comfort
  - a growing demand for helicopter trips amongst the more wealthy and time-poor tourists.

- WTWHA:
  - a strong (but less than for the GBRMP) desire to visit rainforest areas, usually but not restricted to the WTWHA, with some key examples being:
    - Skyrail / Kuranda Village
    - Mossman Gorge
    - Hartleys Creek
    - Botanic Gardens (i.e. not a national park but an example of rainforest)
  - a strong preference for commercial tours (there are currently 11 Chinese-focused tour desks in Cairns and this number is growing) – however, there is only one dedicated Chinese tour company
  - a preference for destinations that involve developed infrastructure (e.g. cable car, boardwalks, visitor centres).

c) Trends in Regional Demand and Capacity

It is known that tourism demand (as reflected by international arrivals at the Cairns International Airport) has declined from around 780 000 in the year to September 2000, to about 630 000 in the year to September 2012, or about 1.8% per annum over this period. Over the longer term, this change is more dramatic as shown below.



1 Upgraded airport.
2 Pilots' dispute.
3 Asian crisis.
4 Australian airlines replaces Qantas and JAL services.
5 Global Financial Crisis – cut in Airline capacity to Japan.

Figure 22-40 Growth in international visitors to Cairns region.

Source: Cummings Economics from TRA International Visitor Survey.

These figures reveal that, compared with the 'Daikyo years' (i.e. late 1980s), international tourism numbers have diminished by about 50%. Tourism infrastructure and capacity over this period has increased slightly, so it is likely that significant latent capacity exists.

Consultation with QPWS (J De Campo pers. comm. 30 May 2014) reveals that over the last 10 years, the number of commercial activity permits for commercial visits to national parks has dropped from about 200 to about 100. Visitor numbers to these protected areas are not known but it is expected that the reduction would be proportional. It is also understood that there are no current signs that visitor numbers are creating serious management problems. Although there is a moratorium on new permits in the Daintree area (and this includes Mossman Gorge), there is considered to be significant latent capacity in the commercial tours sector most likely to be used by Aquis Resort guests

d) Aquis Demand

Aquis Resort is expected to create a significant amount of additional demand by increasing international visitation to TNQ by 900 000 per annum, or about 142% relative to 2012 visitation levels. This is an increase of some 15% over 2000 levels but reaches only about 95% of the 1988 peak which approached 1 million visitors per year. Putting this in perspective, the Aquis Resort is expected to essentially return international visitation numbers to where they were during the last peak.

At full occupancy, the Aquis Resort will support 12 000 people. It is estimated that the average number will be around 10 000. Many of these visitors will undertake an off-site trip on one of the three days on average that they are resident. These visitors can be expected to undertake trips and participate in other tourism activities provided within the region. The actual number and spilt of Aquis Resort guest trips cannot be predicted at this time and can be expected to be influenced by a number of factors.

However the Aquis Resort is expected to essentially return international visitation numbers to where they were during the last peak. From this it is concluded that extra visitation is not expected to be a major issue, as similar numbers of international arrivals have been accommodated in the past. It is expected that most if not all of Aquis Resort guests will utilise existing commercial tour operators and will therefore be subject to management as described below. However, the Chinese free and independent traveller (FIT) market is growing rapidly and this needs to be considered.

e) Great Barrier Reef World Heritage Area Visitation

The following discussion describes existing planning and management arrangements and assesses their effectiveness in managing the impacts of Aquis Resort guests on the GBRWHA.

<u>GBRWHA Management</u>

Management of the GBRWHA – and in particular the GBRMP (Commonwealth) and the GBRCMP (Qld) – includes three main tools as outlined below:

- Zoning Plan. The *Great Barrier Reef Marine Park Zoning Plan 2003* is designed to protect the Region's biodiversity while allowing ecologically sustainable use and the continuation of traditional activities. It achieves biodiversity protection by providing spatial control of use (predominantly extractive activities) and, to a lesser extent, access within the GBRMP. It establishes the need for permits for some uses in the Marine Park, such as tourism, infrastructure and research and also provides for emergency responses in relation to incidents such as risks to human life, pollution threats or vessel groundings. There are complementary zoning arrangements in adjacent areas under Queensland jurisdiction within the Great Barrier Reef Coast Marine Park.
- Plans of management. There are four plans of management for areas in the Marine Park, covering about eight per cent of the Marine Park. They set out specific management arrangements for areas, species, ecological communities or activities and are important in protecting biodiversity and heritage values while ensuring sustainable use (especially tourism and recreation activities). They complement zoning and permitting arrangements. The plans for the Cairns Area, the Whitsundays and Hinchinbrook set out detailed management arrangements applying to all users of these areas, with a focus on protecting key natural values and allowing a range of uses. Some provisions of each plan are legally binding.

- Permits. Permits regulate use of the Marine Park and are a tool to reduce impacts, separate potentially conflicting activities, collect data for planning, and monitor potentially damaging activities. They are issued mainly for marine tourism, research, dredging and infrastructure (for example jetties and marinas). As part of the permitting process, there is a formal environmental impact assessment under the Act for evaluating the likely possible risks or impacts to the environment from a proposed activity or development. Joint Queensland Government / GBRMPA permits may be issued for activities which operate across jurisdictions.

Of importance is the fact that it is not practical for Resort guests to visit the GBR unless on a commercial tour. All commercial tours are covered by the permit system and permits are only issued in accordance with the relevant plan of management and ultimately the zoning plan. Therefore, Aquis Resort guests will add (slightly) to the overall visitation demand and will be subject to current management arrangements.

According to GBRMPA (2013a), the permit conditions seek to limit cumulative impacts. The potential problems arising from significant latent capacity within the permit system have been recognised and, at least, partially addressed through GBRMPA's plans of management, capping permits, and a booking system for sensitive sites. The permitting system is thought to manage tourism well, although the system is complex and its effectiveness in informing and educating tourism operators *'… about what they can and can't do — while delivering required outcomes for the environment, social, cultural and heritage values — requires evaluation*' (GBRMPA 2013a).

As noted above, visitation levels once the Aquis Resort is operational are expected to approximately equal those of the late 1980s peak.

f) Wet Tropics World Heritage Area Visitation

The following discussion describes existing planning and management arrangements and assesses their effectiveness in managing the impacts of Aquis Resort guests on the WTWHA.

<u>FNQ Regional Plan 2009-2031</u>

The role of tourism in the regional economy is well-recognised in the FNQ Regional Plan 2009-2031 (Regional Plan). This notes that:

> … over the past decade, the FNQ region has experienced continuous growth in resident population, visitation, economic activity, and urban development. The region's tourism industry expansion and the national trend of population movement north along the Australian east coast have driven this growth. The government expects this growth to continue over the next 20 years and beyond. The regional plan will help manage this growth in the most sustainable way to protect and enhance the quality of life in the region. (p 6)

The Regional Plan recognises the need for management and states:

> 5.5.C The cumulative number, location and type of visitor sites is managed so that they do not adversely affect World Heritage values while maximising options for presenting the area. (p 101)

This objective is given effect through local government planning schemes and government agencies planning and management arrangements. However, the major management of tourist use of the WTWHA is via the *Wet Tropics Management Plan 1998* (WTMP) prepared under the *Wet Tropics World Heritage Protection and Management Act 1993* (Qld).

WTWHA Management

According to the strategic review of the GBR coastal zone (DSDIP 2013a), visitor use is not listed as one of the major threats to the values of the WTWHA.

Management of the WHA is via a zoning system (that establishes which activities in the Area are prohibited, allowed under permit, or allowed without a permit) and via the associated permit system as appropriate. In general, tourism infrastructure is located within Zone D of the WHA and this zone is managed to minimise any adverse impacts of activities and facilities, and to protect and rehabilitate the land. Between them, the zoning and permit system ensure the likely impact of the proposed activity on the WTWHA's World Heritage values is minimised. Decision-making principles and criteria also include the precautionary principle and consideration of prudent and feasible alternatives, carrying capacity, and community aspects (DSDIP 2013a).

The strategic assessment also notes that promoting presentation of the Wet Tropics WHA to visitors is a key function of the WTMA under the World Heritage Convention and the *Wet Tropics Act*. The WTMA works with QPWS, community conservation groups, and the tourism industry, to inform and educate residents and visitors about the wonders of the WTWHA, its unique plants and animals, and its scenic beauty. Specifically, the WTMA recognises that properly managed, nature based tourism provides a valuable opportunity to present the Wet Tropics WHA and promote regional, national, and international recognition, understanding, and appreciation of the OUV of the WHA. Such recognition and appreciation has resulted in enhanced support for the protection of the WHA and its OUV (DSDIP 2013a).

According to a special annual report on the WTWHA focusing on tourism issues prepared by the WTMA (2010):

> Tourism is an important focus for the Authority. It has the potential to provide local communities with economic and social benefit, as well as benefit the wider Australian economy. It is also one of the key methods of presenting the Area as set out in the World Heritage Convention. Cooperation between the tourism industry, management agencies and the community is essential for the long-term success of tourism. The Authority's Nature Based Tourism Strategy provides the basis for tourism management in the World Heritage Area. The overall aim is to encourage a dynamic, sustainable and professional nature-based tourism industry in the Wet Tropics. (p 39)

The report continues:

> Since its establishment in 1993, The Wet Tropics Management Authority (WTMA), which reports to both the Queensland and Australian Governments, has developed a number of strategies to meet its obligations under the World Heritage Convention, 'to protect, conserve, present and transmit to future generations and rehabilitate the Wet Tropics World Heritage Area'. Building on the 1997 policy framework Protection through Partnerships, and in consultation with stakeholders, WTMA has prepared and implemented a number of strategies and policies for tourism and visitor management that acknowledge and accommodate the important role of the tourism industry in presenting the Area to visitors. The Wet Tropics Management Plan 1998, Wet Tropics Nature Based Tourism Strategy 2000 and Wet Tropics Walking Strategy 2001 provide for a diversity of sustainable tourism activities, including opportunities for Aboriginal communities to develop Indigenous tourism within their cultural landscapes. (p 55)

Management of infrastructure is by the zoning and permit system as described above. Management of commercial use of the WHA is also important. According to WTMA (2010):

> The majority of commercial tourism in the Wet Tropics World Heritage Area occurs in national parks (over 70% of the World Heritage Area) under Commercial Activity Permits administered by QPWS. Most of the current 138 permits allow for guided tours, camping and wildlife viewing in the national parks. Popular destinations are Daintree, Mossman Gorge, Kuranda and Barron Gorge National Parks and the Atherton Tablelands, Palmerston and Mission Beach areas. (p 56)

The QPWS commercial activity permit system requires that licensed operators meet particular standards. In addition, permits are only granted following a formal assessment of the likely issues and impacts associated with the activity, and only when the assessment indicates that the impacts will be within acceptable limits.

The strategic review of the GBR coastal zone (DSDIP 2013) includes a case study of the WTMP (Demonstration Case 1: wet Tropics management plan). It concludes that:

> The Wet Tropics Plan and its administration by WTMA have been effective in avoiding, minimising and mitigating impacts in the Wet Tropics WHA. (p1-24)

This is confirmed by advice from the Queensland Tourism Industry Council (QTIC) (D Gschwind pers. comm. 1 June 2014). Gschwind argues that most Aquis Resort guests who choose to travel to WTWHA destinations will chose to do so in commercial tours and, in QTIC's experience, commercial tours are well-managed and result in fewer impacts per person than the FIT sector.

<u>WTMA Consultation</u>

Specific consultation has been undertaken with WTMA (P Chantrill pers. comm. 28 May 2014) and this can be summarised as follows:

- The Authority believes that tourism is being managed and undertaken sustainably.
- The best way to present and promote discovery, understanding and connection with the World Heritage Area and its rich natural and cultural values is via tourism and WTMA's partnership with the tourism industry. WTMA has extremely positive and constructive relationships with the nature-based tourism sector and cooperate with the like of Skyrail, Daintree Discovery Centre, and Jungle Surfing in presenting the World Heritage Area.
- There have not been any management issues or concerns relating to the operation for the tourism sector over the past five years. Most of WTMA's activities involve partnering and supporting the nature-based tourism sector rather than managing or constraining their operations in any way. WTMA does have a role when there are major infrastructure projects such as erecting the Skyrail cable towers – in this case WTMA places stringent conditions on the construction and erection to ensure they had little negative impact.
- There have been issues present from time to time about non-permitted operators detracting from best standard practices but the new QuEST policy will help ensure that only the best standard operators can operate in our high value and visitation sites.

The QuEST (Queensland Eco and Sustainable Tourism) policy is a recent initiative of the Department of National Parks, Recreation, Sport and Racing (NPRSR). It (NPRS&R 2013) replaces the previous Tourism in Protected Areas policy and continues existing essential policy elements. In addition it incorporates:

- new policy to improve access and provide new opportunities in national parks for ecotourism operators
- reduce administration and streamline processes
- support authorised tourism operators
- promote best-practice tourism experiences.

The key issues are the move towards best-practice standards and accreditation to improve visitor experiences and lead to desirable protected area management outcomes. Also relevant is the Queensland Government's stated policy to expand tourism use of protected areas by permitting new infrastructure, subject to sustainability criteria. This initiative means that if there is additional demand, it will lead to more economic activity and an incentive to increase capacity.

Conclusions

Overall, the existence of the existing management arrangements means that:

- WTMA controls where visitor infrastructure is constructed and conditions permits as required, such that the impacts of the proposed activity on the Wet Tropics WHA's World Heritage values is minimised.
- QPWS controls the location of all commercial tours to the WTWHA, the vehicles used for this access, the routes taken to reach the approved locations, and the number of passengers involved.
- QPWS also has the option to manage impacts via the permit system itself, and by measures such as direct use / capacity, site hardening, or even closure.
- Consultation with TTNQ, WTMA, QPWS, and QTIC reveals little concern that increased visitation of the WTWHA is a significant issue in terms of impacts and management needs.

Based on the above, it is concluded that there are sufficient controls to ensure that visitor use of the WTWHA is managed sustainably. Accordingly, there is a low risk that the operation of the Aquis Resort will create significant consequential impacts on WTWHA values. Additional demand will lead to more economic activity and an incentive to increase capacity by permitting new infrastructure, subject to sustainability criteria. This is consistent with Queensland Government policy.

Visitation levels once the Aquis Resort is operational are expected to approximately equal those of the late 1980s peak. Of course, this analysis ignores other growth which will most certainly follow if Aquis proceeds. Such growth is foreshadowed in the Regional Plan, notwithstanding that Aquis will bring this forward by a number of years.

g) Market Changes

It is Likely that most day trips from the Aquis Resort will to involve commercial tours and for the GBRWHA, there are few feasible alternatives. However, the situation is different for the WTWHA where access by the FIT sector is relatively easily achieved. The Chinese FIT market is growing rapidly and there will be a role for the Aquis Resort management to play in the education of all Aquis Resort guests seeking to embark on day trips once the resort is operational. This is likely to include partnerships with protected area managers and the tourism industry.

22.17.9 Consequential Impacts – Population Growth

The construction and operation of the Aquis Resort will create a demand for a range of services to meet the needs of the workforce. These needs are all a function of population growth and this is a theme addressed in the Great Barrier Reef Coastal Zone Strategic Assessment (DSDIP 2013) outlined in **Section 22.1.6**. Section 5.1.4 of that report deals with population growth and it is pertinent to include the findings verbatim as follows.

> The size, growth rate, distribution and migration patterns of Queensland's population are all important factors that drive land use change and natural resource demand, providing a challenge to the provision of socio-economic services that support high or improved living standards.
>
> The population of the GBR coastal zone is expected to grow at an average annual growth rate of nearly two per cent to approximately 1.4 million by 2031. This predicted growth is particularly evident in the cities of Gladstone, Mackay and Townsville and is in line with the growth rate for the state. A population decline is expected in some of the smaller, more remote coastal communities (see Appendix C [of DSDIP 2013]). Both economic and lifestyle factors will drive this trend.

> As human populations grow there is a need for more land for housing and related urban and industrial infrastructure. Historically, population growth has required increasing amounts of resources and generated larger amounts of waste and emissions which require disposal/treatment or are ultimately returned to the environment. Population growth may, therefore, increase the significance of urban development as an activity creating pressure on MNES in the GBR coastal zone.
>
> However, this may only be an issue where a population is already large, such as a metropolitan area. While the urban development required to accommodate population growth in the GBR coastal zone will increase pressures on MNES, it will generally be localised and of marginal significance relative to other pressures. This is primarily because the population will grow from a relatively small base compared to the land area, and urban development is subject to significant regulation relative to other land use, particularly agriculture. Accommodating a significant increase in population in the major centres of the GBR coastal zone will not require a major new footprint. For example, the Far North Queensland Regional Plan forecast an additional population of about 70 000 for Cairns by 2031. Most of this additional population is planned to be accommodated in the Mount Peter area north of Gordonvale. The area is less than 2000 hectares and is currently used primarily for sugarcane production. A well planned and regulated urban development in this area can be expected to have a net positive impact on MNES over the previous land use in these circumstances.
>
> The Program contains components, including the SP Act, that provide a strong framework for ensuring the planning for and development of urban areas and activities do not have a significant impact on MNES and other important natural values and resources. (p 5-155)

The economic and social assessments have concluded that, although the Aquis Resort was not contemplated in the current Regional Plan, the growth that it will bring was factored in to the plan although this will be brought forward. The Mt Peter case study (**Section 22.5.3d)**) reveals that current management arrangements for Mt Peter will lead to a well-planned and regulated urban development in this area. According to DSDIP (2013a), this is expected to have a 'net positive impact on MNES over the previous land use in these circumstances'.

22.18 ENVIRONMENTAL MANAGEMENT

22.18.1 Overview

The impact assessment has identified the opportunity for mitigation via a range of management actions that could take place during the construction and operation phases of the project. These have been presented at various levels of detail but, in general it is not possible or useful to produce a detailed environmental management plan at this stage of project planning. Mitigation has necessarily been focused on changes to footprint and location of project elements (as there is little chance of reviewing these decisions as the project evolves). However, there are many opportunities to influence the detailed design and how it is constructed and operated.

As noted above, the overall approach to reducing impacts follows that included in the Great Barrier Reef Region Strategic Assessment (Appendix 2 of GBRMPA 2013a), namely *avoid, mitigate, offset, and adaptively manage* impacts.

The proposed environmental management framework is discussed later in this chapter. This is designed to consider the contents of a number of various *Management Strategies* derived from the detailed assessment of impacts (specifically the identification of mitigation and management needs), and convert these, at a later date, to a number of *Management Plans* for progressing this work.

22.18.2 Management Strategies

A strategy can be defined as 'a set of coordinated actions designed to achieve a specific goal and meet identified objectives'. Using this definition, each strategy detailed below includes clear statements of:

- goals
- objectives that clarify the goal
- tasks that when undertaken will serve to meet the objectives (design, construction, and maintenance/operation)
- interaction with other strategies (identified interactions and cases of multiple objectives)
- maintenance needs
- resources and budget.

Strategies are developed for those issues that are unique, unusual, project-specific or site-specific that may have actions to be implemented during each phase of the project. **Table 22-50** collates mitigation measures proposed throughout this EIS and provides a brief description of the relevant strategy. The strategies are designed to form the basis of specific *Management Plans* as described in **Section 22.18.3b)**. In addition to management plans based on these strategies will be the suite of 'usual' management plans dealing with, for example, contaminated land, noise and vibration, air emissions, traffic – all construction and operation phase matters that will require management.

TABLE 22-50 OUTLINE OF STRATEGIES

STRATEGY	OUTLINE
Acid Sulfate Soil Management Strategy	This strategy will document specific actions required during the design, construction and operational phases. Considerable detail is provided in **Section 15.3.4** and this will be expanded to consider the following: • Documenting further sampling required including ASS/PASS sample collection and analysis to achieve compliance with the SPP. • Detailed groundwater and surface water quality monitoring to determine pre-development baseline conditions relating to ASS/PASS. • Using results from sampling to avoid disturbance of soils with higher acid generating potential, where possible. • Ensuring the EMP (Construction) specifies that soil stockpiling prior to treatment is limited to reduce the risk of oxidation. • Impact mitigation by lime treatment (carried out in accordance with Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines), or alternatively, placing PASS materials back below the water table at an approved location. • Ensuring that the timeframe and extent of groundwater drawdown is limited for dry excavation works. • During construction, undertake monitoring of groundwater levels and quality and implementation of water treatment, where required. • During construction, undertake monitoring of surface water and any extracted groundwater/dewatering discharges and implementing water treatment where required. • Avoiding filling on areas where AASS has been identified (if this is not possible, constructing lime trenches to protect surface water features and conducting additional groundwater quality monitoring).
Airport Safety Strategy	This strategy will document actions required to ensure that the project has no impact on the operation of Cairns Airport and to minimise the impacts the airport will have on the project due to the close proximity. Actions identified in this EIS include: • Ensure that the design complies with the requirements of SPP 2013 Planning for infrastructure (Strategic airports and aviation facilities). • No upward facing lights, search lights, laser lights, volcanos or flashing lights. • No light sources stronger than 450 Candela. • No external lighting in parallel lines of between 500 m and 1000 m long. • No reflective cladding. • Remove (drain and fill) aquaculture ponds to reduce bird strike risk. • Use design elements that reduce the risk of attracting wildlife. • Incorporate noise mitigation measures into the design of accommodation buildings. • Ensure that aspects of the design do not amplify the volume of noise generated by aircraft (through resonance). • Acoustically insulate accommodation to minimum standards AS 2021. • Ensure the design does not include structures that emit gaseous plumes at a velocity exceeding 4.3 m/s or excessive smoke or steam. • Ensure the design does not incorporate permanent structures that contravene the requirements of CairnsPlan. • Liaise with CAPL, CASA and Airservices Australia to ensure that temporary breaches of height restrictions (if required) are approved and conditions complied with. • Allow for construction – i.e. cranes will most likely not be permitted to compromise the OLS.

STRATEGY	OUTLINE
Airport Safety Strategy (cont.)	• Building heights to be below OLS and PANS-OPS (varies across site from 50 m to 120 m). • At the southern extent of the site (within 4 km of the airport) buildings not to exceed 21 m. • Ensure that methods and equipment required to construct the project do not interfere with land-based navigational aids. • Locate the helipad in an area that ensures that anticipated flight paths do not pass over residential/public areas. • Ensure that the helipad complies with the requirements of CASA and Airservices Australia. • Develop an EMP (Construction) that: - addresses and minimises the attraction of birds to temporary water bodies that may develop during the construction process - minimises risk of construction activities impacting on flying fox behaviour in such a way that causes impacts on the operation of the airport - includes a detailed dust management strategy to minimise dust emissions from the site during construction - reduces the risk of attracting wildlife during construction activities - specifies lighting requirements to comply with SPP requirements.
Contingency Strategy	This strategy will collate all information relating to conditions that are outside normal operation. These include hazards, emergencies and accidents. Based on the information contained in this EIS the strategy will include the following: • Ensure all habitable structures comply with Australian Earthquake Loading Code (AS 1170.4). • For a shelter-in-place response to be acceptable, it will be necessary that the structure chosen to be the evacuation facility is able to withstand a maximum direct-hit cyclone (wind, cyclone-induced water level), tsunami, and the PMF. • Ensure that buildings to be used as shelter-in-place evacuation centre/s are designed to be critical infrastructure and allow radio communications from within the building to emergency service providers. • Ensure that emergency supplies including generators are located above foreseeable tsunami level (CRC plans for 6 m AHD tsunami height). 7.5 m AHD has been adopted and this is above the PMF. • Design buildings to enable vertical evacuation of visitors. • Adopt minimum floor levels for habitable rooms as 1% AEP plus 500 m freeboard. Adopted levels exceed this (set at 7.5 m AHD). • Incorporate a helipad above PMF to allow evacuation of injured visitors. • Construct the lake to convey flood and provide floodplain storage with zero afflux outside site for 1% AEP flood and ensure acceptable velocities. • Obtain access to council flood level monitoring system and / or incorporate standalone monitoring and associated response plans. • Raise the access road to, and around, the project to a level comparable to flood immunity of Bruce Highway (to allow evacuation if necessary). • Design internal transport / pedestrian routes to facilitate access to evacuation centres. • Investigate value of contributing to Aquis Resort / Government works to stabilise the Thomatis Creek bifurcation. • Design a medical centre to provide level of medical care required in the event of a disease outbreak. • Collaborate with Queensland Health to develop procedures to respond to outbreaks. • Develop an integrated emergency management plan including general spill emergency response including clean up and monitoring of relevant parameters (e.g. hydrocarbons in the event of a fuel spill and faecal coliforms in the event of a sewage spill).

(Continued over)

STRATEGY	OUTLINE
Crocodile Management Strategy	Crocodiles are known to currently inhabit the site. The Aquis Resort includes a lake and other water bodies that may attract crocodiles to areas that will be frequented by visitors. Hence, a strategy is required to coordinate a variety of actions to be implemented during each stage of the project and will include: • Crocodile management plan to be developed to reduce risk of interaction with visitors. • Design initiatives that could reduce the attractiveness of the development to crocodiles: - make the sides of the lake as steep as possible to restrict access to the water (and once in the water, to the adjacent land) - avoid water hazards in the golf course and natural water features in general. • Installation and maintenance of appropriate signage to maximise visitor awareness in higher risk areas. • Physical separation of the board walk / viewing platforms from crocodile habitat, either by elevation or fencing of the walking track and platforms. • Feeding of crocodiles from the board walk / viewing platforms would be strictly prohibited. Hygiene procedures would be required to ensure that crocodiles are not attracted towards the boardwalk. • Interpretative displays on the board walk to increase visitor knowledge on crocodiles where encounters are more likely (e.g., mangrove areas). • Warning signs adjacent to creeks and water bodies (e.g. Yorkeys Creek, Richters Creek) within and adjacent to the development, warning of the potential presence of crocodiles. • Design of lake edges to provide minimal crocodile entry / exit points. Steeper sided or vertical banks would be preferred. • Minimising the creation of breeding habitat on any vegetated portions of the artificial lake area – such areas e.g. islands, may offer ideal undisturbed breeding habitat for crocodiles. • Minimising the attraction of the lake surface – generating a level of random, anthropogenic disturbance that reduces the likelihood of usage, either through automated (aquatic drone) devices, or by incorporating a water taxi/gondola system may create a level of disturbance appropriate to dissuade crocodiles from using the lake. However it should be noted that it is illegal to drive a boat within 10 m of an estuarine crocodile. • Using shallow sand-bunkers with sub-surface drainage on the golf course, in preference to water hazards.
Fauna Management Strategy	This strategy will: • Incorporate flying animal strike mitigation. • Ensure the water bodies have steep sides to discourage use by waders. • Maintain brackish to saline water at a consistent level in lake to deter semi-aquatic plants that are attractive to birds. • Minimising new or novel foraging opportunities. • Minimising the attraction of the lake surface. • Using shallow sand-bunkers with sub-surface drainage on the golf course, in preference to water hazards. • Minimising the creation of breeding habitat on any vegetated portions of the artificial lake area. • Use existing information to determine factors most likely to cause alteration to behaviour of flying foxes and ensure that design elements minimise the risk of altering current behaviour. • Cover potential food and waste sources to prevent wildlife foraging.

STRATEGY	OUTLINE
Indigenous Cultural Heritage Strategy	To be prepared in conjunction with the Cultural Heritage Management Plan.
Integrated Water Management Strategy	The Integrated Water Management Strategy (IWMS) for the Aquis Resort site is guided by a series of principles. These principles are aimed at directing subsequent planning stages to better facilitate the IWMS/WSUD planning and design processes. These principles apply throughout the lifecycle of the development including the planning/design, construction, establishment and operational phases. These principles (many of which are based on those of National Water Commission's (2013) WSUD principles) include the following: Principle 1: Minimise the impact on existing natural features and ecological processes Principle 2: Minimise impact on natural hydrologic behaviour of catchments Principle 3: Protect water quality of surface and ground waters Principle 4: Minimise demand on the reticulated water supply system Principle 5: Improve the quality of, and minimise polluted water discharges to the natural environment Principle 6: Incorporate collection treatment and/or reuse of runoff, including roofwater and other stormwater Principle 7: Reduce run-off and peak flows from development Principle 8: If possible, re-use treated effluent and minimise wastewater generation Principle 9: Increase social amenity through multi-purpose green space, landscaping and integration of water into the landscape to enhance visual, social, cultural and ecological values Principle 10: Add value while minimising development costs Principle 11: Account for the nexus between water use and wider social and resource issues Principle 12: Design to reduce the urban heat island effect and warming of waterways Principle 13: Monitor the efficacy of solutions as well as the response in receiving ecosystems Principle 14: Adaptively manage the development so that it continually maintains the adopted IWMS principles and best practice standards as they evolve.
Interpretation Strategy	This strategy will coordinate actions that improve understanding and appreciation of the natural and cultural values of the site, Far North Queensland and Australia generally. Special attention is to be given to presenting World Heritage values (GBRWHA and WTWHA). The strategy will: • Incorporate interpretation uses in fringing forests which provide excellent opportunities for bird-watching, walking and other forms of recreation. • Interpret site-based conservation initiatives (i.e. restoration, weed management, fauna management). • Interpret Indigenous cultural heritage values in conjunction with the CHMP. • Interpret non-Indigenous cultural heritage values (these will be physically lost but salvage and archiving efforts should be investigated to present values of former use as a cane farm. The cultural centre will play a vital role in this aspect. • Present values of nearby World Heritage areas, especially OUV and flora and fauna of interest. The aquarium will play a vital role in this aspect.

(Continued over)

STRATEGY	OUTLINE
Lake Management Strategy	The lake is a critical feature of the project and poses numerous constraints and opportunities. There are a suite of actions that need to be implemented during the design, construction and operation of the lake to ensure that aspirations for its function are achieved. Some of the actions to be incorporated into the strategy include: • Reduce algal blooms, excess nutrients and organic matter including providing a supply of well oxygenated water, improved pH and salinity by flushing the lake using seawater from Richters Creek or Half Moon Creek. • Quarantine lake from groundwater (liner or cut-off walls) to prevent the potential inflow of polluted or nutrient-rich groundwater. • 14 day lake turnover using water from off-shore in the Coral Sea. • Strict receiving waters discharge criteria with discharge only allowable when set standards are achieved, and only on ebb tide. • Suitable lake bathymetry design and mechanical mixing (vertical and horizontal) to minimise adverse water quality impacts e.g. stratification, benthic growth. • Best practice stormwater management measures for the platform development to reduce pollutant loads into the lake. • Best practice stormwater harvesting for re-use throughout the development. • In-place treatment of lake water before discharge during adverse water quality conditions, including emergency event filtration using the lagoon treatment system. • On-going and comprehensive reactive water quality monitoring regime. • Major commitment to lake management and maintenance measures including clean-up after floods, de-silting through periodic dredging, aquatic plant harvesting, and weed and pest fish management. A specific Tilapia Management Plan will be required. • Best practice stormwater management measures for the development area to reduce pollutant loads into the receiving creeks. • Best practice stormwater harvesting for re-use throughout the development. • Best practice measures for golf course design and operation. • Use of Class A treated effluent from the Marlin Coast / Northern Cairns WWTP as a potable water substitute and the opportunity to remove all residual pollutants on-site, to the benefit of the receiving waters. • As a final option to ensure acceptable water quality within the lake, it is proposed to temporarily suspend the lake pumping system and use the lagoon filtration system to treat the water within the lake to a high level prior to discharge to Richters Creek. • A conceptual *Lake Sedimentation and Maintenance Dredging Strategy* is included in **Appendix M** and will be integrated into the project's EMP (Planning). • Street sweeping of all hardstands (car parking in particular) will be required following a flood event. • Tanks will be required to be located preferably above ground or sealed underground to prevent flood water infiltration. • Release of flood waters from the lake will be in accordance with the Flood Management Plan. • Water quality monitoring with site-based trigger levels and appropriate reactive management actions.

(Continued over)

STRATEGY	OUTLINE
Landscape and Habitat Strategy	The construction of the project will result in the transformation of the landscape from an agricultural sugar cane farm to an international resort incorporating high rise buildings, a 33 ha lake, and entertainment centre. This strategy will be developed to ensure that landscape and habitat values are protected and enhanced where possible by: • Achieving no net loss of habitat (all areas of natural vegetation are to remain except for minor infrastructure crossings). • Improving waterway connectivity (terrestrial and aquatic) by removing tide gates and replacing the undersized culverts with a small bridge in conjunction with a planned infrastructure crossing. • Removing existing aquaculture ponds to reduce bird strike risk, water quality concerns and flood management. • Implementing screening planting to improve scenic amenity and potentially connectivity. • Retaining riparian corridors along creeks, design and management of wide landscaped buffers and ecological restoration (scenic amenity). • Protecting values by design including: - masterplanning to avoid impacting natural areas that currently provide buffers to adjacent natural areas (especially the adjacent FHAs and Marine Park) - avoiding activities that may threaten values, such as clearing, interrupting aquatic connectivity by means of crossings of riparian areas - minimising the above when total avoidance is not practical - adopting best practice in the design of, for example, stormwater drainage (i.e. including WSUD techniques) - adopting a suite of design initiatives as outlined in the EMP (Planning) for the design phase. • Enhancing values by design: - masterplanning to include areas of restoration and additional buffers involving planting additional areas to achieve a range of biodiversity, interpretive, visual, air quality and water quality objectives - removing existing threatening processes such as management actions to reduce invasion by pest plants and animals, removal or modification of existing structures (e.g. tide gates, undersized culverts) where this is practical and leads to better environmental outcomes - adopting a range of technical and educational tools to present (and therefore help to protect) environmental values. • Protecting values by construction and operational management: - adopting a suite of construction management initiatives as outlined in the EMP (Planning) for the construction phase. - adopting a suite of operation management initiatives as outlined in the EMP (Planning) for the operation phase.
Non-Indigenous Cultural Heritage Strategy	Follow detailed recommendations of NICH study: • Action 1: Avoidance of Sites. • Action 2: Recording of Impacted Sites. • Action 3: Interpretation of the Site's History. • Action 4: NICH Management across the site. • Action 5: Archaeologist 'On Call'.

<table>
<tr><th>STRATEGY</th><th>OUTLINE</th></tr>
<tr><td>Restoration and Rehabilitation Strategy</td><td>During the project refinement stage a number of opportunities were identified to improve the landscape and habitat value of the site and provide connectivity through the project. This strategy will coordinate the implementation of actions to optimise the environmental benefits of the project, and will address the following issues:
• Ensure no net loss / net benefit of habitat.
• Ensure a more ecologically connected landscape (strengthened terrestrial and aquatic connectivity).
• Implement actions to increase in the total area of (regional) ecosystems and numbers of endangered, vulnerable or near threatened species.
• Maintain existing views to the greatest extent possible.
• Improvement of aquatic connectivity:
- removal of the tide gates on Yorkeys Creek (Site 1) and Half Moon Creek (Sites 15 and 6a).
- upgrading the small culverts under Yorkeys Knob Road at the crossing of Yorkeys Creek (Site 2)
- restoration of areas immediately adjacent to the site to complement Aquis Resort restoration (these areas are within the Half Moon Creek and Yorkeys Creek FHAs and/or existing Lot 187 and 188 NR6708 sugar licences)
- enhancement of waterway connectivity on Lot 126 NR5009 (council reserve)
- enhancement of waterway connectivity on Lot 2 865122 (freehold).
• Nearly 56 ha of new plantings are proposed and most of these are dedicated ecological plantings.
• A total of 33 ha of lake habitat. Subject to detailed design, the lake could incorporate native fish species and native flora species along the banks to increase available habitat in the area.
• Vegetated spray buffers, roadside plantings, and bio-retention ponds, not specifically required for ecological purposes but which will provide some habitat.</td></tr>
<tr><td>Social Strategies (Miscellaneous)</td><td>The following are a list of strategies identified to mitigate potential social impacts of the project:
• Workforce and Training Strategy.
• Communication and Engagement Strategy.
• Housing and Accommodation Strategy.
• Human Services Strategy.
• Indigenous Engagement Strategy.
• Integrated Emergency Management Strategy.
• Local Content Strategy.
• Local Participation Strategy.
• Strategic Planning (Town Planning) Strategy.
The development of these strategies is expected to be large a Queensland Government exercise.</td></tr>
</table>

(Continued over)

STRATEGY	OUTLINE
Sustainability Strategy	Some sustainability criteria have already been incorporated into the project concept but there is extensive detail required to realise the sustainability aspirations set out in the Project Charter. The key aspects of the project's Sustainability Strategy and relevant comments are: • Ecology (the avoidance of any substantial clearing and the commitment to extensive restoration to act as a greenhouse sink). • Water use (use of re-cycled water from the WWTP, use-minimisation initiatives) – see also the Integrated Water Management Strategy. • Energy efficiency (centralised chilled water storage, possible use of reticulated gas, solar, motion sensors for lighting, energy efficient lighting, training staff in energy efficiency specific to their roles). • Purchase grid electricity from renewable sources such as wind or solar. • Maximise use of natural lighting and ventilation in design of buildings. • Undertake energy audits and track carbon. • Waste management (including WSUD and its role in reducing export of water-borne pollutants, as well as a whole range of solid waste minimisation initiatives). • Materials used (sourced from local manufacturers where possible to reduce fuel consumption, use appropriate materials to improve building efficiency). • During construction, use maximum size machinery to minimise trip numbers. • Climate change (adaptation and prevention actions). • Greenhouse gas emissions (a design matter covering a wide range of design disciplines).
Waste Management Strategy	This strategy will involve: • Adopt the principles of the Queensland Waste Management Hierarchy and align with the CRC waste management strategy where possible. • The measures adopted for waste management will meet current best practice, be in proportion to the potential environmental and health impacts the waste being managed and be cost effective. • Minimise waste and negotiate supply of goods with minimal packaging. • Securely contain waste in bins and skips for the shortest period of time possible. • Ensure responsible management and disposal through considering waste streams as a whole and the final destination before sending waste off-site. • Comply with statutory requirements. • Ensure that waste management options do not place unreasonable burden on existing CRC infrastructure. • Consult with CRC and commercial waste contractors to identify opportunities for introduction of new best practice waste management services that will benefit the Cairns region.

(Continued over)

STRATEGY	OUTLINE
Water Quality Management and Stormwater Management Strategy	See also the Integrated Water Management Strategy. Water quality is a significant issue for this project and it management requires detailed consideration and a combination of actions that apply to each phase of the project. As a minimum it will provide an action plan that will achieve the following requirements: • Maintain water quality via natural filtration wherever possible. • Protect water quality in receiving waters (including lake) involving: - harvesting and storing roof water for re-use - treating runoff from polluted surfaces (e.g. paved areas) prior to discharge via a range of techniques - inclusion of large areas dedicated to water quality improvement. • Undertake further water quality monitoring to establish and maintain baseline data. • Maintain existing tidal waterways to act as a hydraulic barrier. • Avoid the use of the unconfined aquifer outside the lake footprint for water supply. • Ensure the lake design surface levels are maintained. • Ensure excavations do not penetrate the aquitard between the two aquifers. • Limit potential spills and leaks and ensure that fertilisers do not cause nutrients to contaminate the groundwater.
Weed and Pest Management Strategy	This strategy will involve: • The control of *Ravenala madagascariensis* and *Leptospermum madidum var. madidum* presents an opportunity to control significant potential weeds before they have an opportunity to commence transformation within an increasingly at risk ecosystem. • Measures to be implemented through all phases to prevent and control the spread of weeds as a result of the project. • Specific attention to the management electric ants.

Source: Study team compilation.

22.18.3 Environmental Management Framework

a) Introduction

The strategies identified in **Table 22-50** have been derived from the detailed technical reports (appendices) and include a raft of recommendations for impact avoidance, minimisation, mitigation, and monitoring. It is apparent that the detail presented varies between the general and the specific and that considerable work is required to allow the necessary tasks to be identified in detail. This is normal for a project the size of the Aquis Resort in the early stages of concept development and an appropriate management framework is needed to guide future work. It is recognised that management is needed at all future phases of the project, namely:

- planning
- detailed design
- construction
- operation.

The preferred management framework previously described is expanded upon below.

b) Overview of Management Framework

The overall management framework is proposed to take the form of what is called an Environmental Management Plan (Planning) (EMP (Planning)). This is a concept developed by the Department of Transport and Main Roads (TMR) and is documented in the Environmental Processes Manual (EPM) (TMR 2012). According to the EPM, the primary functions of the EMP (Planning) are to:

identify and recommend measures to manage the environmental factors identified in the REF [Review of Environmental Factors report – in the Aquis Resort case, this is the EIS]

- provide environmental input to the project design
- initiate communication between the [EIS team] and the project design component
- assist in managing the construction phase and contract documentation

A TMR EMP (Planning) is designed to provide recommendations for management measures required to be implemented (including design recommendations, reporting, monitoring and auditing, and legislative requirements) for all relevant environmental elements. It should be noted that the EMP (Planning) is proposed to be developed post-approval and that it will include matters relating to all conditions of approval.

<u>**Planning** – during the Planning Phase (i.e. following preparation of the EIS and receipt of land use approval):</u>

- incorporate all avoidance and mitigation principles described in the EIS and associated technical reports (expanded as required to address identified values and possible impacting processes) – this is essentially ‘mitigation by design’
- develop an (EMP (Planning) that provides guidance for impact mitigation through the (post-approval) detailed design, construction, and operation phases (expanding on the *Management Strategies* previously described to protect the values under consideration in an holistic and integrated manner)
- consider necessary offsets for impact that cannot be otherwise satisfactorily addressed (see below).

It is at this planning stage that all the *Management Strategies* are converted to conceptual *Management Plans* by the application of additional information and more detailed consideration of design and construction issues. Each element addressed by the EMP (Planning) will include recommendations for future mitigation during design, construction, and operation. The latter matters will receive more detailed attention in the subsequent EMP (Construction) and EMP (Operation & Maintenance) (see below).

Detailed Design – during the Detailed Design Phase:

- address all measures specified in the EMP (Planning) and as required by subsequent operational approval conditions
- continue to seek mitigation outcomes as detailed design develops
- expand the conceptual *Management Strategies* to detailed Management Plans (some re-sorting may be required to better integrate management actions and to recognise synergies)
- include all required Construction Phase management actions in contract documents, and in particular require that all contractors develop a detailed EMP (Construction) to set out all controls required to protect the identified values (all reputable contractors have systems in place for this and standard plans can readily be adapted for project-specific and site-specific environmental management needs)
- consider all required Operation Phase management actions and specify these in relevant contract documents and operational procedures.

Construction – during the Construction Phase:

- require all contractors to adopt all of the required Construction Phase management actions developed during the Planning Phase by implementing their EMP (Construction) procedures, including monitoring and emergency plans
- provide a comprehensive on-site management system including monitoring, pre-planned responses and contingency plans.

Operation – adopt all of the required Operation Phase management actions developed during the Planning Phase and as expanded on during the EIS and detailed design phase (details to be determined for management of matters such as maintenance of water quality, maintenance and management of revegetated areas, protection of native fauna, and protection of aircraft operations).

c) EMP (Planning)

Structure

The EMP (Planning) will provide a concise summary of material contained in the EIS in a format aimed to inform ongoing phases of the project, namely:

- detailed design
- construction
- operation.

For each element of the natural and social environment (provisionally defined below) information will be provided on:

- summary of values and threats (why the element is important)
- summary of the assessment of likely impacts of the proposed works (adverse and beneficial)
- recommended mitigation/management actions to protect the values from the works via:
  - design
  - construction management (via the EMP (Construction) – see **Section 22.18.30**
  - operation (via the EMP (Operation & Maintenance)) – see **Section 22.18.3e)**
- details of required approvals (expanded on later in the document)
- recommendations for any further investigations during the detailed design phase.

<u>Elements</u>

The following is a provisional list of what are described as ‘elements’. These are essentially the same as those used throughout this EIS, with minor restructuring. These follow a specific order that generally leads a reader through land-forming geographical and bio-geographical processes to those regarding society, culture, and human activity:

- Topography / Geology / Soils
- Climate
- Coastal Processes
- Hydrology and Hydraulics
- Surface Water
- Groundwater
- Aquatic Flora
- Aquatic Fauna
- Terrestrial Flora
- Terrestrial Fauna
- Noise and Vibration
- Air Quality
- Land Use and Planning
- Landscape and Visual Amenity
- Indigenous Cultural Heritage

Non-Indigenous Cultural Heritage

- Social Issues
- Economic Issues
- Education and Interpretation
- Integrated Emergency Management
- Waste Management.

d) EMP (Construction)

Overview

Without appropriate management, the construction phase of the development could involve significant impacts and often these are greater than those of the permanent works. In particular, certain construction phase management needs have been noted previously (e.g. the management of ASS / PASS and contaminated land).

The primary document for modern construction projects is the environmental management plan (EMP (Construction)) prepared by the appointed contractor(s). In addition to covering a range of legal and corporate matters unique to the project and the contractor, the EMP (Construction) should deal comprehensively with each of the elements previously described above via detailed sub-plans appropriate to the element.

Sub-plans

Each sub-plan should address the following:

Element:	Aspect of construction or operation.
Background:	Why the matter requires management.
Aim:	The aim of the particular element of the EMP (Construction).
Initial and on-going actions:	Details of those actions which need to be taken prior to or as part of the implementation of the EMP (Construction).
Performance requirements:	Qualitative and quantitative measurement of an observable parameter over a given time period. These are essentially the desired outcomes.
Monitoring:	The details of how, where and when actual performance indicators will be measured.
Reporting:	Nature, timing and responsibility for reporting and auditing of monitoring results.
Corrective action:	Action to be taken if performance requirements are not met.

The EMP (Construction) should also allow for a mandatory environmental induction for all staff and a comprehensive set of site rules governing on-site activities.

Further Input

It is anticipated that a managing contractor will be appointed as design proceeds, and inputs from this contractor will help inform the assessment of construction management needs, as called for by the adopted construction methodology. The details of management plans can be expected to vary depending on the final detailed design, as well as the construction methodology of the selected contractor(s). For this reason it is inappropriate to provide further detail at this stage.

Each contractor will be required to compile an EMP (Construction) that is relevant to the selected construction methodology, company policy, and company procedures and this will need to include all measures required by the contract and include Environmental Management Systems prepared in accordance with AS/NZS ISO 14001.

e) EMP (Operation & Maintenance)

The operational and maintenance phase also requires environmental management that includes matters raised throughout this EIS. As for construction, this should be via detailed sub-plans.

Key issues are:

- maintenance of the lake / flood mitigation works and associated water quality issues
- maintenance of rehabilitation works (watering, weed control)
- maintenance of drainage structures and all WSUD elements (regular removal of silt and weeds, repair of erosion)
- actions arising from the Integrated Emergency Management Plan
- control of environmental impacts of emergencies (i.e. fuel spills and control of any water contaminated by wash down or firefighting activities).

Some operational management needs are already listed in the context of Management Strategies (**Table 22-50**). It is recommended that further consideration be given to operational management needs as the design develops.

22.18.4 Cost of Mitigation Measures

Mitigation measures described above take the form of one or both of avoidance (by design) and environmental management (during construction and/or operation). The cost of these mitigation measures has been included in the project budget. No additional mitigation measures have been identified as being required and hence no cost implications require discussion.

22.19 SUMMARY AND CONCLUSIONS

22.19.1 Scope

The ToR require that this summary address the following, for each matter of NES:

(a) a discussion on the consideration with the requirements of the EPBC Act, including the objects of the EPBC Act, the principles of ecologically sustainable development and the precautionary principle

(b) reasons justifying undertaking the proposal in the manner proposed, including the acceptability of the avoidance and mitigation measures

(c) if relevant, a discussion of residual impacts and any offsets and compensatory measures proposed or required for significant residual impacts on MNES

(d) the relative degree of compensation and acceptability.

22.19.2 Summary of Values

a) GBRWHA and NHP

The site abuts the GBRWHA and is connected to it by three creeks and adjacent natural vegetation. Overall, the OUV of the GBRWHA supported by the site and surrounds are:

- small (i.e. not regionally significant) on-shore habitats surrounding the land cleared for cultivation and reasonably intact connectivity via the three creeks and the surrounding mangrove forests
- local (i.e. not regionally significant) resources for a small number of listed threatened species that are widespread throughout the area
- ecosystem services of various types that contribute to the function of the WHA and particular the protection of water quality
- local (but not regionally significant) examples of scenic amenity provided by the vegetated buffer between the site and the mouth of Richters Creek where few signs of human existence are present for beach users.

b) WTWHA and NHP

The site is 2.5 km line of sight from the WTWHA and has only a tenuous connection with the WHA though 8.4 km of waterways that are interrupted by the Barron Gorge and the coastal escarpment. Overall, the OUV of the WTWHA supported by the site and surrounds to a small degree are:

- remnants of lowland rainforest communities and associated species of a type representative of the nearby WTWHA in a landscape mosaic that assists in the maintenance of local biodiversity by encouraging species movements between habitats, including those contained within the WTWHA
- locally-significant ICH values
- opportunities for presenting the values of the Wet Tropics.

c) Ecological Communities and Species

Detailed fieldwork was used to inform a detailed assessment of the protected matters search undertaken on 26 May 2014 for the site, plus a 5 km buffer. All listed species were investigated for actual or likely occurrence based on detailed surveys, an overall knowledge of the project site, and understanding of the preferred habitat of listed species. This produced sub-sets of listed species (confirmed and likely) that were then subjected to detailed analysis by specialist terrestrial and aquatic ecologists.

This analysis concludes that the Aquis Resort site contains:

- one listed threatened flora species (*Myrmecodia beccarii* (V))
- one listed threatened fauna species (*Pteropus conspicillatus* (V))
- no listed threatened ecological communities
- 13 migratory species (excluding aquatic species), namely:
  - *Crocodylus porosus*
  - 12 birds of which:
    - five birds considered to be terrestrial migrants within the Australian mainland and all are relatively common species that occur over a wide area
    - two primarily aerial species (Apus pacificus and Hirundapus caudacutus) are summer migrants from the northern hemisphere (these species may forage over a wide range of natural and manmade habitats)
- the near-shore and off-shore waters within 5 km of the site may support:
  - 13 nationally <u>threatened</u> aquatic species (five are assessed as having a moderate likelihood of occurrence, eight are assessed as having a low likelihood of occurrence)
  - 17 nationally <u>migratory</u> species (eight moderate likelihood, nine low likelihood)
  - 67 listed <u>marine</u> species (including fish, sharks, mammals and reptiles) (18 moderate likelihood, 29 low likelihood)
  - 12 <u>whales and other cetaceans</u> (nine moderate likelihood, three low likelihood).

d) GBRMP

At its nearest the GBRMP is 3.5 km from the site and 1.9 km from the lake inlet pipeline. GBRMP values are considered in the context of the GBRWHA.

22.19.3 Conclusions

The following table provides the required response to these matters, most of which have been discussed extensively above. Given that, with the exception of one listed plant and 14 listed animals that may use the site on occasions, no matters of NES actually exist on the site. Accordingly, in many cases the comments relate to indirect actions and off-site impacts as has been explained throughout this chapter.

In most cases the comment regarding the WTWHA / NHP is ‘N/A’ (not applicable) as the project is considered to have no impact on this World Heritage Area or National Heritage Place.

TABLE 22-51 CONCLUSIONS

ITEM	GBRWHA (AND NHP)	WTWHA (AND NHP)	LISTED SPECIES AND COMMUNITIES	MIGRATORY SPECIES	GBRMP	NOTES
Objects of the EPBC Act:						
Provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance.	Complies. There are no significant impacts on the OUV and integrity of the GBRWHA.	Complies. No direct impacts on environmental values. Consequential (tourism) use can be managed by the existing permit system.	Complies. There are no significant impacts on listed threatened species. No listed communities are present.	Complies. There are no significant impacts on listed migratory species.	Complies (via *Great Barrier Reef Marine Park Act*). There are no significant impacts on the GBRMP's environmental values. Consequential (tourism) use can be managed by the existing permit system.	Complies. There are no significant impacts on the OUV and integrity of the GBRWHA, listed species, or the GBRMP. Consequential (tourism) use can be managed by the existing permit system.
Promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources.	See Notes (final column).	N/A.	See Notes (final column).	See Notes (final column).	See Notes (final column).	Complies. See ESD summary (**Section 22.19.4a)**).

ITEM	GBRWHA (AND NHP)	WTWHA (AND NHP)	LISTED SPECIES AND COMMUNITIES	MIGRATORY SPECIES	GBRMP	NOTES
Promote the conservation of biodiversity.	Complies. Protection and enhancement of terrestrial habitat, integrity, and ecological values will protect off-shore values. No significant impact on GBR biodiversity. Interpretive program will assist in presentation of values.	Complies. Interpretive program will assist in presentation of values.	Complies. Retention of 53 ha of natural vegetation. Provision of additional habitat (56 ha) and reinforcement of waterway connectivity, removal of waterway barriers.	Complies. Protection and enhancement of terrestrial habitat, integrity, and ecological values will protect off-shore values.	Complies. Protection and enhancement of terrestrial habitat, integrity, and ecological values will protect off-shore values.	Complies. Overall protection and enhancement of terrestrial habitat, integrity, and ecological values. Interpretive program will assist in presentation of values.
Provide for the protection and conservation of heritage.	Complies. There are no significant impacts on heritage values.	Complies. There are no significant impacts on heritage values. Consequential (tourism) use can be managed by the existing permit system.	N/A.	N/A.	Complies (via *Great Barrier Reef Marine Park Act*). There are no significant impacts on the GBRMP's heritage values. Consequential (tourism) use can be managed by the existing permit system.	Complies. No direct impacts on environmental or heritage values. Consequential (tourism) use can be managed by the existing permit system.

ITEM	GBRWHA (AND NHP)	WTWHA (AND NHP)	LISTED SPECIES AND COMMUNITIES	MIGRATORY SPECIES	GBRMP	NOTES
Promote a co-operative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples.	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	Complies. On-site conservation works and the Interpretation Strategy will promote values of site and adjacent areas. Production of CHMP will formalise relations with relevant Indigenous people and protect existing sites (outside development footprint). Opportunity for further collaboration – to be explored in EMP (Planning).
Assist in the co-operative implementation of Australia's international environmental responsibilities.	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	Complies. No actions will be inconsistent with international environmental responsibilities.

ITEM	GBRWHA (AND NHP)	WTWHA (AND NHP)	LISTED SPECIES AND COMMUNITIES	MIGRATORY SPECIES	GBRMP	NOTES
Recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity.	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	Complies. Production of CHMP will formalise relations with relevant Indigenous people and provide an opportunity for ongoing ecologically sustainable use of on-site biodiversity resources.
Promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	Complies. Production of CHMP will formalise relations with relevant Indigenous people and provide an opportunity for ongoing ecologically sustainable use of on-site biodiversity resources.
ESD Principles:						
Decision making processes should effectively integrate both long and short-term economic, environmental, social and equity considerations.	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	Complies. See ESD summary (**Section 22.19.4a)**).

ITEM	GBRWHA (AND NHP)	WTWHA (AND NHP)	LISTED SPECIES AND COMMUNITIES	MIGRATORY SPECIES	GBRMP	NOTES
Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	Complies. No threats of serious or irreversible environmental damage have been identified despite rigorous assessment.	N/A.	Complies. No threats of serious or irreversible environmental damage have been identified despite rigorous assessment.	No threats of serious or irreversible environmental damage have been identified despite rigorous assessment.	No threats of serious or irreversible environmental damage have been identified despite rigorous assessment.	Complies. No threats of serious or irreversible environmental damage on matters of NES have been identified despite rigorous assessment.
The global dimension of environmental impacts of actions and policies should be recognised and considered.	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	Complies. It is considered that most impacts apply at a local scale only. The exception is international jet travel associated with Aquis Resort use – this is a global issue and applies to all projects with an international client base.
The need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised.	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	Complies. The proposed commitments to conservation and sustainability initiatives can only be made within the context of a viable and profitable project.

ITEM	GBRWHA (AND NHP)	WTWHA (AND NHP)	LISTED SPECIES AND COMMUNITIES	MIGRATORY SPECIES	GBRMP	NOTES
The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised.	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	Complies. The proponent is satisfied that the commitments to conservation and sustainability can be afforded in the international market. Such initiatives are seen as contributing to the project's green credentials.
Cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive mechanisms.	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	N/A.
Decisions and actions should provide for broad community involvement on issues which affect them.	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	See Notes (final column).	The proponent has committed to support a suite of community strategies that include community participation.

ITEM	GBRWHA (AND NHP)	WTWHA (AND NHP)	LISTED SPECIES AND COMMUNITIES	MIGRATORY SPECIES	GBRMP	NOTES
Justification regarding manner proposed to undertake project	See Notes (final column).	N/A.	See Notes (final column).	See Notes (final column).	See Notes (final column).	The proposed manner by which the project will be undertaken includes an integrated suite of avoidance, minimisation, and mitigation measures. Mitigation is largely by way of construction and operation phase management – most impacts have been avoided through planning and design initiatives.
Acceptability of avoidance measures	See Notes (final column).	N/A.	See Notes (final column).	See Notes (final column).	See Notes (final column).	Acceptable. Avoidance measures are focused on habitat protection and restoration, reduction in export of pollutants in stormwater drainage, and attention to lake water quality.
Acceptability of mitigation measures	See Notes (final column).	N/A.	See Notes (final column).	See Notes (final column).	See Notes (final column).	Acceptable. Mitigation measures are focused on on-going environmental management to cover the construction and operation phases.

ITEM	GBRWHA (AND NHP)	WTWHA (AND NHP)	LISTED SPECIES AND COMMUNITIES	MIGRATORY SPECIES	GBRMP	NOTES
Acceptability of residual impacts	Acceptable – no significant adverse impact.	N/A.	Acceptable – no significant adverse impact.	Acceptable – no significant adverse impact.	Acceptable – no significant adverse impact.	Overall, the outcome is acceptable as there are no significant residual adverse impacts on any matter of NES.
Need for and effectiveness of offsets	Not required as there is no significant adverse residual impact.	N/A.	Not required as there is no significant adverse residual impact.	Not required as there is no significant adverse residual impact.	Not required as there is no significant adverse residual impact.	Overall, no offsets are required as there are no significant adverse residual impacts on any matter of NES.

Source: Study team compilation.

22.19.4 Discussion

a) Ecologically Sustainable Development

The principles of Ecologically Sustainable Development (ESD) – including the precautionary principle – are described in **Section 22.1.6e)**. In practical terms, the application of ESD to the Aquis Resort development has been addressed through the following:

- protection of terrestrial and aquatic habitats, species, and ecological processes to the greatest extent possible and where practical, the enhancement of these values
- protection of the values of surface water and groundwater and where practical, the enhancement of these values
- the wise use of natural resources, especially the use of any soil to be removed for beach replenishment and other beneficial uses
- a raft of sustainability initiatives to reduce energy consumption, conserve water, reduce waste, and re-use materials where possible
- vegetation screening and other strategies to limit visual impacts
- protection of indigenous and non-indigenous cultural heritage values
- interpretation and education programs to present natural and cultural values.

All of these will lead to either mitigation of adverse impacts on matters of NES or net beneficial impacts.

Areas where the proposed development will result in unavoidable impacts that may not be consistent with the principles of ESD are:

- alienation of Strategic Cropping Land (i.e. a natural resource
- the quality of the (rural) landscape (while some mitigation is possible the project will involve a fundamental change in land use
- the net production of greenhouse gases by virtue of construction, operation and oversees air traffic.

None of these (with the exception of possible long term impacts arising from greenhouse gas emissions) affect matters of NES.

These are unavoidable consequences inherent in the fourth guiding principle, namely ‘the need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection’. The fact that the Aquis Resort development will make possible substantial enhancements to ecological values and nutrient export demonstrates the application of this principle.

22.19.5 Impacts

The threats assessment applied in the strategic assessment of the GBR (GBRMPA 2013a) was used as a screening tool for likely impacts on matters of NES. Those impacts found to be likely were then subjected to detailed assessment, firstly in terms of the effects of the actions themselves (and associated mitigation), and secondly using the formal assessment of significance contained in *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoTE 2013). This assessment concluded that no significant impacts on OUV and matters of NES were likely.

Of all likely types of impacts:

- The construction process (including acid sulfate soil, agricultural contamination, and general soil and water issues) can be adequately managed by normal construction management techniques as committed to and outlined in **Section 22.18**.
- The protection of 99% of the 53 ha of natural vegetation on-site and its enhancement by a further 57 ha, together with the removal of five waterway barriers, will enhance on-site habitat and the connectivity provided by the site to the GBR and its catchment.
- The use of treated sewage effluent as a potable water substitute and the adoption of water sensitive urban design techniques will remove 133 t/a of sediment and nutrients when compared with the existing cane farm.
- Water quality modelling of the lake and the receiving waters shows that water quality of the discharge is expected to be superior to that of Richters Creek into which it will be discharged. Even if this is not the case, modelling shows:
  - Ninetieth (90^{th}) percentile changes (i.e. 90% of all modelled observations) in water quality off-shore were less than 0.1%.
  - Median tracer concentrations at the mouth and near/off-shore of Richters Creek is in the order of 3.9% to 9.5%. Dilutions within the bed of the channel are notably less and tracer concentrations are in the order of 30% to 42% for 90^{th} percentile concentrations indicating the effect of salt-wedge stratification in this region.
  - Dilution rates upstream of the outlet are also generally high with median tracer concentrations in the order of 1% to 7%. Dilution rates are notably less near the bed of the channel and tracer concentrations are in the order of 10% to 62% for the 90^{th} percentile.
- In terms of visual impacts:
  - Tall buildings on the site will be able to be seen from off-shore, from some elevated houses at Yorkeys Knob and Smithfield, and will be glimpsed above the mangroves as seen from the Cairns Esplanade; but will not be seen from Green Island, Fitzroy Island, Palm Cove, Redlynch or Redlynch Valley Road. The site will be clearly visible from arriving and departing aircraft.
  - The existing quiet beach at the mouth of Richters Creek will lose its perceived naturalness and seclusion.
  - The lighting associated with this major complex will be noticeable over a wide distance, either directly or as night-time glow, and from a distance may appear to be similar to or compatible with airport lighting.
  - There are unlikely to be any visual impacts on the GBRWHA, its OUV and associated aesthetic attributes, or on intangible perceptions or responses, as the built form will be no more visible from off-shore than Cairns CBD buildings.
- Indirect impacts associated with day trips to the GBRWHA and WTWHA can be adequately managed by the existing management arrangements. A policy framework (i.e. QuEST) exists within which extra capacity can be sustainably added if needed. However, it is known that the visitation to natural areas has diminished well below a peak of some ten years ago and there is ample latent capacity in the commercial tour market.
- Consequential / facilitated impacts arising from population growth and expanded economic activity are considered to be adequately dealt with by the Regional Plan and current Queensland legislation.

22.20 DEALING WITH UNCERTAINTY

This EIS and the detailed appendices are based on the best information available at the time of writing and commentary is made within the discussion of each element where relevant. With respect to environmental matters, this includes:

- findings of targeted site surveys (terrestrial and aquatic ecology, soils, groundwater, surface water) undertaken during the period between August 2013 and March 2014
- literature research, largely involving previous studies of a range of matters undertaken specifically in the site and surrounds, as well as more regional data when appropriate
- databases, mapping, and other records available from Government and private sources (it should be noted that the Queensland Government, the Commonwealth Government, and CRC have all invested heavily in recent years to map and otherwise identify biodiversity values. These resources have been extensively relied upon and correlated with local findings)
- personal communications with officers from government agencies, interest groups and associations, and the general public.

Specific details are provided throughout this document and in the appendices where relevant. It is believed that the scope and quality of this information is adequate for the purposes of this EIS, namely to support an application for a change in land use and also to demonstrate that there are likely to be acceptable environmental impacts and feasible solutions to environmental issues. However, it is recognised that further information is required for a number of purposes to allow the project to progress to construction and operation. These are:

- to verify certain assumptions made in areas where insufficient information exists at present and to demonstrate that the adopted solutions are feasible
- to inform detailed design and perhaps allow for the development of alternative prudent and feasible solutions to those upon which this EIS is based
- to support post-EIS applications for operational works as required to conduct and operate the development
- to provide a baseline against which changes to the existing environment can be compared and to underpin reactive management strategies to minimise adverse impacts
- to support a formal monitoring and auditing program associated with the above and to allow for continuous improvement in environmental outcomes.

Section 23.6 provides details of committed additional seasonal and baseline work respectively.

The formal approach to dealing with uncertainty is included in the concept of Ecologically Sustainable Development (ESD) outlined in **Chapter 4**. One of the guiding principles of ESD deals with the precautionary principle expressed as:

> Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The Precautionary Principle is defined almost identically in the EPBC Act as follows:

> Lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage.

The essence of the precautionary principle is that it relates to ‘threats of serious or irreversible damage’ – this focuses attention on the risk and significance of impacts (and by extension, the significance of the values under threat). In this EIS the precautionary principle is applied to the adequacy of information such that where there is a threat of a serious impact on a matter with a high value, high quality data is required. However, where values are low, or where the risk of serious impacts on these values is low, less stringent standards can apply. Overall, the approach has been that when there is uncertainty on critical matters (as defined in the ToR):

- conservative solutions are proposed
- verification will take place based on higher quality information to be collected specifically for this purpose.

The preliminary approval process described in **Chapter 4** provides that no actions that could actually impact on values can be taken until such information is collected and specific construction approval sought, this approach is appropriate.

22.21 REFERENCES

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