AQUIS RESORT AT THE GREAT BARRIER REEF PTY LTD

ENVIRONMENTAL IMPACT STATEMENT

VOLUME 4

CHAPTER 23

ENVIRONMENTAL MANAGEMENT PLAN

23. ENVIRONMENTAL MANAGEMENT PLAN

23.1 SCOPE

The previous chapters have described in various ways all matters required by the ToR in terms of values, threats, and impacts on the nominated matters (elements), together with identification of necessary mitigation and management actions where appropriate. This chapter brings these and allied matters together to address impact-related ToR, namely:

- summary of impacts (adverse and beneficial, cumulative and consequential, short term and long term, reversible and irreversible, and predictable and unpredictable)
- environmental management strategies as referred to in pervious chapters
- proposed environmental management framework
- future investigations and monitoring.

The environmental management framework is designed to mitigate and manage impacts and deliver project objectives. Its initial development will be a major precursor to the detailed design phase.

23.2 SUMMARY OF IMPACTS AND MANAGEMENT NEEDS

23.2.1 Impact Assessment Context

The actions required to construct and operate the Aquis Resort have been designed to achieve the project's commercial objectives while avoiding, where possible, or minimising—to the greatest extent possible—adverse environmental impacts on the values of the site and its surrounds.

By necessity, this has involved consideration of multiple values and objectives, as the solution to one constraint inevitably involves other matters. The best example that can be used to explain this issue is the lake and its effect on key environmental matters (the relevant chapter heading is shown in bold):

- The lake was selected as the preferred means of mitigating Barron River flooding (**Chapter 9** – Flooding). The lake provides compensatory waterway area and floodplain storage that allows floodwaters to pass around the elevated 'island' without causing unacceptable afflux and changes to patterns and velocities of flows.
- Excavation for the lake could impact on acid sulfate soil (**Chapter 15** – Geology and Soils) and groundwater (**Chapter 10** – Water Resources) as well as the risk of flooding during construction. The selected mitigation solutions for these impacts are the appropriate design of earthworks and construction management.
- Operation of the lake involves attention to water quality issues (**Chapter 11** – Water Quality) solved by seawater exchange and therefore the need to construct inlet and outlet pipework, which has associated impacts (**Chapter 7** – Flora and Fauna, **Chapter 9** – Flooding). The selected mitigation of all of these is the appropriate design of the lake (predominantly depth, edge treatment, and water exchange), location of infrastructure in areas of environmental lowest value, and management of water quality for all possible circumstances.
- Lake operation also could involve interaction with groundwater (**Chapter 10** – Water Resources) and adversely impact on surrounding natural vegetation (**Chapter 7** – Flora and Fauna). The selected mitigation is to quarantine the lake from groundwater (**Chapter10** – Water Resources).

23.2.2 Impacts on EPBC Act Issues

Impacts on EPBC Act issues (matters of NES and OUV) are described in **Chapter 22**.

23.2.3 Impacting Processes

The project description provided in **Chapter 4** describes both the completed works and the construction process required to achieve these works. Both the construction and operation of the resort will involve potential impacts on the values of the site and its surrounds and these are discussed throughout the preceding chapters. Other aspects of the development affect the economy, community and transport and infrastructure networks and these are dealt with in **Chapters 13**, **14**, **24** and **25**.

In terms of the construction of the resort, the most important impacting processes and associated impacts (beneficial and adverse) are considered to be:

- clearing a very small area of natural vegetation for infrastructure corridors – the balance is to be retained and managed as one of two key components of the Environment Conservation and Management Precinct
- restoring large areas of adjacent degraded cane land using natural vegetation appropriate to the area – as the second key component of the Environment Conservation and Management Precinct
- removing existing waterway barriers (tide gates and undersized culverts) to reinforce waterway connectivity through the site
- excavating the lake and the potential impact on groundwater and acid sulfate soils (and to a lesser extent, soils contaminated by past agricultural use)
- installing the impermeable barrier around the lake to quarantine lake water from adjacent groundwater
- constructing all built resort infrastructure in the Hotel Complex Precinct
- constructing the golf course and other components of the Sport and Recreation Precinct
- draining and filling the existing abandoned aquaculture ponds to reduce the risk of birdstrike and river migration and reduce the risk of adverse water quality impacts during flooding
- installing the lake inlet pipeline from the off-shore inlet and the outlet works in the mouth of Richters Creek
- minor construction impacts managed under the site's EMP (Construction) described in this chapter (especially erosion and sedimentation and noise, dust, and light emissions).

Operation phase impacts are expected to be

- operating the lake (in particular its water exchange processes under all possible conditions) and the impact that discharge could have on the receiving waters
- stormwater drainage and possible discharge of pollutants and nutrients, including beneficial use of treated effluent
- noise emissions
- light emissions.

23.2.4 Overall Summary of Impacts

A summary of key impacts of all types is provided in **Table 22-49** below.

TABLE 23-1 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.	✓	✓	✓		✓	

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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**.	✓	✓	✓		✓	

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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.

23.2.5 Adverse Impacts

The principal 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.

23.2.6 Beneficial Impacts

The principal 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.

23.2.7 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 23-1**. 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.

A more detailed discussion on the assessment of cumulative impacts on the GBR is provided in **Section 22.17.5**. This assessment reveals that when the consequential / facilitated impacts of the Aquis Resort 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.

23.2.8 Consequential Impacts

Consequential impacts involve the raft of adverse and beneficial effects of the construction and operation of the project and 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.

- 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.
- 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. CAPL 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. This is assessed in **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.

23.2.9 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 purely 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) usually disappear practically as soon as the source of noise or emission ceases unless they are of a major nature that involves animal mortality. Biosecurity impacts generally can be reversed.

Technically, impacts on RP Details, 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 extinguishment of 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.

Climate change effects are unpredictable although the best advice available has been incorporated.

23.2.10 EPBC Act Summary

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. Such restoration would enhance landscape connectivity and surrounding aesthetic values.

A more detailed assessment of impacts on matters of NES is provided in **Section 22.17** to **22.19**.

23.3 ENVIRONMENTAL MANAGEMENT STRATEGIES

23.3.1 Environmental Management

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.

The proposed environmental management framework is discussed later in this chapter. This is designed to consider the contents of a number of various environmental 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.

23.3.2 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.

23.3.3 Outline of Strategies

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 23-2 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 Airport Safety	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
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'.

STRATEGY	OUTLINE
Restoration and Rehabilitation Strategy	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.
Social Strategies (Miscellaneous)	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.

(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.

23.4 ENVIRONMENTAL MANAGEMENT FRAMEWORK

23.4.1 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 Aquis management framework previously described is expanded upon below.

23.4.2 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 designers
- 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) will be developed post-approval and that it will include matters relating to all conditions of approval.

Planning – during the Planning Phase (i.e. following review of the EIS and receipt of land use approval):

- 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 any impacts 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).

23.4.3 EMP (Planning)

a) 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 23.4.4**
  - 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.

b) Elements

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
- Education and Interpretation
- Integrated Emergency Management
- Waste Management.

23.4.4 EMP (Construction)

a) 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) will deal comprehensively with each of the elements previously described above via detailed sub-plans appropriate to the element.

b) Sub-plans

Each sub-plan will 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) will also allow for a mandatory environmental induction for all staff and a comprehensive set of site rules governing on-site activities.

c) 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.

23.4.5 EMP (Operation & Maintenance)

The operational and maintenance phase also requires environmental management that includes matters raised throughout this EIS. As for construction, this will 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**). Further consideration will be given to operational management needs as the design develops.

23.4.6 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.

23.5 OFFSETS

Offsets are not required as there will be no un-mitigated impacts.

23.6 FUTURE INVESTIGATIONS AND MONITORING

23.6.1 Overview

This EIS is based on ecological, water quality, groundwater, and sediment analysis obtained during the following periods:

- July 2013:
  - terrestrial ecology
  - aquatic ecology
  - water quality
  - groundwater.
- October 2013
  - terrestrial ecology
  - aquatic ecology
  - water quality
  - groundwater.
- December 2013 to March 2014:
  - water quality
  - flows, tides, water quality (for calibration of water quality model)
  - groundwater

- February to April 2014:
  - terrestrial ecology (including first two quarterly mangrove monitoring surveys)
  - aquatic ecology.

This is part of an on-going program that is committed to run until January 2015 at least and includes:

- aquatic ecology including intertidal invertebrates, water quality and sediments (dry season 2014, wet season 2014/15)
- terrestrial ecology including mangroves and terrestrial flora and fauna (dry season 2014, and wet season 2014/15)
- quarterly mangrove surveys to establish a baseline (July 2014, October 2014, January 2015)
- water quality and hydrodynamic parameters for calibrating the hydrodynamic / water quality model (quarterly for all parameters and monthly for selected parameters)
- monthly monitoring of groundwater (level and physico-chemical properties).

23.6.2 Ecological Surveys

a) Terrestrial Ecology

Two surveys are planned:

- a 2014 dry season survey will be undertaken when conditions are appropriate (most likely in July 2014)
- a 2014/15 wet season survey will be undertaken when conditions are appropriate (most likely in February 2015).

These surveys will involve a repeat of the work documented in **Appendix J** (dry season and wet season) as well as an assessment of:

- terrestrial flora (species composition in three forest strata, foliage projective cover, leaf litter cover, presence absence of coarse woody debris, presence absence of epiphytic life forms, overall vegetation health)
- terrestrial fauna (avifauna (nocturnal, diurnal), microbats (nocturnal), small mammals (nocturnal), aquatic invertebrates (diurnal), terrestrial invertebrates (nocturnal, diurnal), crab mounds/m^2 (diurnal), amphibians (nocturnal, diurnal).

b) Aquatic Ecology

Two surveys are planned:

- a 2014 dry season survey will be undertaken when conditions are appropriate (most likely in July 2014)
- a 2014/15 wet season survey will be undertaken when conditions are appropriate (most likely in February 2015).

These surveys will involve a repeat of the work documented in **Appendix H** (dry season and wet season) as well as an assessment of:

- macroinvertebrates in the sediment of the receiving environment at three sites in Thomatis / Richters Creek and at a comparative site
- macroinvertebrates in mangrove ecosystems of Richters Creek (to be coordinated with the terrestrial ecology mangrove survey) and to include a sediment sampling program
- estuarine fish surveys at five locations in Richters Creek and elsewhere

- water quality (samples to be taken from all sites where biota are sampled) with testing of:
  - TN
  - TP
  - ammonia
  - nitrate
  - nitrite
  - reactive phosphorous
  - chlorophyll a
  - total organic carbon
  - BOD
- sediment quality (samples to be taken from all sites where biota are sampled) including testing of grain size, moisture content, total organic carbon, total nitrogen and total phosphorous.

23.6.3 Baseline Monitoring

a) Terrestrial Ecology

The program of quarterly baseline surveys is planned to continue (the first – January 2014 – is now complete). These will include regular mangrove surveys and involve:

- species composition and density
- tree growth
- canopy cover
- seedling density, species richness and growth
- soil salinity (conductivity)
- soil pH
- sediment levels.

b) Groundwater

It is known that the water quality of the upper aquifer on the site varies considerably, both spatially and temporally. Baseline water quality monitoring is required to quantify these fluctuations.

The baseline groundwater monitoring program started in December 2013 and is planned to continue until January 2015 at least in order to capture a full cycle of seasonal variation. Eight existing shallow aquifer wells are being monitored – these have been selected in areas where groundwater disturbance is expected to be greatest (in the lake footprint), as well as locations providing broad coverage of the site.

A monitoring schedule detailing the parameters for analysis is presented below. The suite of parameters will also provide a sufficient baseline for acid sulfate soil related groundwater conditions.

TABLE 23-3 BASELINE GROUNDWATER MONITORING

MONITORING LOCATION	FREQUENCY	PARAMETER	
YK1 YK2 YK3 YK4 YK7 YK8 YK9 YK10	Monthly	Groundwater Depth pH EC Total Acidity Total Alkalinity Sulfate	Chloride Aluminium (filtered) Iron (filtered) Redox (field) Dissolved oxygen (field)

Source: Appendix I.

c) Surface Water

Purpose

A detailed water quality baseline program is included in **Appendix M**. This was developed specifically to characterise existing water quality within Richters Creek, Yorkeys Creek and Half Moon Bay (marina area). These three water bodies are regarded as 'project-related' and will be used as a source of water or have the potential to be impacted upon by the proposed development. The primary objective of the water quality monitoring campaign is to collect data with which to:

- develop a robust and defensible water quality baseline dataset
- ensure availability of sufficient and up to date information with which to calibrate and verify the numerical water quality modelling tools
- determine creek trigger and compliance levels for the construction and operational phases of the development.

Ultimately, the program will be converted to require two years of monthly monitoring data to enable long-term compliance limits to be set.

Details

In Situ Monitoring

Twelve months of continuous in situ water quality data will be collected using submersible YSI water quality logging instruments and this work commenced in December 2013. The instruments are being configured to collect the following continuous data:

- turbidity
- depth
- conductivity/salinity
- temperature
- dissolved oxygen
- pH.

Four YSI monitors were initially placed exclusively in Richters Creek during an intensive wet weather (i.e. 3 month) monthly monitoring campaign during the months of January, February and March at the following general locations within Richters Creek:

- off-shore from the mouth of Richters Creek – representing the marine receiving environment
- just inside the mouth of Richters Creek – downstream of the proposed development
- mid-way along Richters Creek – upstream of the proposed development, and downstream of Ponderosa Prawn Farm
- upper reach of Richters Creek – upstream of the proposed development and upstream of the Ponderosa Prawn Farm.

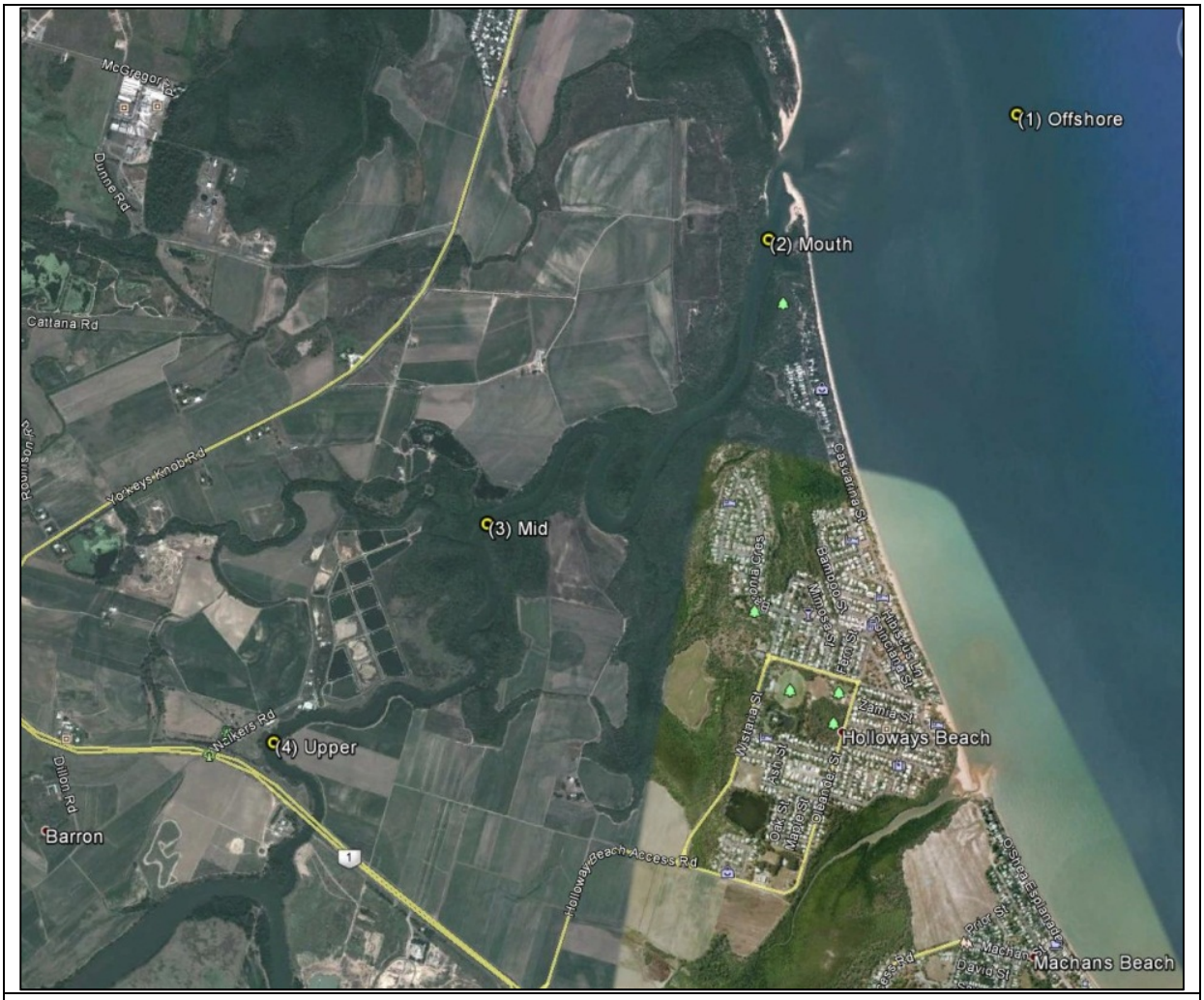

Figure 23-1 Water quality in situ monitoring locations.

Source: Appendix M (Figure D-1).

Further to the intensive wet weather monitoring campaign recently completed, an intensive dry weather monitoring campaign of three months' duration will also be undertaken. Following the wet and dry weather intensive monitoring campaigns, a normal dry weather monitoring campaign is planned in Half Moon and Yorkeys Creek to collect a minimum of six months of data within these watercourses. This data, in addition to any historic water quality data, will be used to confirm baseline conditions in the local receiving waters.

Grab Sample Monitoring

During the proposed monthly YSI equipment servicing period, water quality grab samples will be taken at each monitoring location for laboratory analysis of the following water quality parameter suite:

- Total N incl. NOx, TKN and ammonia
- Total P and Reactive P
- TSS
- Chlorophyll a
- Metals typically include the following: Sb, As, Be, B, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Ag, Sn, Zn, Hg.

Hydrodynamic Data

Monitoring has also been completed to provide the hydraulic and hydrographic data needed within Richters Creek with has been used to refine, calibrate, and validate the numerical hydraulic and water quality models. This has involved collecting the following data:

- flow profiles during a full spring and neap tide cycle in both dry and wet seasons to provide data with which to respectively calibrate and validate the tidal hydraulic model
- echo sounding work to supplement and detail the bathymetry of the creek along its full length.

Ultimately, the full water quality data set (e.g. nutrients, DO, SS etc.) as described in the data collection campaign above will be used to further calibrate and verify the full water quality model to represent in situ conditions within Richters Creek, Yorkeys Creek, and in the receiving waters of trinity Bay. This water quality model will be used in detailed design and in the development of appropriate water quality parameters for discharge.

23.6.4 Reporting

As all future monitoring is being undertaken outside the EIS process, results will be reported on within the framework of the EMP (Planning) and will be focused on setting design and construction standards and establishing a future impact and compliance monitoring framework.

23.7 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.