VOLUME 3

Draft : Environmental Impact Statement

Part D : East Trinity Environmental Factors

D.1 Introduction

Chapter A2, Dredge Material Placement Options of this Environmental Impact Statement (EIS) provides an options assessment for both land and marine placement. The chapter concluded with the selection of a preferred land placement site (East Trinity option) and a preferred marine placement site (Option 1A).

Chapter A3, Appropriateness of Preferred Land Placement Site at East Trinity addresses the appropriateness of preferred land placement at East Trinity in accordance with the assessment process for dredge material disposal interpreted from the National Assessment Guidelines for Dredging (NAGD) (2009). The conclusion of **Chapter A3** was that while it may be technically feasible, the placement of dredge material at East Trinity is not appropriate when assessed against the current NAGD. This is based on a lack of long- term planning intent for development of the land, its environmental reserve status, prospective impacts to cultural heritage and native title, and the potentially high likelihood, severity and uncertainty associated with environmental impacts. Placement at the East Trinity site also holds potentially significant human health and public safety risks primarily associated with the long settling and containment period which would require ongoing site security measures (five to 10 years), and direct cost disproportionality when compared with marine placement.

Based on the appropriateness assessment undertaken, the marine placement option for the project was adopted and fully assessed under Parts B and C of the EIS in accordance with the project Terms of Reference (TOR) and EIS Guidelines.

This Part has been included in the EIS on the basis that there are a number of emerging issues related to Port development and dredging that could lead to a change in the assessment processes for capital dredging. A number of key environmental reports, Port project announcements, environmental and costs considerations could, in the future, open the opportunity to reframe the criteria for assessing the acceptability of undue risk to human health or the environment or disproportionate costs that is included in the appropriateness test in the NAGD. If this does occur, particularly around the measure of cost disproportionality, then it provides an opportunity for further examination of East Trinity as a fill placement site option.

Due to the outcomes of the appropriateness assessment contained in **Chapter A3, Appropriateness of Preferred Land Placement Site at East Trinity**, a full environmental impact assessment was not undertaken on the East Trinity land placement site as key indicators of appropriateness, human health and cost disproportionality under NAGD were not met by the site.

If East Trinity is subsequently deemed appropriate for further investigation, more extensive assessments would need to be undertaken. **Part D** of the EIS has been prepared to provide a more detailed Review of Environmental Factors (REF) for the East Trinity site and to guide these future assessments if land based placement of the dredge material was required to be investigated further as part of the EIS.

D.2 Methodology and Scope

The Initial Advice Statement (IAS) for the project indicated a marine placement option was the preferred option for dredge material disposal; therefore the TOR and EIS Guidelines provide less guidance on assessment requirements for land-based placement of dredge material compared to marine placement, and no specific guidance for the use of East Trinity. If land-based placement is to be further investigated, changes to the TOR and EIS Guidelines may also be required to be considered by Government agencies. However, it should be recognised that both documents include consideration of relevant issues and matters that could guide a more detailed land-based assessment which has been used to inform this part of the EIS.

An assessment of the baseline conditions, and potential impacts on planning, environmental and socio economic criteria associated with land-based placement has already been undertaken for each of the land-based sites investigated in **Chapter A2, Dredge Material Placement Options**. Additional assessment was then undertaken in **Chapter A3, Appropriateness of Preferred Land Placement Site at East Trinity** for the East Trinity site looking at its appropriateness, (environmental, human health and public safety risks) and comparative direct costs with marine disposal in accordance with the appropriateness criteria outlined in the NAGD.

This appropriateness assessment in **Chapter A3, Appropriateness of Preferred Land Placement Site at East Trinity** identified a range of key uncertainties as follows:

- East Trinity is currently reserved for Environmental Purposes; it is not known whether a change in the purpose of this site would be supported
- Development at East Trinity is not supported by current state and local planning documents; the suitability of the site for purposes other than placement of material in the long term would require significant further investigation beyond the scope of this EIS
- The cost, controls and responsibilities for the ongoing site management at East Trinity
- The impact of placement of material at East Trinity on the previous and ongoing rehabilitation works that have been undertaken
- The cultural heritage values of the site are likely significant and may be impacted by the works
- Access to the site would be required through lands over which native title has been granted. There is significant uncertainty over whether an Indigenous Land Use Agreements (ILUA) can be reached. Further consultation with Aboriginal Parties must be undertaken
- Given the scale of works and the treatment required, it is not known whether the environmental values of the site and its surrounds can be adequately protected without environmental incidents occurring
- There is uncertainty as to whether the material to be placed at site can be effectively dried out over time such that it could be used for future urban or agricultural purposes
- There is uncertainty over whether the site can be effectively secured from the effects of coastal hazards (future sea level rise, storm tide and cyclonic and flood activity).

This **Part D** of the EIS builds on this appropriateness assessment and provides a more detailed gap analysis on what further information and studies would be required to undertake a full environmental impact assessment using each issue heading from the TOR and EIS Guidelines. In order to identify information gaps, potential impacts are briefly described, but not quantified or explored in detail.

A separate report (**Development Options for Land at East Trinity – RPS, 2014**), included in **Appendix E2** investigates potential future use/development options that could be considered for the development site. It then goes on to consider a range of matters relevant to each option, including statutory/planning, environmental, infrastructure and cost implications, before providing a preliminary “cost/benefit” analysis of each development option. The report includes a feasibility analysis indicating that the development of East Trinity results in major financial losses and that the site has negligible development potential for urban development, due to massive infrastructure costs and competition with better located, and better serviced land (e.g. the Edmonton-Gordonvale Growth Corridor).

This REF is therefore limited to the issues involved with the placement and on-going management of material only (e.g. disposal only). Should a beneficial re-use be found for East Trinity (i.e. a residential subdivision or tourism development), this would require further assessment of matters such as the required ground improvements, additional fill, infrastructure and other impacts and would be subject to a separate assessment and approvals process in the future.

D.2.1 Information Sources

This REF relies on publically available scientific papers, reports and mapping. Some limited additional mapping and technical information has been supplied by the Queensland Department of Science, Information Technology, Innovation and the Arts (DSITIA). DSITIA have indicated that they are currently undertaking water quality and ecological surveys at East Trinity; however, these were not available at the time of publishing. Whilst some ground-truthing of available information has been undertaken, and on site reconnaissance was undertaken to inform the appropriateness assessment, no detailed site investigations have been performed. An EIS was prepared for a proposed residential development at East Trinity in 1995; but this development did not proceed. Scientific information presented in this previous EIS is considered to be largely out of date given the significant changes that have occurred on the site since remediation commenced in 2000, and therefore has not been relied upon for this REF.

In order to gain an understanding of the potential footprint of the placement area, a conceptual material placement design has been developed, as detailed in **Section D.5**. Should further assessment of a land-based placement site proceed, a conceptual design with greater detail (including consideration of further siting and layout options) would be progressed.

Information gaps and areas for further investigation are highlighted in **Section D.6**.

Key sources of information upon which this REF is based include:

- Series of CSIRO scientific papers on Acid Sulfate Soil (ASS) treatment options and remediation outcomes
- A conceptual material placement design (Refer to **Section D.5**).
- Department of State Development, Infrastructure and Planning mapping layers
- A site walkover conducted by a qualified ecologist
- Reports prepared by DSITIA officers on rehabilitation outcomes at East Trinity.

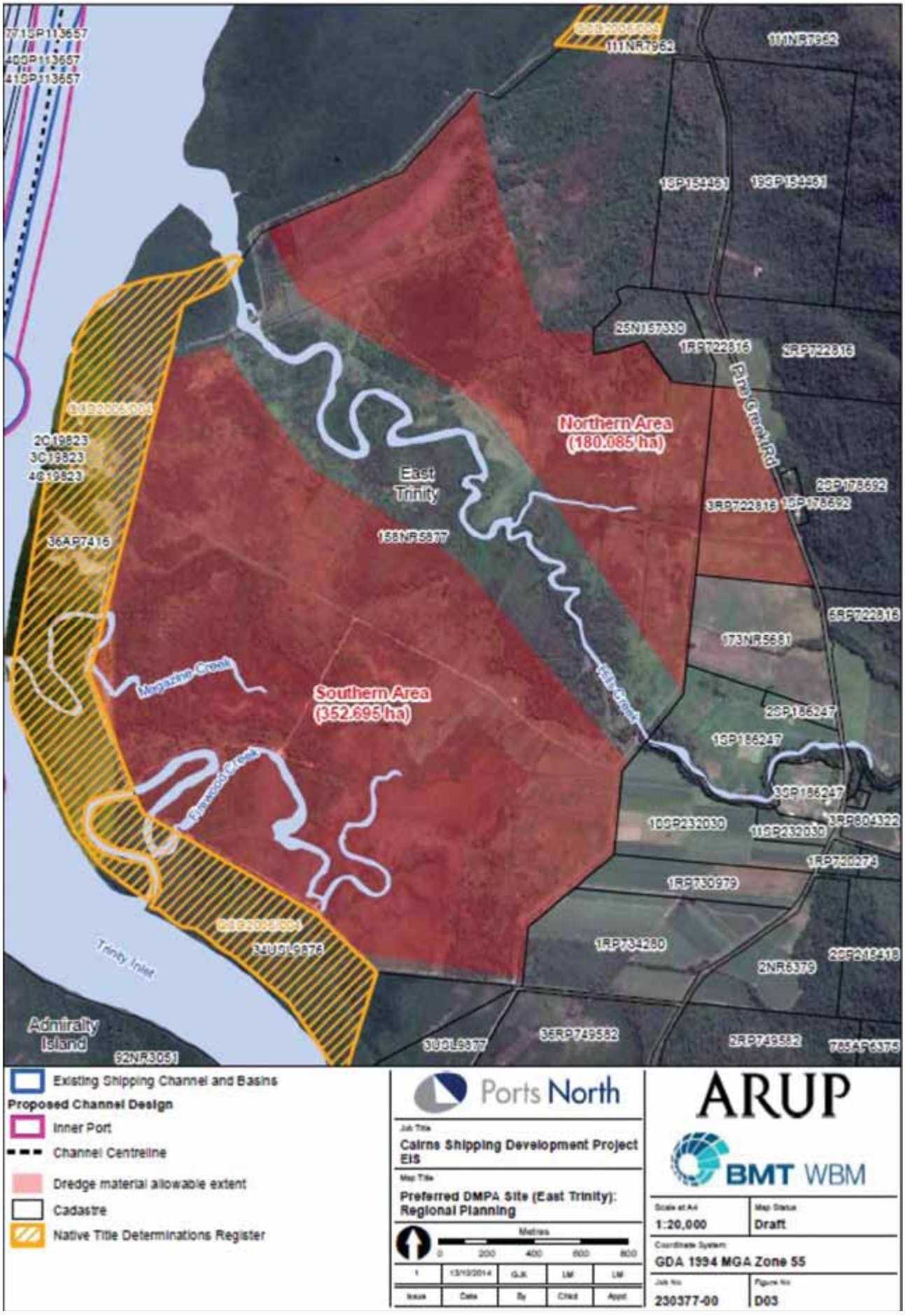
D.3 Site Description

The 940 ha East Trinity site lies to the east of the Cairns CBD (and Cairns port), across Trinity Inlet. It includes two parcels of land; Lot 158 on NR5877 and Lot 3, RP722816 which are held in reserve by the State of Queensland. **Figure D.3a** shows East Trinity viewed from Cairns, looking south-east. The site is situated on relatively flat coastal plain, but rises steeply to the hills of the Grey Peaks National Park to the east. The site is bordered to the west and south by tidal mangroves over which the Mandingalbay Yidinji people have been granted exclusive Native Title. A mixed tidal mangrove and melaleuca forest is to the north of the site, which is held in reserve by Cairns Regional Council (CRC). Freehold agricultural properties and the Yarrabah Road lie to the east. There are some small residential areas to the north.

Figure D.3a East Trinity viewed from Cairns CBD

Historically, the East Trinity site was a small tidal wetland dominated by mangroves and samphire flats with fringing melaleucas (Smith et al: 2003). The site includes four creek systems that form part of the Trinity Inlet catchment. The majority of the site occurs below 1.5 m Australian Height Datum (AHD). Figure D.3b shows the surrounding land uses and tenure of East Trinity.

Figure D.3.b Land tenure of the site and surrounds, including areas over which native title has been granted.



East Trinity has limited existing infrastructure. The most substantial built form is the bund wall and floodgates which were constructed in the 1970s to drain the land for agricultural purposes. There is an internal road network consisting of unsealed roads, drainage channels and causeways. Site access is via the sealed Yarrabah Road, with the Cairns CBD being a 40 minute drive away.

D.4 History of the Site

The site known as 'East Trinity' was bought by CSR Pty Ltd in the 1970s to grow sugar cane. A bund wall (rock levee) was constructed through foreshore mangroves to prevent salt water entering the site and floodgates were installed to allow water to leave the site (but not enter) and the enclosed area was drained. Draining of the area exposed ASS leading to acidification of onsite soils and discharges of sulphuric acid and heavy metals to Trinity Inlet following rainfall. Sugar cane production was not successful (as a result of the soil becoming acidic) and the remaining natural vegetation onsite was seriously degraded. Fish kills in and near the site were reportedly common (Lord, 2006).

Various unsuccessful plans for development were proposed during the 1980s and 1990s, whilst the site was left largely unmanaged (Smith et al, 2003). In the early 1990s a proposal to develop a satellite city on the site attracted community attention, but failed to gain approval.

In 2000, the Queensland Government purchased the site with the intent of preserving the scenic rim of Cairns and for remediating the acid sulfate problems. It was designated an Environmental Reserve (the East Trinity Reserve) and rehabilitation measures to reduce acidic discharges to Trinity Inlet and improve its environmental values have been ongoing. In order to maintain pH levels at East Trinity and prevent the release of acidic waters, a large portion of the site is tidally inundated daily, via flood gates (Lord, 2006). Ninety per cent of East Trinity Reserve lies below two metres above mean sea level, with significant areas at even lower levels.

The site is owned by the Department of National Parks, Recreation, Sport and Racing (NPRSR). DSITIA is the resident manager of the site and undertakes pest and weed management as well as acid sulfate remediation and site rehabilitation program.

Site investigations undertaken by Fisheries Queensland and the Department of Employment, Economic Development and Innovation (DEEDI) indicate that remediation works have substantially improved the water, soil, vegetation and the diversity and quantity of native fauna (DNPRSR, 2014). The site has also attracted some international scientific interest as a successful case study for the remediation of acidic soils.

D.5 Description of Work

D.5.1 Conceptual Design

A conceptual design of the placement area was developed to gain an understanding of the potential required footprint of works at East Trinity. Should further investigation of a land-based placement option proceed, this preliminary design will be need to be refined.

Key steps to devise the conceptual design were:

- Quantifying the amount of material to be placed
- Identifying the area available for placement of material
- Determining the level of treatment required for the material, appropriate to its end use.

D.5.2 Design Fill Volume

The approximate fill volume required at East Trinity was determined from calculating the volume of material, the process water required to pump this material ashore (which varies depending on the type of material and the method of dredging) and a contingency volume should additional water be required for pumping purposes and also to account for some rainfall. The estimated fill volume required is approximately 12 million m^3, as detailed in **Table D.5.2a**.

Table D.5.2a Volume of Material

Material	Volume (m^3)
Very soft to soft clay	3,570,500
Process water for very soft to soft clay	3,570,500
Firm clay	459,400
Process water for firm clay	939,100
Water for flushing	1,179,950
Stiff clay	320,100
Contingency	1,960,400

D.5.2.1 Area Available for Placement

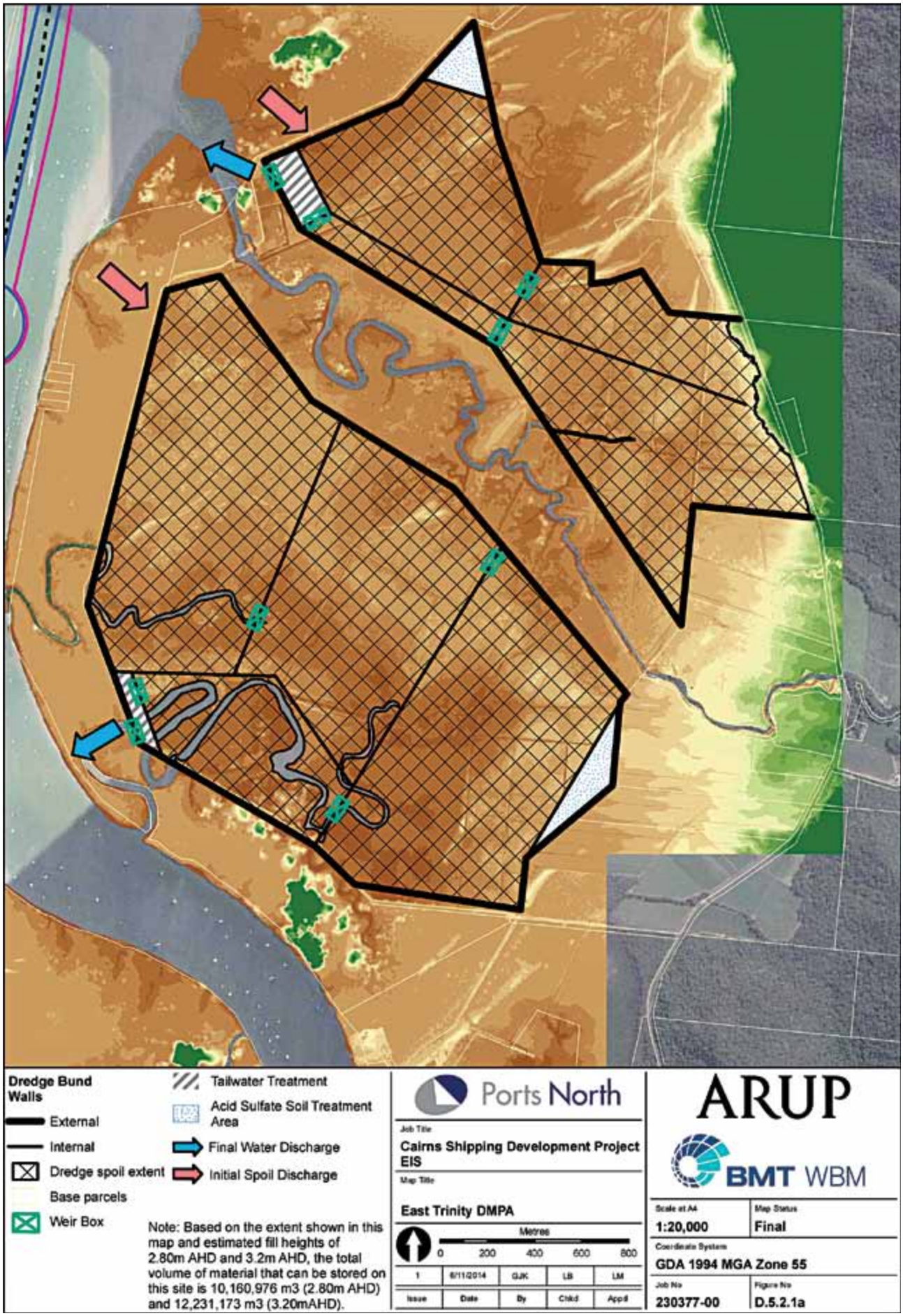
For conceptual design purposes, it has been assumed that the entire site is available for the placement of material. It is acknowledged that there are a number of constraints which may ultimately reduce the area of land upon which placement occurs; and this would be confirmed through more detailed investigations. **Chapter A3, Appropriateness of Preferred Land Placement Site at East Trinity** discusses the suitability of partial placement options.

As a conceptual measure to minimise environmental impacts, the area available for placement has assumed the following restrictions:

- A buffer of at least 100 m would be provided either side of Hills Creek (middle of the site) to retain its environmental values. Hills Creek has been extensively rehabilitated and has the highest quality of native fauna and flora; the tidal areas of the creek are also part of the Great Barrier Reef World Heritage Area (GBRWHA). Magazine and Firewood Creeks would be consumed by the proposed placement areas in this conceptual design
- A wetland in the northern section of the site is protected under state legislation and provides habitat for an existing migratory bird population. Placement of material in this location would be restricted
- The northernmost part of the site, which contains endangered and 'of concern' vegetation communities protected under the *Vegetation Management Act 1999* would also be avoided.

Based on the above, the areas available to receive the dredge material are indicated in **Figure D.5.2.1a**, and totals approximately 520 ha. This shows two sites, East Trinity North and East Trinity South, which would be filled to a level of 3.2 m AHD. The bunded area would provide sufficient volume to take the required 12 million m3 fill volume (refer to **Section D.5.2**), with additional areas allowed for tailwater treatment and PASS treatment of the dredge material (refer to **Section D.5.2.2**).

Figure D.5.2.1a Conceptual placement area design



D.5.2.2 Treatment Requirements

The material to be placed at site contains potential acid sulfate soils (PASS) and would consequently require treatment to prevent the leaching of acid and mobilisation of potential contaminants to the receiving environment. The land farming method of treating acidity has been assumed which involves drying the pumped material and blending it with lime (refer to **Section D.5.3.2** for further detail). An area of approximately 7.2 ha would be required for this treatment method, as shown in **Figure D.5.2.1a**.

In addition, tailwater derived from the pumping of the material to site must be treated in tailing ponds prior to discharge to the receiving environment (Trinity Inlet, likely via Hills and Firewood Creeks). A nominal area of at least two-three ha would be required for final treatment (testing and treating of tailwater would be undertaken throughout the site prior to the final treatment).

The areas required for treatment are nominal only, and would be refined should the works progress; however, allowances made at this stage are considered to be sufficient to determine whether there is enough space/volume available.

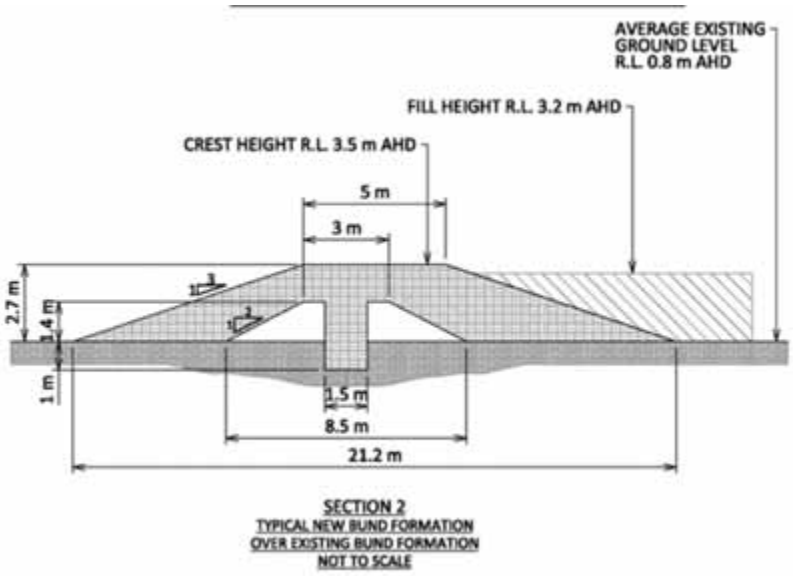
It is noted there is no precedence for this scale of treatment of PASS dredged material and this therefore involves inherent risk that the proposed measures could be ineffective.

D.5.2.3 Conceptual Bund Design

A conceptual bund design has been established for both the perimeter and internal bunds which would contain the placed material. The design assumes:

- Bund walls would be constructed with an impermeable clay barrier
- A one in three side slope would be required
- The bund crest width would be an average of five m to provide for vehicular access
- The crest level of the perimeter bund would be designed to withstand a present day storm tide level of two metre Highest Astronomical Tide (HAT) plus a nominal freeboard allowance for external waves, based on the Queensland Government Coastal Hazard Areas Storm Tide Inundation Areas (Queensland Government, 2013). Hence the bund crest level would be 3.5 m Australian Height Datum (AHD)
- The required length of external and internal bund walls is 22 km
- Internal bund walls would be constructed to cater for the initial fill level, with a freeboard allowance of 0.3 m for internal wind induced waves
- The existing site bund wall is approximately six km long and is of insufficient height and width for the volume of material to be placed and to meet current Australian Design Standards; however, it could potentially be incorporated into a new bund wall, as illustrated in **Figure D.5.2.3a.** Further testing would be required to assess its structural integrity for this use.

Figure D.5.2.3a potential new bund wall design incorporating the existing bund wall



D.5.3 Construction Methodology

Prior to the placement of material at East Trinity, construction of a more robust and structurally sound bund wall would be required. This would involve the importation of fill material from a currently unknown source for the walls and also grading and waterproofing of the base area. The majority of the bund material would likely be sourced from quarries within the vicinity of the Edmonton region, but higher quality impermeable core material may need to come from as far as the Atherton Tablelands. Based on typical quarry supply and earthworks production rates it is estimated that the pre-construction (i.e. design and tender procurement) and construction of the bund walls and preparation of the site would take approximately three years.

The majority of dredging material would be removed by Trailer Suction Hopper Dredger (TSHD), which would sail to a designated anchorage site off East Trinity. A new pump-out mooring would need to be constructed. Material would be hydraulically pumped from the TSHD to the bunded area continuously over a 24-hour period. The dredge material would be placed within the bunded area in a slurry form.

A small portion of dredging works may be undertaken by a Backhoe dredger. This material would likely be unloaded at a dedicated unloading wharf and trucked to within the bunded placement area. Alternatively, this material would be dredged by a Cutter Suction dredge and pumped directly to site. Once on land, the material would be dewatered, consolidated and treated for ASS.

D.5.3.1 Dewatering

Pumped material would be delivered to site in a slurry form with a moisture content of approximately 90 percent. It would need to be dewatered to a moisture content of approximately 40-60 percent to enable rehandling by machinery (excavators and trucks) and potentially by specialised dewatering equipment (e.g. mudscroll). Specialised designated areas would need to be constructed to enable efficient dewatering.

The period required to dewater the material from a moisture content of 90 percent to 60 percent to enable treatment of PASS (see below) using natural solar processes alone would depend upon the thickness that the dredge material was placed and the rainfall experienced during the period of the drying process. Because rainfall often exceeds evaporation rates in Cairns, there is some risk the material may never dry. This would present an ongoing maintenance issue as well as pose environmental and human safety risks; therefore some level of dewatering would be necessary regardless of whether the site is used for placement only.

The majority of the dredge material is very soft to soft clay, with an approximate fine content of 96 percent. This material would not dewater easily and reduce in volume. If the material is simply to be placed and maintained at East Trinity, then slow dewatering over time may be acceptable. Should an alternative end use (e.g. urban development) be proposed, it is likely that a period of at least five years would be required before preparation of the site for development could commence. There is likely to be a requirement for the importation of additional fill and further treatment to improve the strength of the material beyond that proposed in the concept design (which assumes an end use of placement only) in preparation for urban uses.

Traditional methods to accelerate the drying and consolidation process should it be required to develop the site for alternative purposes or to minimise environmental/health risks include the following:

- Horizontal drains embedded in the bottom of the placement area in a layer of drainage sand
- A combination of wick drains and horizontal drains whereby the horizontal drains are connected to the vertical drains and to a pumping system
- Sandwiching of layers of clay and sand, combined with horizontal or vertical drains. To enhance the above processes a layer of sand could be placed on top of the layers to be drained to provide pressure and accelerate the drying process (i.e. surcharging). Systems exist also whereby the layers are covered with plastic foil and a pumping system creates a vacuum in the package (i.e. vacuum consolidation). However, previously, large scale projects have not been executed successfully with this method.

In regard to the implementation of dewatering acceleration methods in the Cairns region, the following constraints have been identified:

- When filled with dredge material, the land placement sites would not be accessible with earth moving equipment such as bulldozers, excavators, etc. This makes it very difficult, inefficient and very expensive to install wick or horizontal drains without a prolonged solar drying period beforehand
- Due to the low bearing capacity of the placed dredge material, installing a layer of sand on top as an accelerator would not be possible
- Installing a vacuum consolidation system would be very difficult and expensive, due to the fact that traditional land equipment could not be used to handle the large sheets of foil needed to seal off the surface.

Other projects with similar land placement issues are using the sandwiching method (Port of Brisbane, Singapore) in combination with a drainage system. The clay is pumped in a thin layer by the TSHD or CSD, and on top of this layer a sand layer with an approximate thickness of two metre is pumped. The sand layer partially stays on top of the clay layer, partly mixes with the underlying clay layer and partly pushes soft material as a wave in front of the face to the end of the placement area. The result is in general a reclamation that can be accessed by traditional land equipment which can install drainage systems. For the Cairns area, very limited sand is available from dredging for installing the sandwich layers.

The only system that may be partly feasible is a horizontal drainage system, with the drains embedded in a layer of drainage sand, and constructed before the filling of the placement area. The principal challenge would be that due to the composition of the dredge material it is likely that the drains could become easily clogged by the fine clay particles, and that new drains would need to be regularly reinstalled during the period of dewatering.

Golder (2014) suggests that a land farming process similar to that used for the treatment of PASS could be adopted to aid drying of dredge material.

A new technique commonly known as 'mud farming' is also potentially an option for more rapid dewatering that would reduce maintenance and environmental/health risks or accelerate alternative future uses. It involves repeated scrolling, or machine passes, to more rapidly drain water and consolidate material. Whilst this option has potential, it has not been trialled or developed for dredged material such as that which would be placed at East Trinity. Additionally the technique requires material to be placed in thin layers (approximately one metre thick) with a sloping surface profile which may have significant implications for the area of land and preparatory earthworks required, the number of separate containment cells, additional site access and additional time and cost in dredge material placement complexity.

Further investigations would be required to determine the most appropriate dewatering method, and its timing, but it is estimated that it will take five to 10 years for dewatering to occur.

D.5.3.2 Acid Sulfate Soils

As described in **Section D6.4**, the material to be placed at East Trinity contains PASS which will require on-site treatment to prevent the release of acid to the environment. Golder (2014) has recommended the following treatment requirements:

- Liming of the top one metre of dredge material (which is described as 'self-neutralising' PASS at a rate of approximately three to five kg/m^3 using a lime slurry which is mixed into the pumped material
- Liming of the remaining material at a rate of between 30 kg and 270 kg/m^3, using a physical blending of lime into the material post placement (a lime slurry treatment would not be feasible at these higher liming rates).

This equates to a need to import approximately 275,000 tonnes of lime to the site in order to effectively neutralise the PASS.

This amount of lime would equate to:

- Approximately 6,875 B-double truck movements (assumed capacity of 40 tonnes), or
- Approximately 9,170 semi-trailer movements (assumed 30 tonnes capacity).

The large quantity of lime (275,000 tonnes) could potentially be sourced from the Tablelands west of Cairns including:

- Miriwinni Lime – confirmed capacity to increase tonnage if required
- Phoenix Lime at Ootann – currently seeking approval to supply 350,000 tonnes of lime per annum
- Additional smaller operators in Mt Garnet, Almaden and Ootann regions.

As indicated above, in-line addition of lime slurry into pumped dredge material is not considered feasible as a treatment method at rates above about 5 kg/m^3 (Golders, 2014 in Appendix D1). At higher rates the lime is unlikely to mix uniformly throughout the deposited dredge material and may result in alkaline tailwater discharges.

There are a range of lime treatment methodologies available, with two options being land farming and pugmill treatment. These are summarised as follows:

- Land farming – a dedicated treatment area (with treatment cells) is set aside where dredge material is spread thinly (0.3 - 0.5 m) in batches, then worked by machinery (e.g. dozer) to assist in drying and incorporation of lime. Each treatment cell would require approximately a five-day cycle
- Pug mill – equipment suited to processing of finer grained materials (with some initial drying prior to treatment). Storage and processing of ASS by the pug mill process should occur within a bunded facility with similar construction requirements to the land farming facility described above.

Lime can also be added to soil to improve the strength characteristics of the material. While Aglime is generally used for the treatment of PASS, it provides minimal strength improvement to the treated soil. For strength gain, hydrated lime or quicklime is typically used. It is noted there is a significant price premium for hydrated lime or quicklime (approx. $400/tonne) compared to Aglime (around $100/tonne).

Golder (2014) advised that the risk of releasing saltwater and leaching of acid will need to be considered for the design and construction of the dredged material containment ponds. These issues may require construction of low permeable (or lined) base and walls.

The liming rates and treatment methods outlined here would need to be confirmed through more rigorous testing and assessment to meet the Queensland ASS technical manual requirements and minimise the risk of an environmental incident occurring. This is particularly necessary given that the volume of dredge material proposed, and the liming rates required, is at least an order of magnitude higher than that previously attempted in Queensland (Golder 2014). This increases the likelihood of an environmental incident occurring as a result of an accidental or uncontrollable release of acid due to the scale and complexity of treatment.

D.5.3.3 Timeframes

The placement of material would occur over a period of approximately 29 to 35 weeks. This is slightly longer than the timeframe for marine placement due to pumping operations.

As traditional dewatering acceleration methods are not considered feasible for the placement areas in Cairns (due to the composition of material and the large quantity involved), dewatering using land farming is proposed (refer to **Section D.5.3.1**). This is estimated to have a treatment timeframe of about five to 10 years before the material is dried and neutralised. Should the site be developed for urban purposes in the future, further works would be likely (e.g. additional fill, surcharge).

D.5.3.4 Maintenance

Once treatment is completed, the site would require regular ongoing maintenance which would include activities such as inspection and maintenance of the bund wall, site security, ground and surface water management, ASS monitoring and vegetation/weed management. This is further discussed in the cumulative and consequential impact discussion in **Section D.6.14**.

D.6 Review of Environmental Factors

This section provides a detailed description of environmental considerations at East Trinity, in a similar order to those described in Part B of the EIS. As discussed in **Section D.2 (Methodology)**, while potential impacts and knowledge gaps have been identified for each issue, no conclusion about the level of significance of potential impacts has been provided and associated measures to reduce or mitigate these impacts are not able to be provided at this preliminary stage.

D.6.1 Land Use Planning, Tenure and other Relevant Legislation

D.6.1.1 Land Use Planning

Far North Queensland Regional Plan 2009-2031

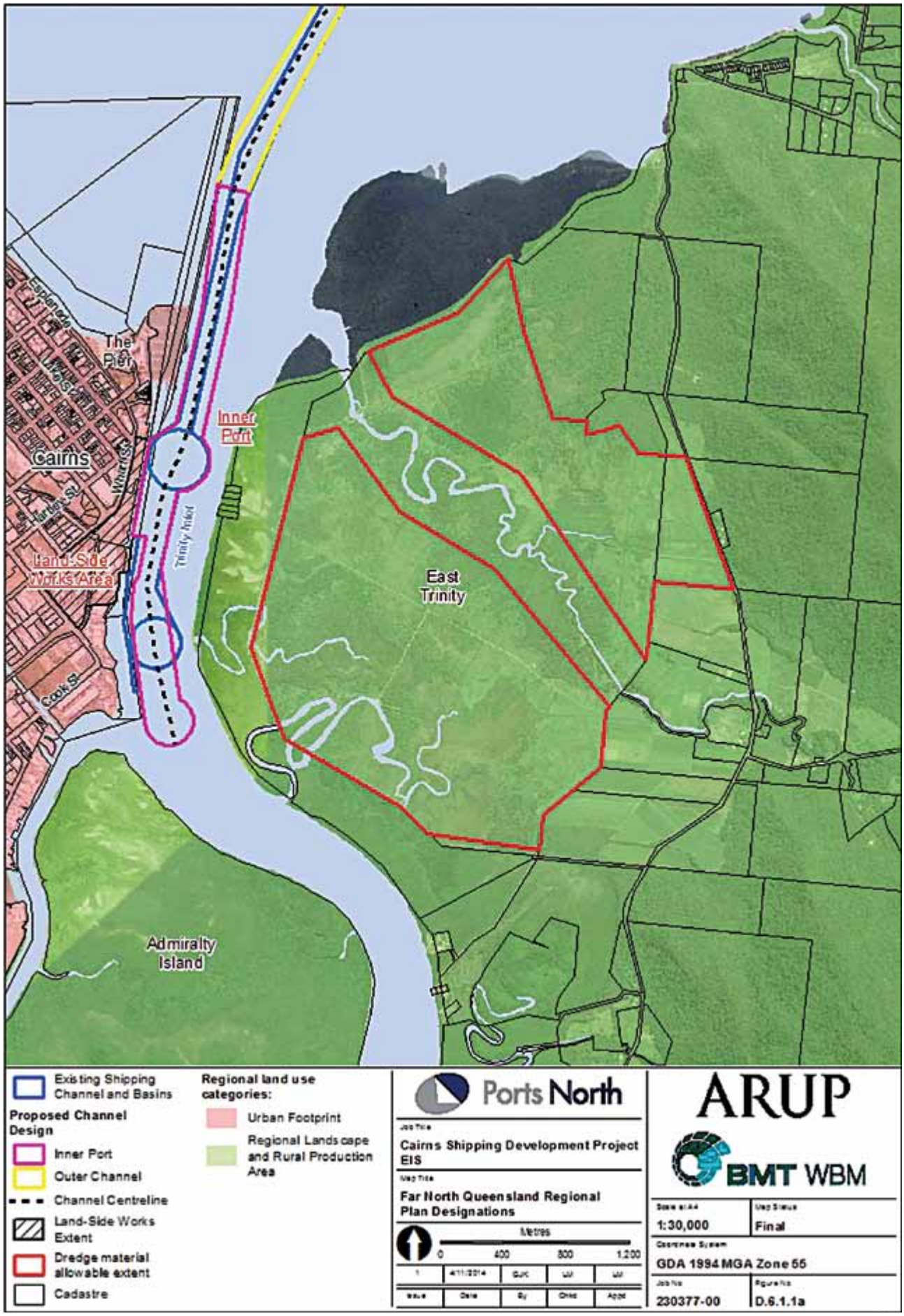
The Queensland Government provides strategic direction and guides land-use planning in Queensland to achieve state interests through regional plans. The FNQ Regional Plan is a central planning document designed to guide development in the region in a manner that achieves key environmental, social, economic and urban objectives. It was prepared jointly by all levels of government and key community stakeholders.

Specifically, the FNQ Regional Plan designates areas as 'Urban Footprint', 'Regional Landscape and Rural Production' (RLRP) and 'Rural Living'. The designation of the urban footprint assists in providing the region's urban development needs to 2031 by managing the growth of the region through limiting urban sprawl and out-of-centre growth. The RLRP designation identifies lands that have regional landscape, rural production or other non-urban values, and protects these areas from encroachment by inappropriate development, particularly urban or rural residential development.

Future urban growth will be accommodated in clearly defined areas, immediately adjacent to existing centres, whilst limiting coastal development which is vulnerable to a range of natural hazards.

East Trinity is designated as a RLRP area under the FNQ Regional Plan, as shown in **Figure D.6.1.1a**; it is not within the Urban Footprint.

Figure D.6.1.1a Far North Queensland Regional Plan Designation



The greatest proportion of growth for Cairns is earmarked for the Mount Peter Master Planned Area, the area west of the Bruce Highway between Edmonton and Gordonvale, known as the Southern Growth Corridor. This area is preferred as it supports the most efficient use of services and infrastructure, is easily accessible and has fewer environmental and natural resource values in comparison to other areas of the region.

Expansion into areas with significant regional landscape or rural production values or land use constraints is to be avoided (FNQ Regional Plan). Potential urban growth at East Trinity is not supported by the FNQ Regional Plan, limiting the potential for future residential development within the short to medium term.

Land Act 1994

East Trinity is held in trusteeship by the Queensland Government as a Reserve for Environmental Purposes, under the *Land Act 1994* (Land Act). Under the provisions of the Land Act, changes to the site may not be undertaken which are not consistent with the purpose of the reserve, unless that use is deemed not to diminish the amenity of the area. Approval to utilise the site cannot be granted unless it is:

- Appropriate for the purpose and qualities of the trust land
- In the public interest
- Not substantially commercial in nature.

Cairns Plan 2009 and Draft Cairns Region Planning Scheme

At a local government level, the Cairns Regional Council (CRC) details their planning intent for the City of Cairns through the *Cairns Plan 2009* (the Cairns Plan). The draft Cairns Region Planning Scheme is not yet endorsed, however, does provide additional direction on planning issues for Cairns. East Trinity is designated as Rural Land under both plans, as shown in **Figures D.6.1.1b** and **D.6.1.1c**. Surrounding land uses are designated as either Conservation or Rural Lands. Rural Land should support uses such as primary production, farm forestry and outdoor recreation.

East Trinity is also subject to a number of overlay codes, which provide site specific guidance on desired development outcomes; these take planning precedence over the general land use designation. Overlay codes are illustrated in **Figures D.6.1.1d** to **D.6.1.1k** and include:

- *Cairns Plan 2009*
  - Potential or Actual Acid Sulfate Soil Material Code
  - Flood management
  - Vegetation Conservation and Significant Waterway Code
- *Draft Cairns Region Planning Scheme 2014*
  - Acid Sulfate Soils
  - Biodiversity area and Biodiversity Buffer
  - Flood and inundation hazards
  - Landscape Value
  - Wetlands
  - Waterway and Waterway Buffer

Figure D.6.1.1b Cairns Plan 2009 – Planning Areas

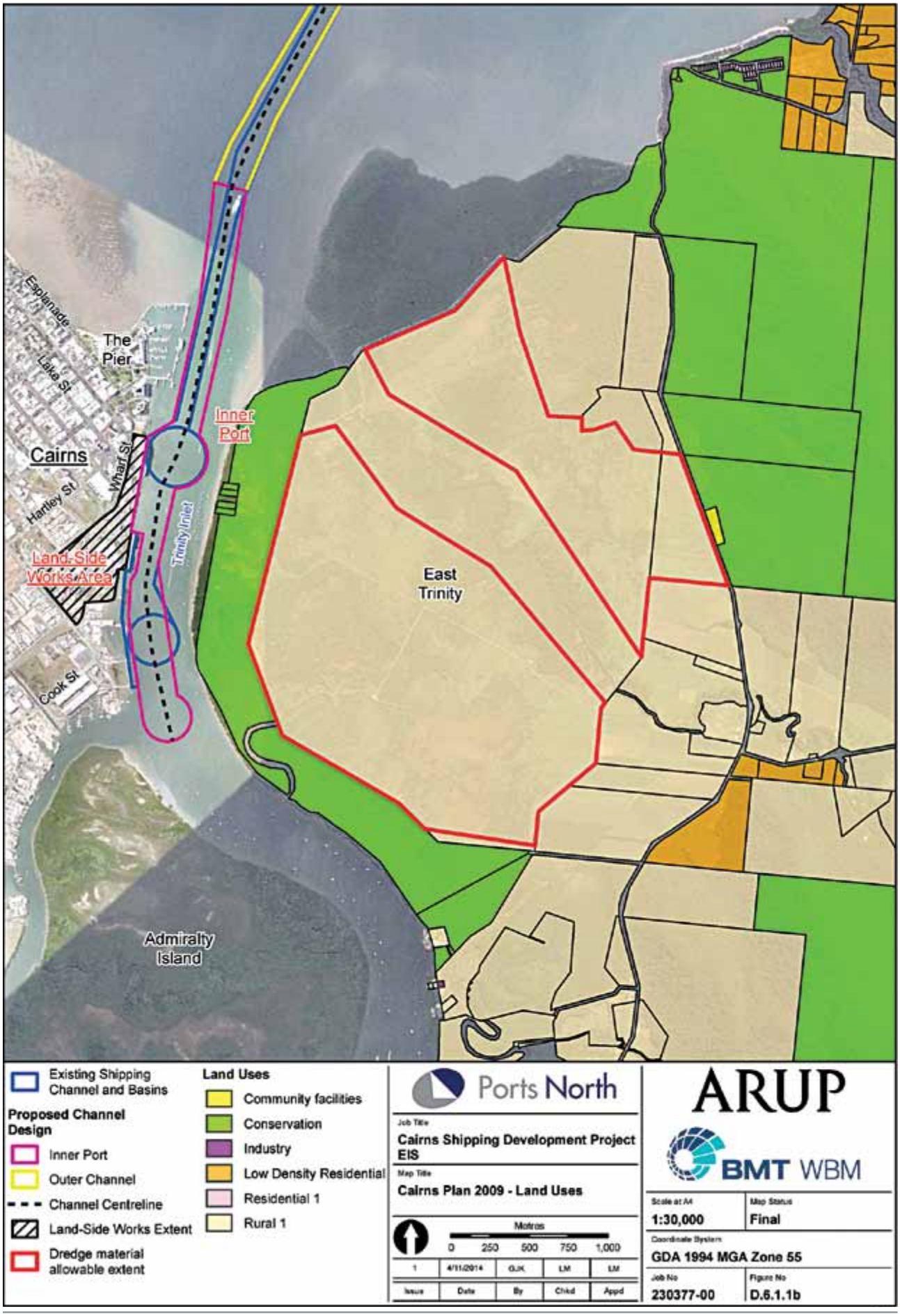


Figure D.6.1.1c Cairns Region Plan (draft) – Planning Areas

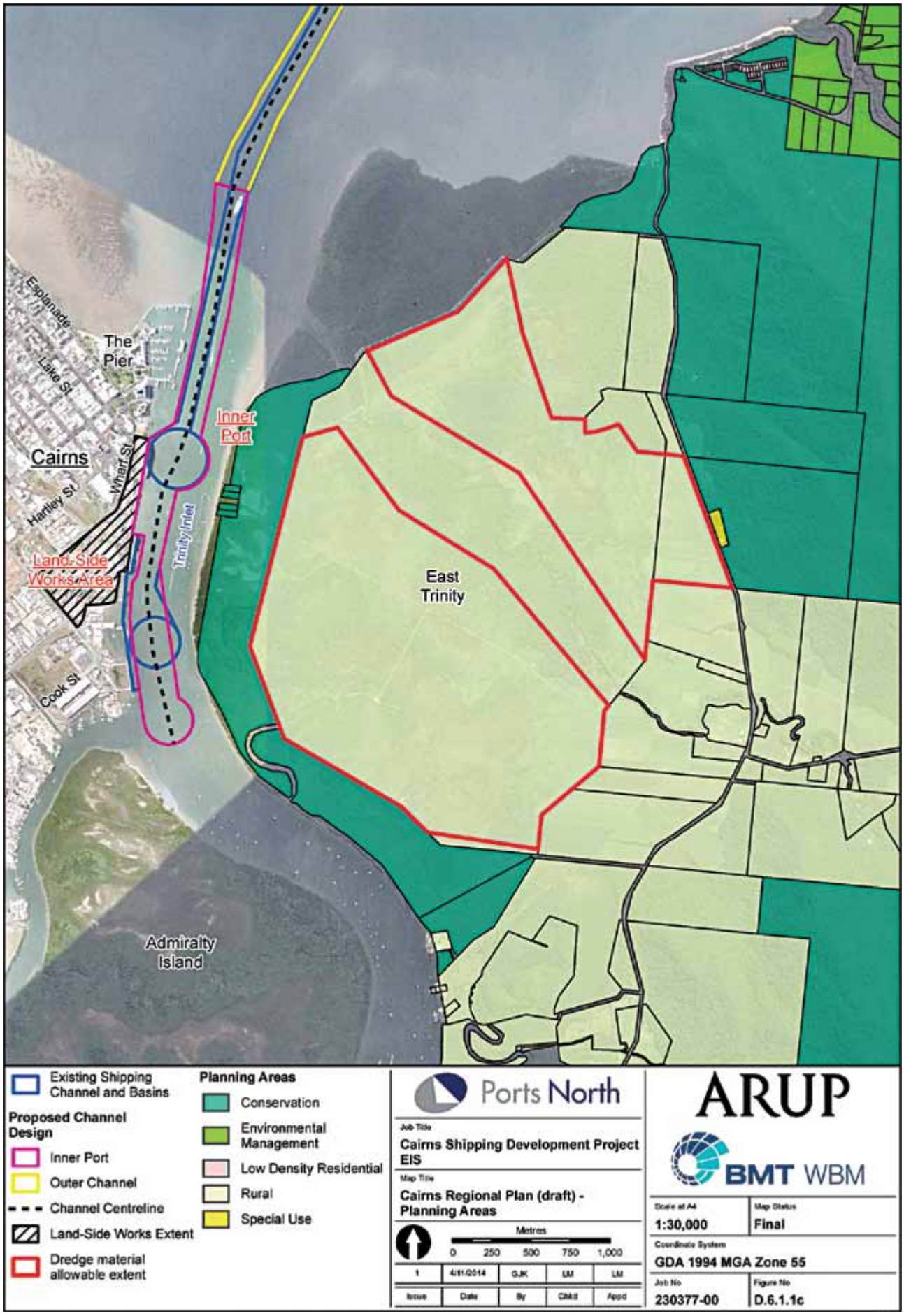


Figure D.6.1.1d Cairns Plan 2009 –Vegetation Conservation Overlay

Figure D.6.1.1e Cairns Plan 2009 – Acid Sulfate Soils Overlay

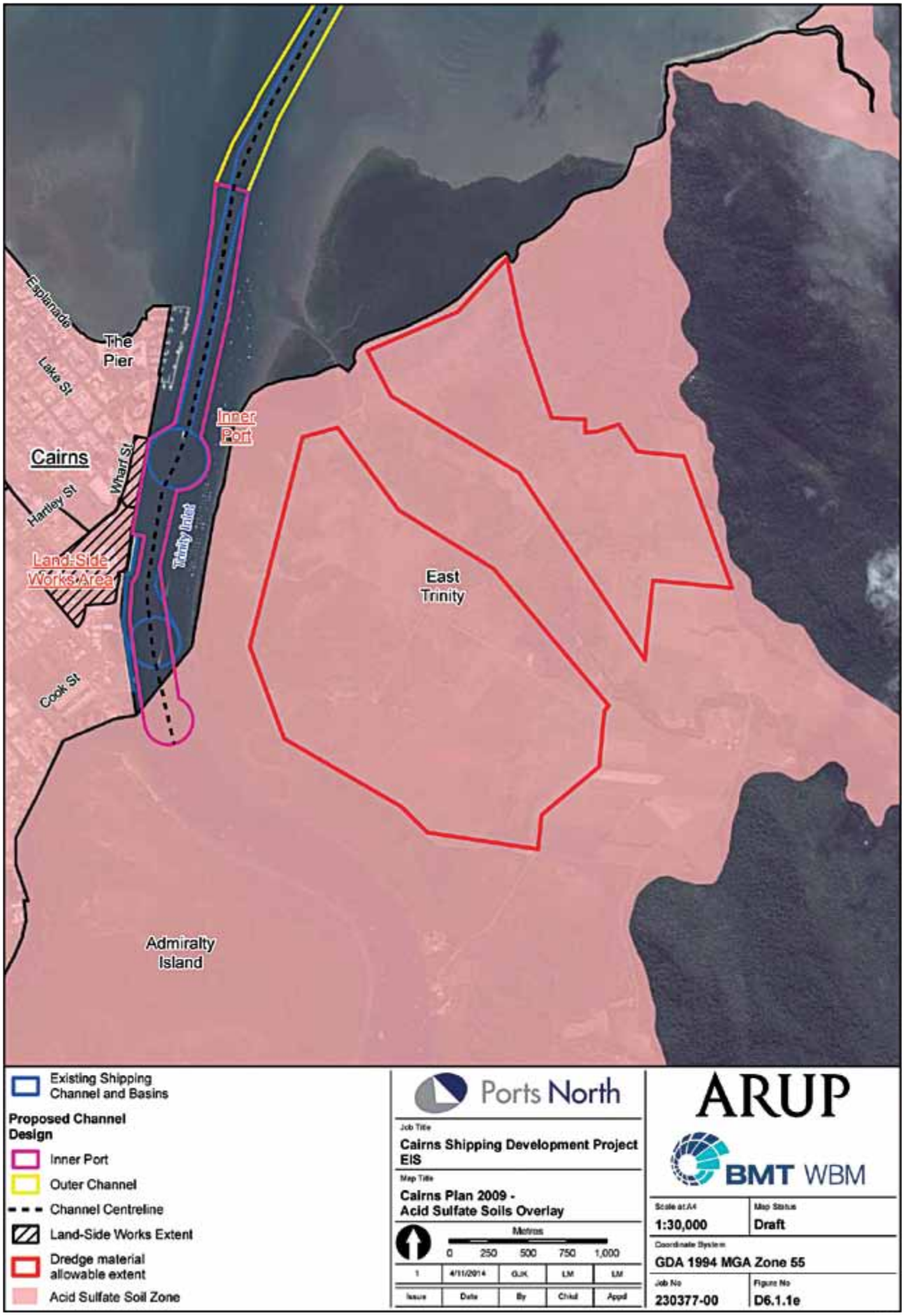


Figure D.6.1.1f Cairns Plan 2009 – Waterways and Flood Zone Overlay

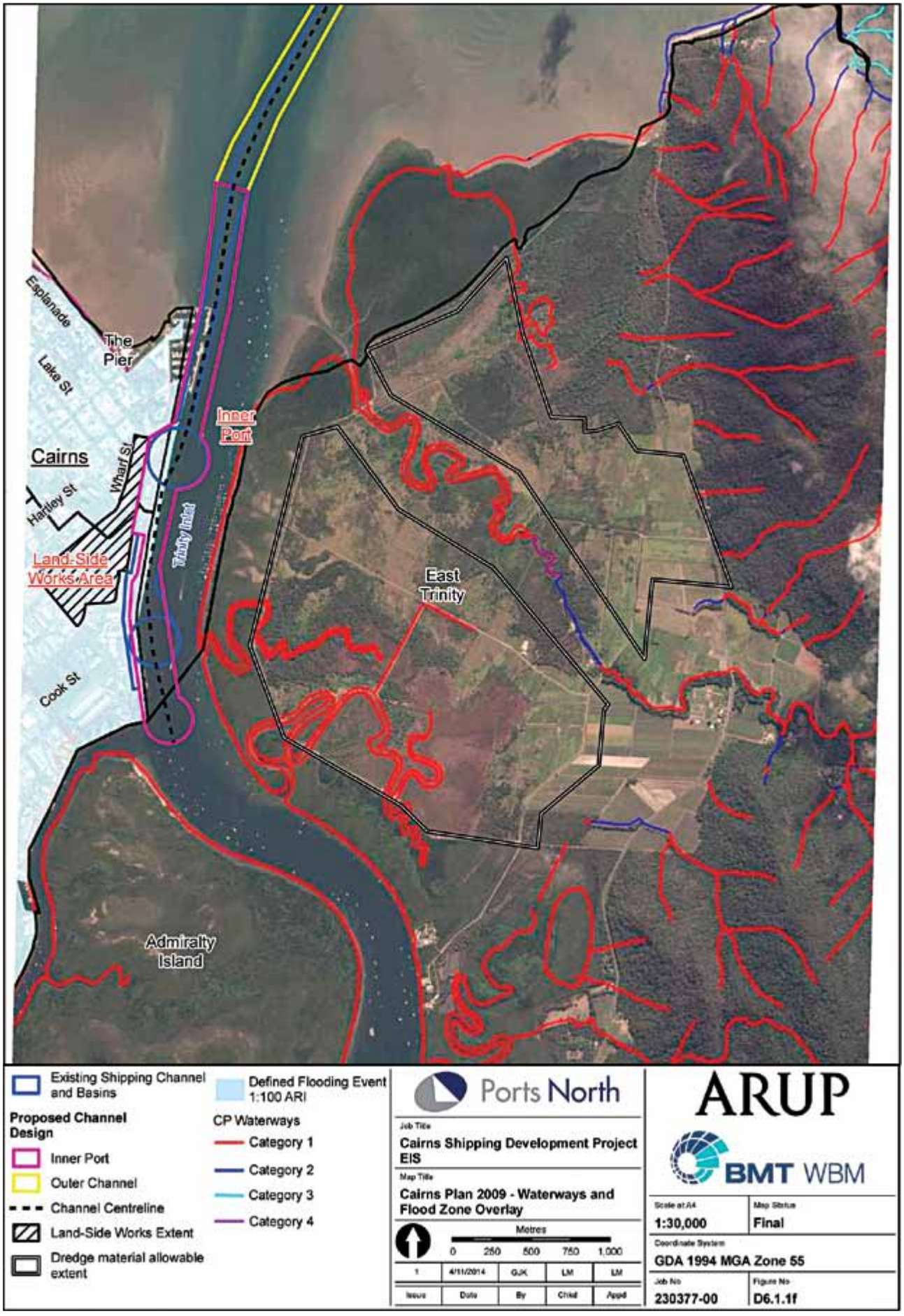


Figure D.6.1.1g Cairns Region Plan (draft) – Flood Inundation and Waterways Overlay

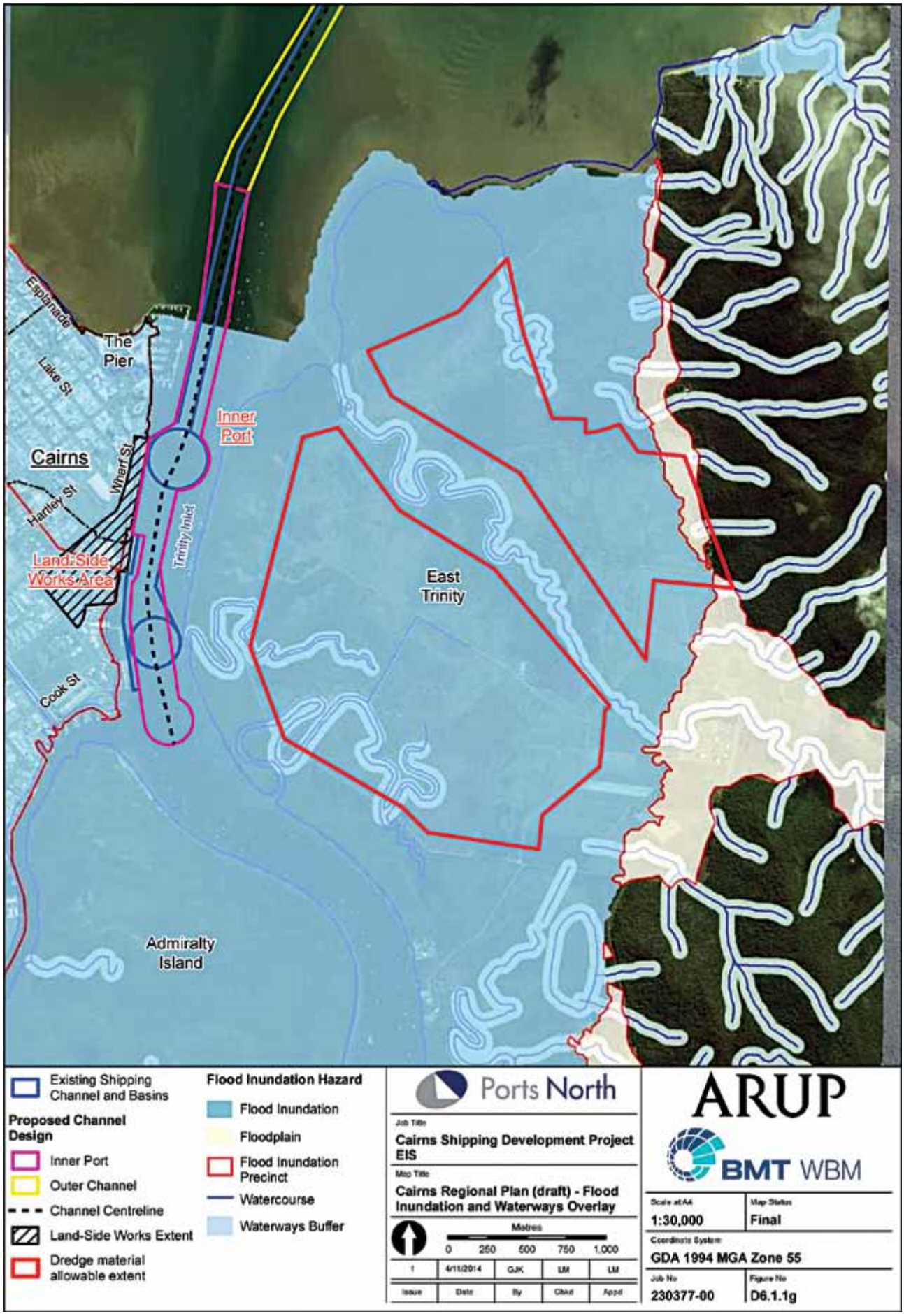


Figure D.6.1.1h Cairns Region Plan (draft) – Landscape Values Overlay

Figure D.6.1.1i Cairns Region Plan (draft) – Acid Sulfate Soil Overlay

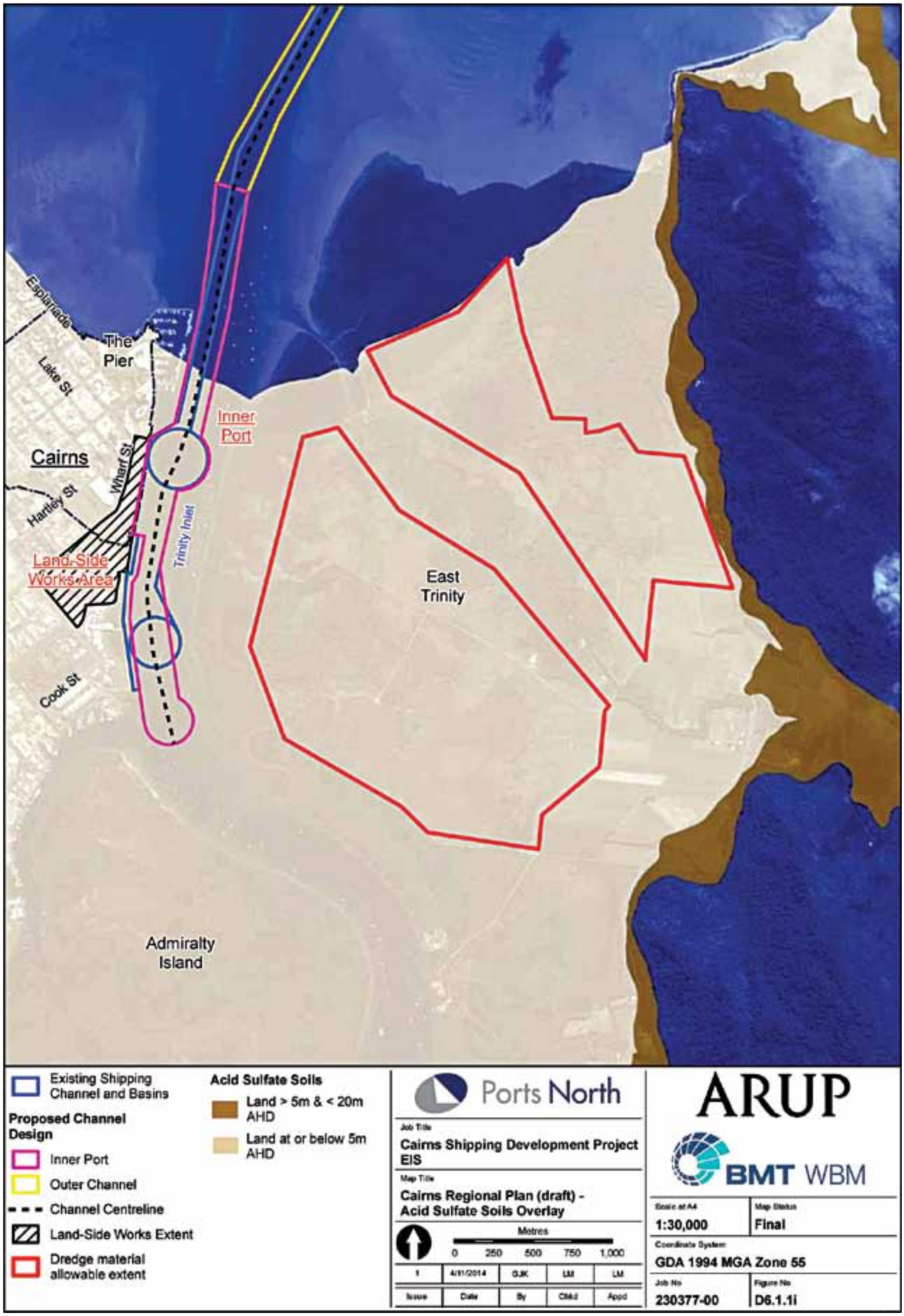
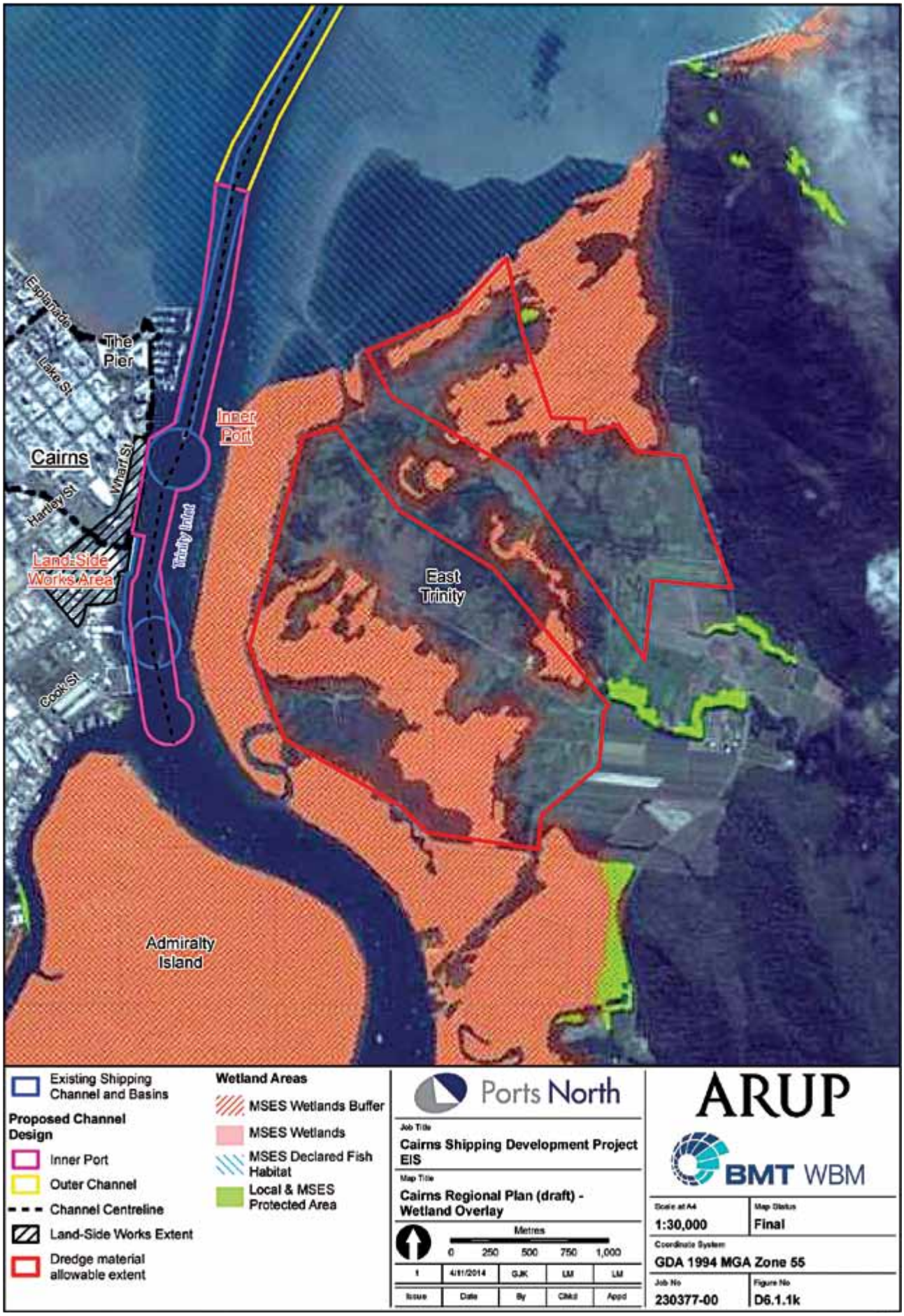


Figure D.6.1.1j Cairns Region Plan (draft) – Biodiversity Overlay

Figure D.6.1.1k Cairns Region Plan (draft) – Wetland Area Overlay



Performance criteria for each of these codes is contained in **Appendix E1**.

D.6.1.2 Tenure

Placement would occur over two land parcels: Lots 158, NR5877 and Lot 3, RP722816 which are owned by the State of Queensland and reserved for the purposes of Environmental Protection.

Access to the site may also be required over Lot 36, AP7416 which is State Land and Unallocated State Land to the south of Hills Creek. Native Title has been granted to the Mandingalbay Yidinji over this area (refer to **Section D.6.10** for further information).

D.6.1.3 Relevant Environmental Legislation and Approval Requirements

Appendix C (Legislation and Approvals) provides a full description of legislation that is of relevance to the project. **Section A1.9** describes the broader environmental impact assessment process for the project. **Table D.6.1.3a** below provides a summary of key approvals that would most likely be required before works could commence at East Trinity.

Table D.6.1.3a Potential Legislative Approvals required for works to proceed

Activity	Relevant Legislation	Approval Required
Removal of protected vegetation	*Nature Conservation Act 1992*	Permit to take protected plants or animal breeding places
Undertaking works within a Coastal Management District and/or tidal waters	*Coastal Management Act 1995 & Sustainable Planning Act 2009*	Prescribed Tidal Works Works in a coastal management district
Clearing of remnant and regulated regrowth vegetation	*Vegetation Management Act 1999 and Sustainable Planning Act 2009*	Operational Works
Interference with an area of high ecological significance which require an offset	*Environmental Offsets Act 2014*	Negotiation of an offset agreement
Gaining entry to the site through a Fish Habitat Area	*Fisheries Act 1994 & Sustainable Planning Act 2009*	Operational Works that are partly within a FHA
Placement of material on a site reserved for environmental purposes	*Land Act 1994*	Closing or surrendering a reserve
Removal of marine plants and construction of a waterway barrier	*Fisheries Act 1994 & Sustainable Planning Act 2009*	Marine Plants Permit Waterway Barrier Works Permit
Placing fill with George, Magazine and Firewood Creeks	*Water Act 2000*	Works that interfere with water in a watercourse
Undertaking works on land over which native title has been granted	*Native Title Act 1993*	Negotiation of an Indigenous Land Use Agreement(ILUA).
Interfering with indigenous cultural heritage	*Aboriginal Cultural Heritage Act 2003*	Development of a Cultural Heritage Management Plan

Potential Impacts

Placement of material at the site would not significantly conflict with the rural designation of the site under both the existing and draft CRC Land Use Plans, however, there are a number of overlay codes (i.e. wetlands, waterway buffer, biodiversity, etc.) which would likely restrict the area available. Placement does directly conflict with the designation of the site under the Land Act as an environmental reserve, unless it can be proven that it would be within the public interest.

Unless an ILUA can be negotiated, access to the site from Trinity Inlet would not be available, which is a significant barrier to the placement of material as trucking it to site from another location would not be considered viable.

Whilst not the subject of this REF, should the site be developed for urban purposes, this would significantly conflict with both the FNQ Regional Plan and the local planning scheme (both existing and proposed).

Numerous land use planning and environmental approvals would be required before works could commence on site. It is possible that some may not be granted at all, or the conditions restrict placement to an extent that works may not proceed. Amendments to the Land Act and the negotiation of an ILUA particularly, may be difficult to achieve.

Further Assessment Required

Any change to the existing land use at East Trinity would require both a development application and approval under the Land Act. Both processes would likely be lengthy and involve extensive stakeholder and community consultation beyond the EIS process.

D.6.2 Nature Conservation Areas

This section describes the existing formally recognised nature conservation designations at a Commonwealth and State level. Local (CRC) values are described in **Section D.6.1.1**.

D.6.2.1 Commonwealth Nature Conservation Values

Matters of National Environmental Significance

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) seeks to protect the environment, particularly Matters of National Environmental Significance (MNES). The matters of MNES designated as protected areas under the Act that could be relevant to the placement of dredge material at East Trinity include:

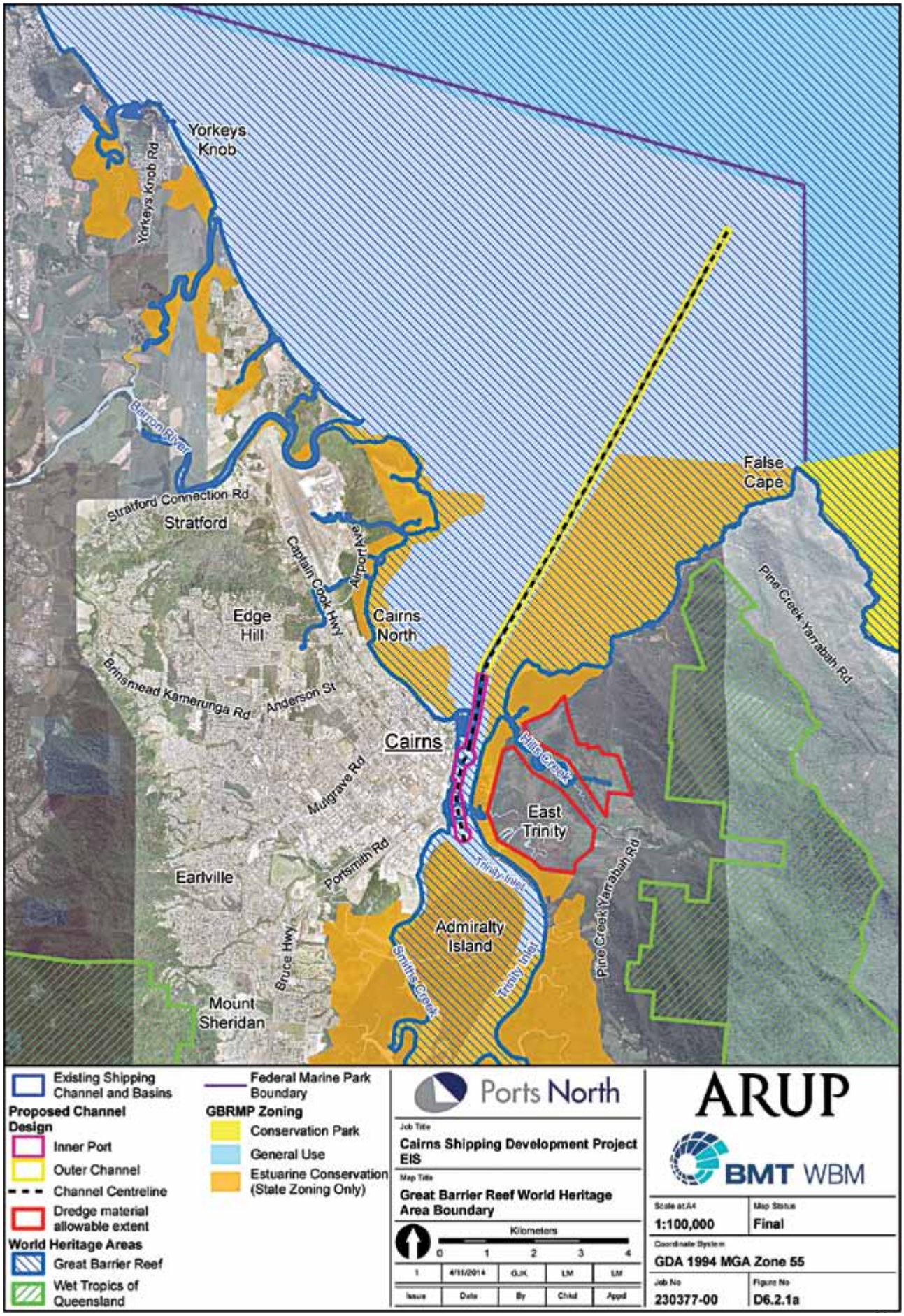
- World Heritage properties
- National heritage places
- The GBRMP

The site itself is not contained within any of these areas (other than part of Hills Creek), but land-based placement of dredge material on the site could have indirect impacts on these neighbouring conservation areas through changes to surface and groundwater or similar processes as described further below.

World Heritage Area and National Heritage Places

The GBRWHA bounds the coastal edge of East Trinity, and extends upstream of Hills Creek, as shown in **Figure D.6.2.1a**.

Figure D.6.2.1a Great Barrier Reef World Heritage Area Boundary



The Great Barrier Reef National Heritage Place boundary is identical to that of the WHA.

Chapter B2, Nature Conservation Areas of the EIS provides a description of the Outstanding Universal Values (OUV) of the GBRWHA and how the project may impact upon them. **Chapter B2** describes the attributes of the project study area that contribute to the OUV of the GBRWHA. The attributes that Hills Creek (the section of East Trinity within the GBRWHA) would support include mangrove forests, migratory waterbirds, fish species and seascapes/landscapes. Although a buffer from development has been provided to Hills Creek, there is still a potential for indirect impacts (e.g., deterioration in water quality) on OUVs to occur.

Great Barrier Reef Marine Park

East Trinity is not located within the GBRMP; its boundary is five km north-east of the site boundary, as illustrated in **Figure D.6.2.1a**.

Wetlands of National Importance

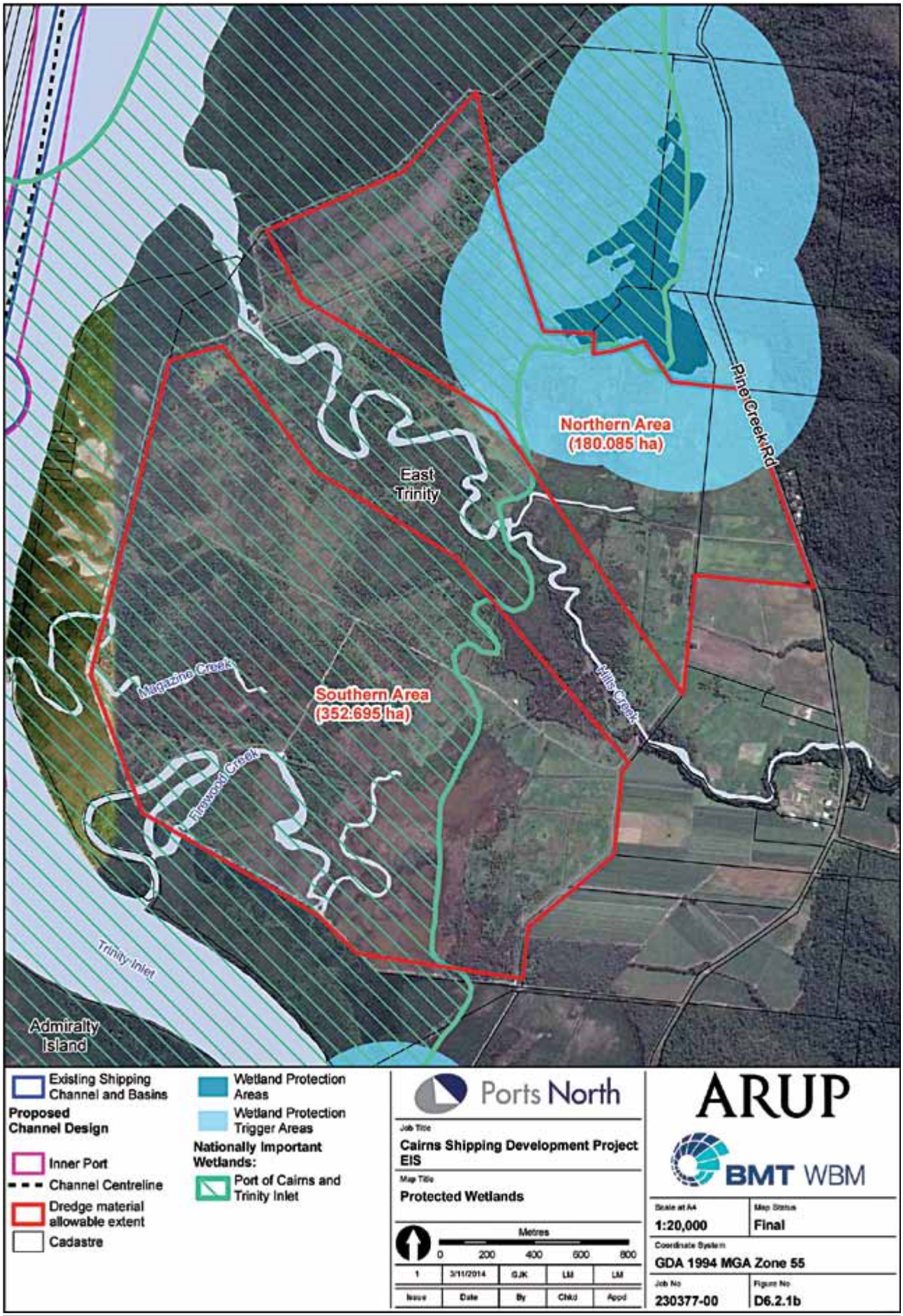
On a national scale, the Commonwealth has developed a Directory of Nationally Important Wetlands in Australia (DNIWA). A wetland may be considered nationally important if it meets at least one of the following criteria:

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance.

Wetlands of National Importance are not specifically protected under legislation; however, they do give indication of an area's environmental value and are often considered during assessment of proposed development.

The majority of East Trinity is within the 6,410 ha Port of Cairns and Trinity Inlet Nationally Important Wetland, as illustrated in **Figure D.6.2.1b**.

Figure D.6.2.1b Protected Wetlands



The Australian Wetlands Database (Australian Government, 2014) reports that overall water quality of the wetland is fairly good, and supports a large population of birds, fish and prawns. It represents a valuable resource which provides research opportunities, a nursery for juvenile fish and natural areas which enhance the quality of life of the region. The wetlands also provide a valuable sediment and nutrient sink for runoff from residential and surrounding agricultural areas.

D.6.2.2 Queensland Government Nature Conservation Values

Matters of State Environmental Significance Areas

Matters of State Environmental Significance (MSES) are established in the ***Environmental Offsets Act 2014*** and in the context of the single State Planning Policy, under the ***Sustainable Planning Act 2009***. The MSES areas of relevance to East Trinity include:

- The State Marine Park (Great Barrier Reef Coast Marine Park)
- Protected estate including National Parks
- Wetlands of High Ecological Significance (HES), protected under the ***Environmental Protection Regulation 2008***
- The Trinity Inlet Fish Habitat Areas declared under the ***Fisheries Act 1994***
- Regional Ecosystems and Essential Habitat

Each of these areas is discussed in the following sections.

Great Barrier Reef Coast Marine Park

The Great Barrier Reef Coast Marine Park is a state marine park that runs the full length of the GBRMP but differs in its boundary. It provides protection for Queensland tidal lands and tidal waters (refer to **Figure D.6.2.1a**). The Great Barrier Reef Coast Marine Park is managed under provisions in the ***Queensland Marine Parks Act 2004*** and sub-ordinate ***Marine Parks (Great Barrier Reef Coast) Zoning Plan 2004***.

East Trinity is directly adjacent to the Estuarine Conservation Zone of the park, as shown in **Figure D.6.2.2a**.

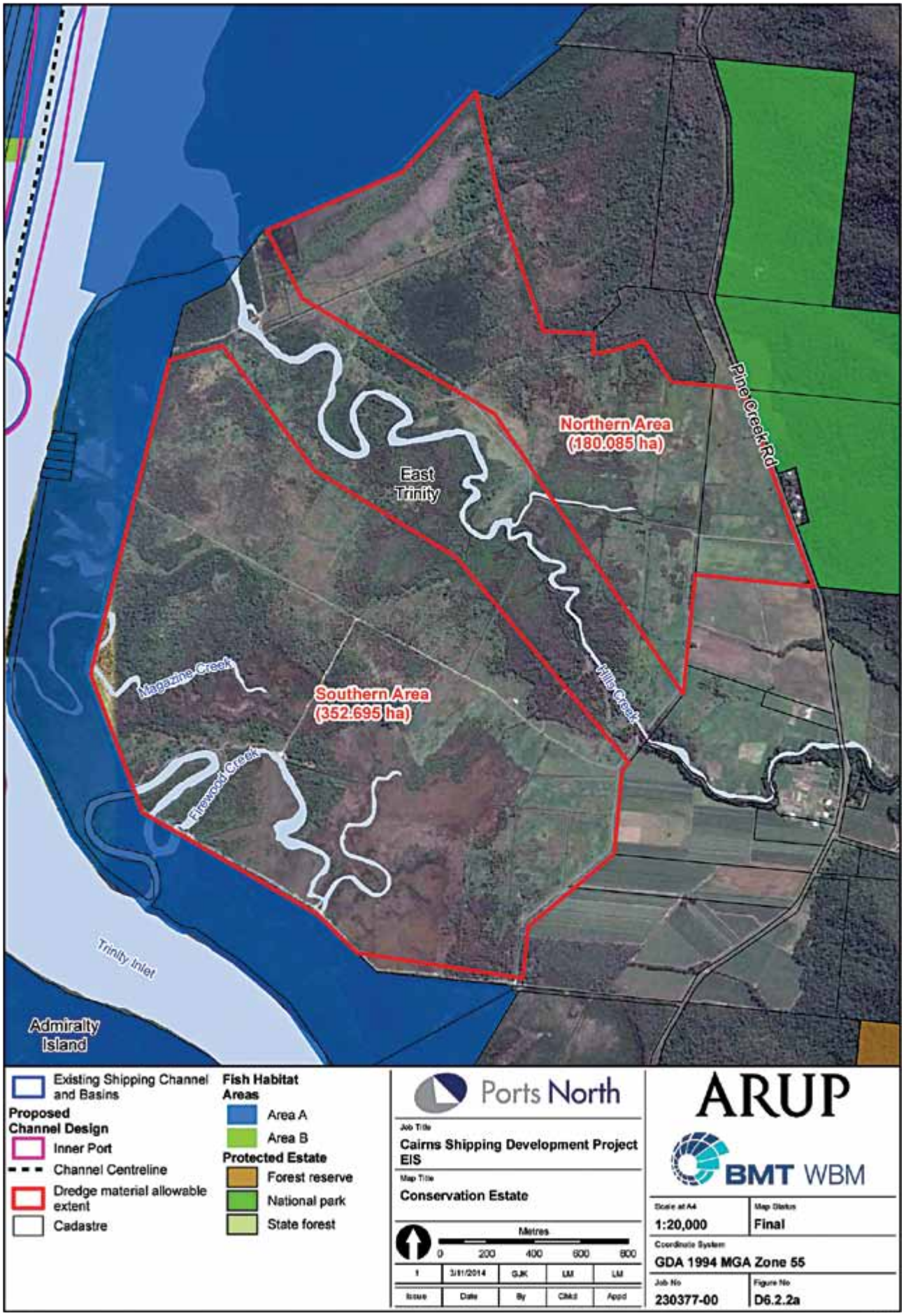
The Great Barrier Reef Coast Marine Park adopts similar zoning and management objectives to the GBRMP, although some Queensland-specific provisions apply.

Protected Estate

Protected estate includes National Parks, Conservation Parks, Forest Reserves, Resource Reserve, Nature Refuges, Wilderness Areas, State Forests or Timber Reserves. These are established under the ***Forestry Act 1959*** (Qld) and the ***Nature Conservation Act 1992*** (Qld).

Whilst East Trinity itself is not a protected estate, the Greys Peak National Park borders the site to the immediate east, as shown in **Figure D.6.2.2a**.

Figure D.6.2.2a Conservation Estate



Wetland Protection Areas

The northern part of East Trinity contains a Wetland Protection Area (WPA), with an associated 100 m trigger buffer, as shown in **Figure D.6.2.2b**. Statutory regulation of WPA wetlands has been established to maintain ecological processes of wetlands and reduce threats. High impact earthworks which threaten damage to WPAs require impact assessment and may attract an environmental offset should they potentially damage the wetland. Placement is not currently proposed within the WPA or its designated protection buffer.

Trinity Inlet is mapped as a High Ecological Value (HEV) wetland on the basis of its location in the GBR catchment. On that basis, the description of its value as outlined above are also relevant to its significance under Queensland legislation, including the ***Environmental Protection Regulation 2008***, as a referrable wetland.

Trinity Inlet Fish Habitat Area

FHAs are managed under the ***Fisheries Act 1994*** (Qld) and limit certain activities that may affect fisheries habitat values. The Trinity Inlet FHA lies directly adjacent to East Trinity. It contains the largest FHA in the Cairns region, covering 7,212 ha (DNPRSR 2012).

Whilst there is no placement of material proposed within the boundaries of the FHA, the waterways of East Trinity (Hills Creek in particular) provide nursery areas for fish species. In the past, the creek systems within the site have been heavily disturbed, and displayed little habitat value. Species diversity and numbers were very low. Since remediation, however, aquatic fauna is returning to these systems and its fishery habitat value would continue to improve over time. Potentially, impacts from the placement of material at East Trinity would halt this ecosystem improvement and reduce the condition of fisheries habitats at East Trinity and any tidal areas adversely affected by discharged waters or runoff. Most notably, fish habitat would be lost completely where (i) waterway infill is proposed (George, Firewood and Magazine Creeks) and (ii) where marine plant habitats (e.g. saltmarsh vegetation) are directly replaced by the placement of dredged material.

Construction of infrastructure (e.g. dredge mooring and pump-out point, pipelines and vehicle access routes through/ within areas designated as FHA would be required to enable use of the site as a material placement area.

Coastal Management District

East Trinity lies wholly within a Coastal Management District (CMD), which is protected under the ***Coastal Protection and Management Act 1995*** (Coastal Act). Changes are proposed to the current extent of the CMD; however, East Trinity would still remain within the proposed CMD.

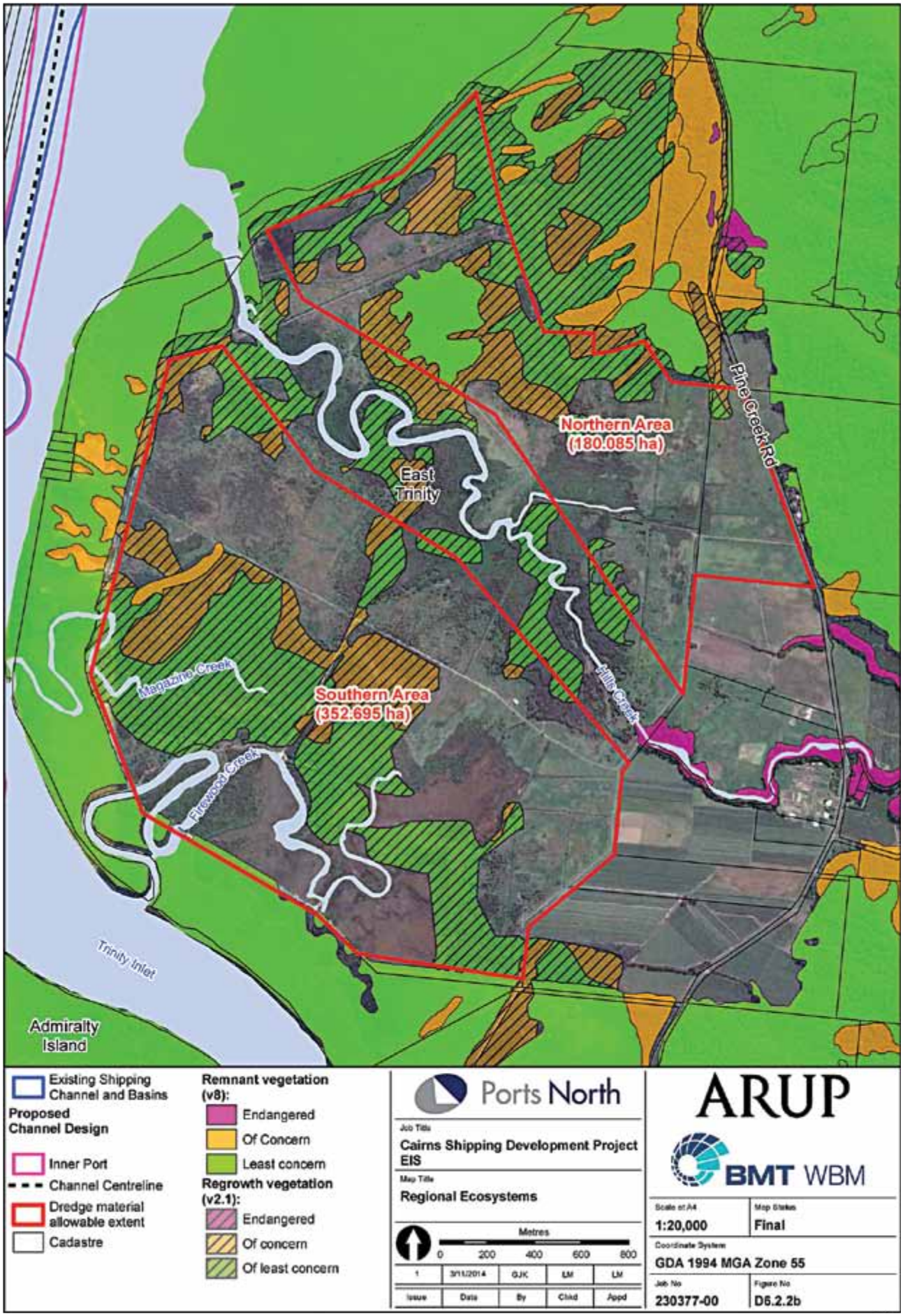
The Coastal Act provides for the declaration of coastal management districts over coastal areas that need protection or management especially with respect to the area's vulnerability to erosion, to maintain or enhance coastal resources or for planning and development management of the area. **Section D.6.3** provides further information on the potential impacts to coastal processes.

Remnant and Regrowth Regional Ecosystems

Remnant and Regrowth Regional Ecosystems (RE) are regulated under the ***Vegetation Management Act 1999*** (Qld) (VM Act). RE types are described based on a combination of geology, landform, soil and flora. Within the VM Act, REs are also classified into Endangered, Of Concern, and Least Concern conservation classes based on the extent of previous clearance of each RE type.

The majority of vegetation at East Trinity is mapped as regrowth RE; although a patch of Least Concern RE (7.1.1, Mangrove Forest) is located in the northern half of the site (refer to **Figure D.6.2.2b**). Mangrove and melaleuca forests on the western edge of the site boundary are mapped as Least Concern and some Of Concern REs.

Figure D.6.2.2b Regional Ecosystems



Essential Habitat

There is no mapped essential habitat within the proposed placement area.

D.6.2.3 Local Government Nature Conservation Values

At a local government level, the *Cairns Plan 2009* includes Planning Area and Overlay Codes that directly relate to the conservation of environmental values. The application of the Cairns Plan is discussed in **Section D.6.1**.

D.6.3 Coastal Processes

Coastal processes within the broader study area including Trinity Inlet are described in **Chapter B3, Coastal Processes** of this EIS.

Given its low lying nature below 1.5 m AHD and location adjacent to Trinity Inlet, the site is subject to active coastal processes in the form of an erosion prone area, storm tide hazard area and coastal management district. Each of these are discussed and described below.

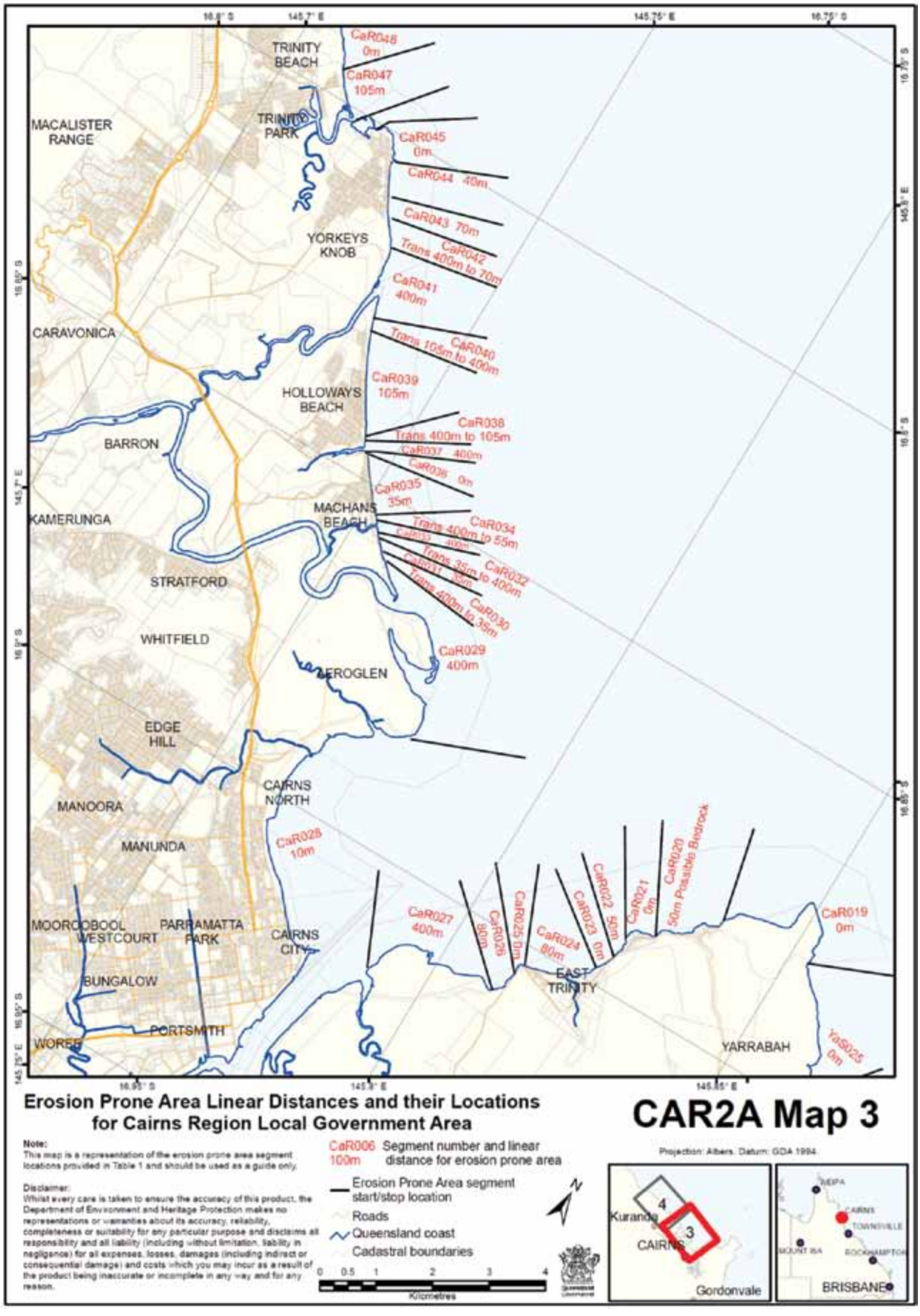
D.6.3.1 Erosion prone area

Erosion prone areas include areas subject to inundation by the highest astronomical tides (HAT) and at risk from sea erosion. On land adjacent to tidal water the landward boundary of the erosion prone area is defined as follows (noting whichever of the following methods gives the greater erosion prone area width is the adopted area):

- A line measured 40 m landward of the plan position of the present day HAT level
- A line located by the linear distance shown on the Table within the erosion prone area plan and measured, unless specified otherwise, inland from:
  - The seaward toe of the frontal dune (the seaward toe of the frontal dune is normally approximated by the seaward limit of terrestrial vegetation or, where this cannot be determined, the level of present day HAT; or
  - A straight line drawn across the mouth of a waterway between the alignment of the seaward toe of the frontal dune on either side of the mouth
- The plan position of present day HAT.

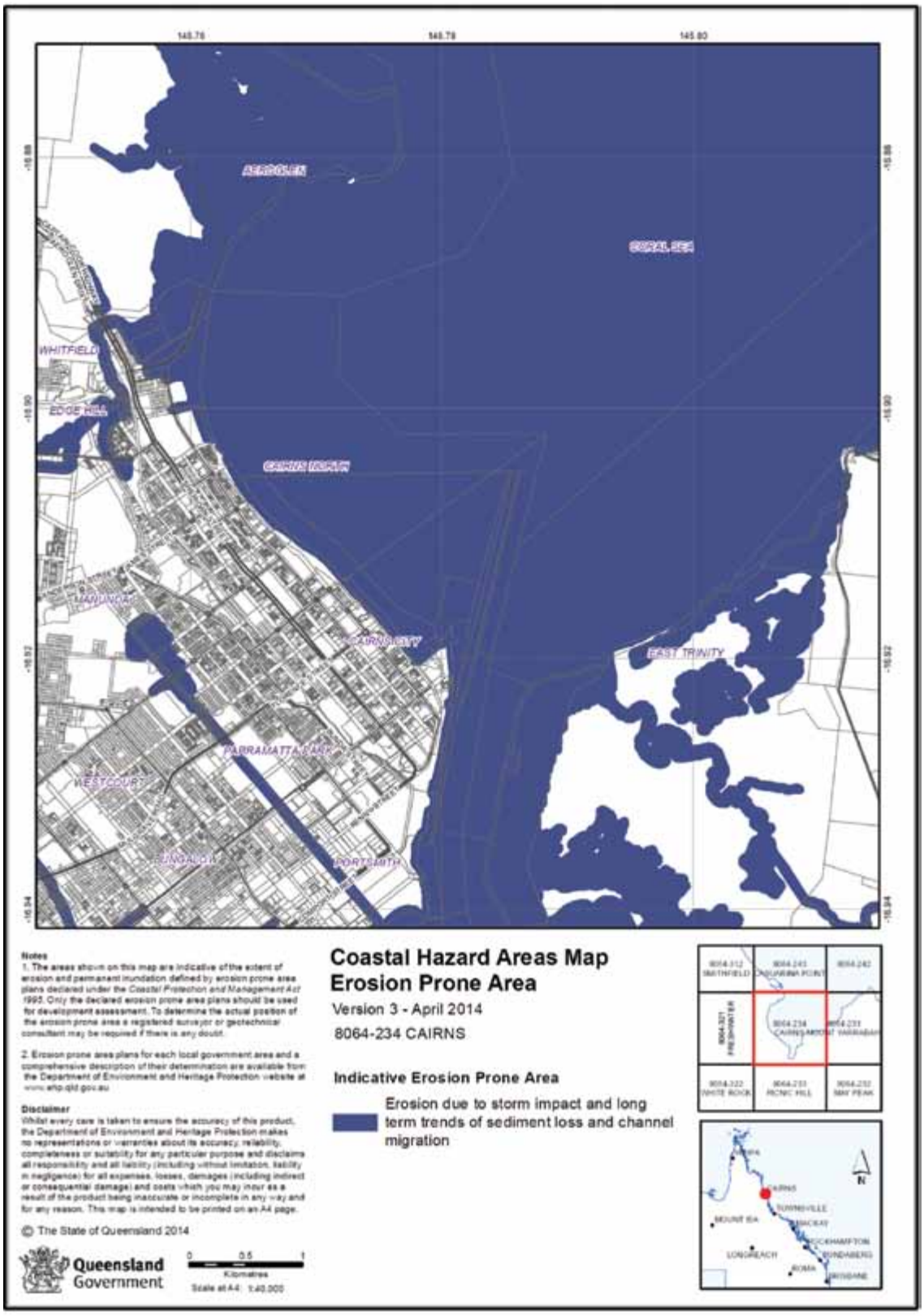
The erosion prone area plan for the study area is shown in **Figure D.6.3.1a**.

Figure D.6.3.1a Erosion Prone Area Plan (from DEHP)



Along the open coast to the north of the East Trinity site, the erosion prone area extends inland from the embayments at the distances shown in the erosion prone area plan. Along Trinity Inlet, the erosion prone area extends to the limit of HAT on the East Trinity site including all tidal waterways and associated estuarine wetlands. This is shown in the indicative erosion prone area map shown as **Figure D.6.3.1b** published by the DEHP. The implications of being in the erosion prone area means that those areas of the site could potentially experience erosion damage (e.g. erosion in a storm event at least once and potentially multiple times) during the defined planning period of 50 years.

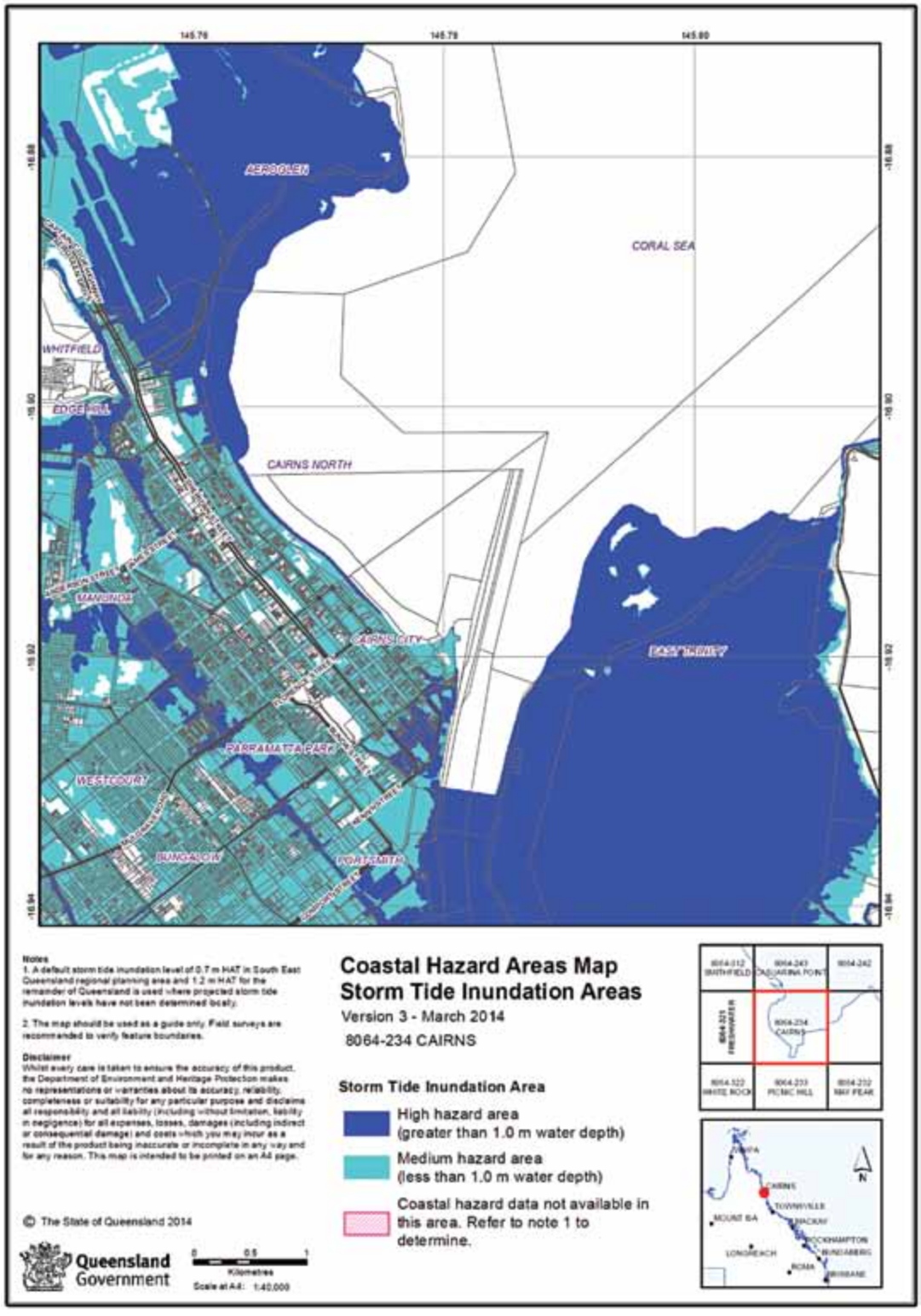
Figure D.6.3.1b Mapped Erosion Prone Area (from DEHP)



D.6.3.2 Storm Tide Inundation Coastal Hazard Area

As shown in **Figure D.6.3.2a**, the entire East Trinity site has been mapped as being prone to storm tide inundation of over one metre height in a coastal hazard event. This means the site is particularly susceptible to coastal hazards and any future placement of dredge material would need to be specifically engineered to be contained on the site and impervious to impacts from storm tide flooding as well as overland flooding (noting the East Trinity site is bordered by high elevation catchments on its northern and eastern boundaries). It should be noted that the plans produced by the DEHP are indicative only, using a 1.2 m Storm Tide Level and would need to be further investigated and validated for the site (see information gaps below).

Figure D.6.3.2a Mapped Storm Tide Inundation Area (from DEHP)



D.6.3.3 Coastal Management District

Most of the East Trinity site is contained within the Coastal Management District under the ***Coastal Protection and Management Act 1995*** (refer to **Figure D.6.3.2a**). Whilst changes are proposed to the extent of Coastal Management Districts, East Trinity would still lie within the changed boundaries. This reflects the coastal hazards and natural values present on the site. The inclusion in a district means that regulatory provisions of the Act can be applied including the need for Queensland Government approval of works and other types of development through the ***Sustainable Planning Act 2009***.

Potential impacts

The prospective impacts on coastal hazards from the use of East Trinity for the placement of dredge material include as follows:

Susceptibility to coastal hazards

As outlined above, any future placement of dredge material would need to be specifically designed and engineered to be contained on the site and impervious to impacts from coastal hazards (erosion prone areas, storm tide inundation and overland flooding).

Bund walls that are developed for this purpose would need to be designed accordingly and carefully maintained and inspected to prevent catastrophic loss of placed material.

The implications of placed material leaking or otherwise breaking through bunds (through a partial or complete failure of the bund wall) would lead to very high sedimentation impacts to the discharge channel from the site, adjoining areas and ultimately Trinity Inlet and the nearshore areas of Trinity Bay.

Tailwater

Particularly during the construction phase, dredge tailwater will be pumped on to the land-based placement site in high quantities by the dredge vessel. There will be insufficient capacity to hold this water on the site for any considerable period of time and it will need to be moved through a series of bunded reclamation cells to a final sedimentation pond and discharged off the site. This would likely occur via one (or more) of the site waterways into Trinity Inlet as shown in the concept design. The potential impacts on coastal processes from tailwater release include:

- Potential scour of the bed of the tailwater discharge channel and of Trinity Inlet from the volume and velocity of discharge
- Potential changes to local hydrodynamics (e.g. currents) from the tailwater release
- Transport of additional fine sediment into the Trinity Inlet system leading to potential erosion or accretion of neighbouring shorelines

Further assessment required

Further assessment would be required for coastal processes in relation to the following:

- Confirming the precise location of the erosion prone area and storm tide inundation area for the site using a combination of additional site survey and numerical modelling
- Determining the optimal height, design and material to construct bunds noting the high hazard risk of the site
- Confirming the impact of tailwater release will not cause scour of the natural sediments and other impacts on coastal processes including erosion or accretion of neighbouring shorelines. This would need to be achieved through detailed modelling of the likely tailwater release including the volume, velocity and characteristics (e.g. fine content) of the discharge waters
- Modelling would also likely need to be undertaken of the impact of a bund wall breach or failure and the impacts the uncontrolled release of sediment may have on local environmental values on the site's waterways and in Trinity Inlet.

D.6.4 Geology and Soils

The East Trinity site is on a coastal plain and contains deep stratified Holocene sediments (up to 30 m deep) overlying Pleistocene basement strata down to 80 m (Lord, 2006). Geologically, it has been subject to various phases of deposition related to sea level changes.

Trinity Inlet lies at the northern end of an extensive alluvial valley formed over a fault lineament (Rubenach, 1978). This elongated physiography developed during a period of Palaeozoic faulting and folding, resulting in the granite ranges flanking the eastern (seaward) side of the valley. The northern tip of these ranges from Cape Grafton and False Cape.

The Holocene infill of Trinity Embayment is predominantly chenier plain in character (as may be expected in a protected, tropical, north-facing embayment) (Bird 1970, Jones 1985).

Pre-Holocene age deposits exist at site and consist of mature, heavy clays, which are interlaced with sand/gravel layers in alluvial fans deposits. These deposits are not typically acidic. Acidic soils are mostly encountered in organic swamp silt/clay deposits in abandoned stream channels from coastal plain deposition. These occur primarily around Firewood and Magazine Creeks and areas adjacent to the present course of Hills Creek (Lord, 2006).

D.6.4.1 Acid Sulfate Soils

East Trinity is known to contain Acid Sulfate Soils (ASS) that have been previously disturbed and which are subject to ongoing rehabilitation by the Queensland Government. **Figure D.6.4.1a** shows the extent of historical damage to the environment caused by the disturbance of ASS. Much of these disturbed areas have now been remediated and are in a state of recovery. **Figure D.6.4.1b** illustrates the recovery of select examples of some vegetation communities.

Figure D.6.4.1a Damage to Marine Ecosystems as a Result of the Disturbance of ASS

Figure D.6.4.1b Photographic Evidence of Remediation and Recovery of Vegetation Communities at East Trinity.

Chenier swamp at East Trinity in 2003 and 2006
(source: DSITIA)

A road drain at East Trinity in 2003 and 2010
(source: DSITIA)

Firewood Creek in early 1980s and 2006

Flood gates allow tidal inundation of areas up to one metre AHD in order to manage the acidity of water discharged from the site. Based on investigations undertaken over a number of years, the Queensland Government determined that this tidal regime needs to be maintained to manage acidity on site (Smith ***et al***. 2009). This inundation regime is also considered optimal for maintaining the current mangrove and wetland communities (refer to **Section D.6.6.2**, **Terrestrial Ecology**). Alternative methods of remediation were considered, but controlled and monitored use of lime-assisted tidal exchange was judged to be the most cost-effective and practical option in the prevailing circumstances.

The goal of the remediation strategy at East Trinity is to have water of acceptable quality (pH> 6) exiting the site on a consistent basis, in all seasonal conditions, under a self-managed tidal regime without lime augmentation. The existing remediation strategy has two objectives:

- Neutralise existing acidity (actual and retained) in the upper oxidised layers in soils
- Limit further acid production and metal generation from potential ASS layers in soils and transported sediments.

Sediment sampling of the material to be dredged (refer to **Chapter B4, Marine Sediment Quality**) has indicated that PASS is present in the proposed dredge material in the very soft to soft clay and silt materials. The likely ASS characteristics of the proposed dredged material has been summarised by Golder (2014) as follows:

- Potential Acid Sulfate Soils (PASS) have been identified to more likely be present in the very soft to soft clay and silt materials (about 3.67 M m^3). Firm, stiff and very stiff materials are unlikely to be PASS or require lime treatment if the material was placed on land
- The majority of samples tested by BMT WBM indicated self-neutralizing PASS within the top one metre along most of the channel (i.e. these samples had shell or other neutralising material). However, Golder (2014) notes that on other dredging projects involving 'self-neutralizing' materials, there has been some acidity released from these materials and therefore nominal lime treatment of about three to five kg lime/m^3 would still be required if this material was placed on land. Also, separation of materials of varying PASS during the dredging process may not be practical or indeed possible
- PASS materials that are not self-neutralising were detected in 17 samples results from all investigations to date. These 'positive' samples were typically from depths of more than one metre below the existing surface. This material would require substantial lime treatment of between 30 to 270 kg lime/m^3 if placed on land.

Section D.5.3.2 provides a description of potential treatment methods for neutralising PASS materials. The liming rates and treatment methods outlined here would need to be confirmed through more rigorous testing and assessment to meet the Queensland ASS technical manual requirements.

Contaminated Soils

Investigations into the characterisation of the physical and chemical properties of proposed dredged sediment was undertaken, and is detailed in **Chapter B4, Marine Sediment Quality** of the EIS. The parameters tested include metals and metalloids, organotins, Total Petroleum Hydrocarbons and Polycyclic Aromatic Hydrocarbons, Organochlorine and Organophosphate pesticides, the herbicide Diuron, Perflourinated Compounds, Nutrients, ASS and Total Organic Carbon. Soil samples analysed had concentrations of contaminants below respective water quality screening levels for all tested parameters in accordance with the ***National Assessment Guidelines for Dredging*** (Commonwealth of Australia, 2009) and were deemed suitable for disposal at sea.

The National Environmental Protection Measure (NEPM) Guidelines 2013 sets health-based investigation screening levels for recreation, commercial and residential development as well as worker health. These health-based investigation screening levels are all higher than those set within the NAGD, with the exception of levels of tributyltin (TBT) which are within thresholds for worker health and recreational land use but exceed the threshold suitable for low density residential development. Therefore material to be placed at East Trinity would generally be considered suitable for placement on land from a human health perspective, however should the final land use be determined to be residential, further assessment and management measures for elements such as TBT, may be required.

Potential Impacts

The management of ASS is complex, and made more so in this instance by the combination of existing acidity at East Trinity and the further placement of large volumes of acidic material. Uncertainty exists as to how such a large volume of material would be treated successfully as it has not been attempted on such a scale before in Queensland. It is also poorly understood at present how treatment of the existing site acidity would be carried out during material placement and what impact this may have on the groundwater, surface water and site's ecological values. The placement of material as a capping layer to treat existing acidity at the site was ruled out by the CSIRO in 1999 (Hicks W.S, Bowman G.M and Fitzpatrick R.W, 1999) as liming was thought to be unlikely to be successful due to the low hydraulic conductivity of the soil.

Whilst a technical solution to manage acidity could be arrived at through further studies, there is always a risk acidic material is released to the receiving environment (groundwater beneath East Trinity or Trinity Inlet). Further studies are required to be able to quantify the significance of this risk.

ASS, and the associated leachate and runoff have the potential to create both chronic (low-level, long term) and acute (severe, short term) ecosystems effects. Depending on the pH of soil and runoff, plant life usually shows a marked decline in health in affected areas. High acidity reduces plant productivity due to the lowered availability of soil nutrients. Similarly, waterways receiving ASS leachate or runoff often show reduced biological health and reduced function.

Reductions in pH associated with ASS leachate or runoff provides a risk to ecosystems, as most aquatic life requires a pH of at least six to survive. High acidity can cause skin damage to fish, increasing their susceptibility to disease and fungal infection (e.g. red spot disease). Damage to gills from the acidity also affects respiration. High acidity also causes heavy metals within the water column to precipitate, leading to high aluminium levels which are toxic to fish and other marine creatures. Fish kills from such mechanisms were a regular occurrence prior to the commencement of remediation activities at the East Trinity site.

Further Assessment Required

Further extensive soil testing would be required to determine the most appropriate liming rate and treatment method to neutralise the significant volumes of material to be placed at site. Further investigation of the impacts of placing material on the area currently being rehabilitated would also be required to understand if this would significantly alter the existing acidity treatment regime, which has been developed and fine-tuned over a number of years.

A detailed ASS Management Plan would be prepared for approval by the Queensland Government technical specialists. Regular monitoring during placement and maintenance of the site would also be required.

D.6.5 Water

D.6.5.1 Marine

Trinity Inlet is the receiving marine environment for freshwater discharges from the East Trinity site. Water quality of Trinity Inlet has been described in Chapter B5, Marine Water Quality of the EIS.

Trinity Inlet is fed by numerous freshwater creeks which drain small catchments, including Smith's Creek, Skeleton Creek, Redbank Creek, and also Chinaman's Creek and Fearnley Street Drain which contribute urban and industrial inputs. From the East Trinity site, Hills Creek, Magazine Creek and Firewood Creek discharge into Trinity Inlet (freshwater discharge from Hills Creek causing turbid plumes in Trinity Inlet is shown in **Figure D.6.5.1a**).

Figure D.6.5.1a Naturally Occurring Turbid Plumes in Trinity Inlet Resulting from Freshwater Discharge from Hills Creek, East Trinity

Sediment and nutrient fluxes into Trinity Inlet continuously occur due to tidal flushing and riverine discharge of catchment-related runoff associated with (sometimes cyclonic) rainfall events between November and May. Additional sources of pollutants within Trinity Inlet include:

- Two sewage treatment plants, the Southern STP (19.4 ML/day) and the Edmonton STP (6.7 ML/day) discharge to Trinity Inlet and provide a constant source of nitrogen and phosphorus to that waterway (CRC 2013)
- If not appropriately managed, boating and shipyard activities have potential to release petroleum-based pollutants, anti-fouling leachates, litter and some organic waste (Mitchell et al 2006)
- Urban stormwater flows that discharge into the port area via constructed drains that may contribute gross pollutants and potential industrial sourced pollutants, along with dissolved and particulate contaminants.

The baseline water quality data for Trinity Inlet indicated that pH is highly variable. The data is indicative of both inlet and open-ocean, however, the pH values observed are likely due to anthropogenic causes, including the influence of ASS from East Trinity.

While turbidity in more exposed areas is influenced by wind speed and direction, turbidity in the more protected areas of Trinity Inlet appears to be more likely influenced by freshwater inflows during the wet season.

Baseline data indicated that some metals/metalloids, including tributyltin, cadmium, copper, chromium and zinc exceeded the water quality guideline values in Trinity Inlet. Furthermore, there were elevated nutrient levels in Trinity Inlet relative to the guideline values for total phosphorus and ammonia, the likely source of which is STPs.

Importantly, there are tidal wetlands along the coastline of the East Trinity site (Figure D.6.5.1b and Figure D.6.5.1c) which were not assessed in regard to water quality as part of this EIS. If the East Trinity placement option is progressed, these wetlands will need to be characterised further.

Potential impacts

The prospective impacts on surface water quality (marine and fresh) from the use of East Trinity for the placement of dredge material includes as follows:

Tailwater

The potential impacts on water quality from tailwater release, unless appropriately managed, include:

- High turbidity associated with fines present in the dredge material noting these fine sediments may impact on sensitive receptors in Trinity Inlet and Trinity Bay through reducing light availability and smothering of benthos
- High (low pH) or low (high pH) acidity of tailwater depending on the effectiveness of ASS treatment practices. As outlined in **Chapter A3, Appropriateness Assessment** and **Section D.6.4,** the scale of ASS treatment associated with the East Trinity site is unprecedented and untested. As such there is considerable uncertainty to the ability to control the pH of tailwaters and the likely range of values that may be experienced and their impacts on receiving environments. Certainly, there would be a greater risk of high acidity impacts such as fish kills and similar stress on estuarine and marine species
- Depending on the location of the tailwater discharge, the placement of the material and associated discharge of tailwater may have salinity impacts on freshwater creeks and water bodies on the site. This could occur both as a result of surface water as well as through groundwater infiltration
- Transport of soluble metals (such as Fe and Al) that are naturally present in the dredge material but become oxidised in an acidic environment and may cause impacts in marine environments following exposure.

Stormwater

Following the construction period where the capital material is placed at East Trinity, the site will need to be actively managed, monitored and maintained in terms of water quality for a long consolidation period (years to decades). Stormwater will need to be managed and diverted around the bonded site and provisions made to manage the stormwater runoff from the bunded area, noting it will have a higher risk of turbidity and acidity compared to *in situ* soils elsewhere on the site. This is a particular challenge in the North Queensland environment where heavy rainfall can mobilise the otherwise contained sediments.

Figure D.6.5.1b Hills Creek

Figure D.6.5.1c Tidal Wetland Showing Dieback of Artificially Colonised Melaleuca Species, and Subsequent Regrowth of Mangrove Vegetation Following Reinstatement of Tidal Regime

D.6.5.2 Freshwater and Groundwater

Freshwater resources within the broader study area are described in **Chapter B6, Water Resources**. There are a number of freshwater creeks and wetlands on the East Trinity site, including:

- Freshwater sections of Hills Creek
- Freshwater sections of Magazine Creek
- Freshwater sections of Firewood Creek
- Natural and constructed wetlands.

Examples of some of these freshwater resources are shown in **Figure D.6.5.2a** and **Figure D.6.5.2b**.

The water quality of these creeks and wetlands was not assessed in regard to water resources as part of this EIS. If the East Trinity placement option is progressed, these creeks and wetlands will need to be characterised further.

Figure D.6.5.2a Freshwater Wetland Adjacent to Hills Creek

Figure D.6.5.2b Constructed Freshwater Wetland

Groundwater

As parts of East Trinity are intertidal, the groundwater resource is especially vulnerable. Groundwater and soil chemistry in intertidal environments is complex and highly dynamic over small spatial and temporal scales. In these areas, the groundwater resources are effectively subterranean estuaries with oscillating hydraulic gradients. There is dynamic exchange of groundwater with surface water, which has been observed at East Trinity by Johnson et al (2010) - where groundwater seepage was observed via surface-connected pores along the intertidal slope during the ebb tide.

East Trinity site is a vulnerable area in terms of groundwater resources. Previous landform modification at this site involved construction of more than 27 km of drains and levelling of the land surface in order to reduce water-logging and leach salt out to enable sugar cane production. The lowering of the natural groundwater table created a highly acidified landscape and released acid and toxic levels of iron, aluminium and other heavy metals from the soil into the waterways (Ahern 2010).

Potential Impacts

In recent years, East Trinity has been slowly rehabilitated through active floodgate management which has reinstated tidal inundation throughout the area. While great success is reported to have been achieved at East Trinity using this method (Ahern 2010), this is only a permanent solution to the ASS problem if the site is kept perpetually wet (using tidal exchange). Any reversion to former drained conditions without regular tidal inundation would allow oxidation of the reformed sulfides and would reverse the gains, allowing re-creation of an environmental hazard (Ahern 2010). Johnson et al (2006) support this conclusion, stating that due to the formation of high concentrations of pyrite in intertidal surficial sediments during the rehabilitation of East Trinity, there is potential for long-term adverse consequences if tidal inundation is ceased at East Trinity.

Further assessment required

Based on the assessment issues identified above, further assessment would be required for water quality in relation to the following:

- Increased, targeted data collection of water quality and hydrological information on the site and in site waterways. This baseline will be important to determine the natural condition and variability of the system from which to assess the impacts of changes from dredge material placement on both water quality and hydrology
- Detailed modelling assessment of tailwater discharge with specific attention placed on the extent and concentration of tailwater impacts on sensitive receptors through consideration of:
  - Turbidity and PAR (light) impacts
  - Salinity impacts (see below)
  - pH and acidity impacts
  - Other relevant parameters including dissolved oxygen, nutrients, dissolved metals and potential for the tailwater to generate algal blooms
- Modelling assessment of saline intrusion into surface freshwaters in combination with groundwater modelling for the site
- Design of an operational stormwater management plan or strategy for the site. This would need to include the assessment of operational phase runoff from the site, and in particular, any point source discharge of stormwater from the bunded dredge material into the marine environment. This would need to be integrated with a surface hydrology assessment examining downstream flooding or other changes to local hydrology
- As with **Chapter B5**, the results of these construction and operational water quality assessments need to be compared to relevant water quality objectives of receiving waters (under the EPP Water) as well as development of 'zones' of impact as per the methodology outlined in that chapter to consider both chronic and acute effects.

D.6.6 Ecology

D.6.6.1 Aquatic Ecology

Originally, the East Trinity site was a small tidal wetland dominated by mangroves and samphire flats with fringing melaleucas (Smith et al: 2003). The site includes four creek systems that form part of the Trinity Inlet catchment.

Aspects of that tidal environment persist, particularly following rehabilitation measures to reintroduce tidal processes to wetland areas containing ASS. Current management of the site has contributed to an improvement in some areas of estuarine habitat across the site by this reintroduction of tidal inundation and flushing.

To the north of Hills Creek there is a 14 ha patch of remnant mangrove forest (RE 7.1.1). The vegetation in this area consists of low to mid-high closed mangrove forest, composed of Black Mangrove ***Lumnitzera racemosa*** and Grey Mangrove ***Avicennia marina***.

Trinity Inlet and its waterways are known habitat for saltwater crocodiles Crocodylus porosus and this species is known to move up the creeks within the site when the floodgates are open. Saltwater crocodiles breed in isolated, freshwater swamps that are generally disconnected from tidal inundation. There is likely to be areas of suitable breeding habitat in the upstream sections of the site.

The mangrove habitat along the site's waterways supports marine fauna such as fish, migratory birds, crocodiles, mudskippers, molluscs, crustaceans, worms and other benthic animals (Joyce, 2005). Furthermore, the sheltered nature of mangrove forest and the calmer waters of the estuary provide for an array of species that require calmer conditions generally, or for breeding or protection of juveniles.

As identified in **Chapter B7, Marine Ecology** seagrass communities are present both in Trinity Inlet and in the shallow areas of Trinity Bay. These resources would be particularly vulnerable to turbid tailwaters generated during construction and longer-term sedimentation and turbidity generated by stormwater discharges from the site.

As outlined previously, the site is currently zoned as an environmental reserve and abuts or adjoins several areas of ecological significance under Commonwealth (World Heritage Area) and Queensland (Marine Park, Fish Habitat Area) legislation. The protection of the values that underpin these areas would be a key performance criteria for land-based placement at East Trinity.

Potential impacts

Direct impacts

The current concept design proposes the loss of approximately 200 ha of mangrove and other intertidal habitat on the site. These areas need to be filled in order to achieve the placement of the required full volume of dredge material (4.4 M m^3) and associated land area that would be required for the management of dredge tailwaters and ASS.

As the impacts on these intertidal areas are unavoidable, this would likely result in a significant residual impact that would need to be offset by the project, given the loss of important habitat to fisheries, waterbirds, saltwater crocodiles and other marine key species.

The placement of a large volume of saline dredge material may also have edge effects on neighbouring habitats but these are likely to be more significant to adjacent freshwater habitats compared to saline/estuarine habitats and species.

Tailwater

The prospective impacts on surface water quality from the use of East Trinity for the placement of dredge material would need to be assessed as outlined in the water quality section above. High turbidity associated with fines present in the dredge material may impact on sensitive receptors in Trinity Inlet and Trinity Bay through reducing light availability and smothering of benthos when discharged as tailwaters. High (low pH) or low (high pH) acidity of tailwater may also impact on marine ecology of the local area and potentially at broader scales depending on the ability of site management measures to regulate acidity to acceptable levels, noting there is considerable uncertainty to the potential effectiveness of such management.

Key estuarine and marine ecological sensitive receptors within and adjacent to the site that would need to be considered as part of this assessment include:

- Seagrass (mapped as being present in both Trinity Inlet and Bay)
- Mangroves and saltmarsh (remnant and regrowth areas within and adjacent to site waterways and along Trinity Inlet and Admiralty Island)

- Fish species of commercial and recreational significance (including impacts on nursery habitat and how the loss of mangroves and other tidal habitat may impact fish stocks and fisheries)
- Megafauna including saltwater crocodiles, marine turtles, dugong and inshore dolphins that may use Trinity Inlet as habitat from time to time (noting crocodiles have been observed on the site and in site waterways).

Further assessment required

Further site specific surveys of the marine ecological resources of East Trinity and its waterways is required to establish its flora and faunal assemblages, baseline conditions, natural variability and their relative significance at broader spatial scales. A range of MNES and MSES may be present based on desktop protected matters searches but have not been verified on site, including fish species of conservation significance such as sawfish. These surveys may need to be seasonally targeted depending on the species involved.

The extent and importance of the site for estuarine crocodile breeding is not well understood and will likely need further investigation given the conservation status of this species and its use of the site for a major life cycle function.

The results of the tailwater and stormwater water quality assessment (as was the case in **Chapter B7**) will need to be assessed in terms of the ecological significance of water quality impacts. This will need to include both short-term (acute) and longer-term (chronic) changes to water quality that may affect sensitive receptors.

D.6.6.2 Terrestrial Ecology

Terrestrial Ecology

The baseline terrestrial ecology features of the East Trinity site have been described by reviewing publicly available mapping, database resources and previous studies on the site, including:

- Aerial photography (Google 2012)
- Regional Ecosystem (RE) and Regulated Vegetation mapping, version 8 (Queensland Government 2014)
- Great Barrier Reef Wetland Protection Area mapping (Queensland Government 2014)
- Wildlife Online database (accessed 7th October 2014)
- *Environment Protection and Biodiversity Conservation Act 1999* Protected Matters Search Tool (accessed 7th October 2014)
- Vegetation Communities of the East Trinity Rehabilitation Area (3D Environmental 2009).

A general walkover was completed by a qualified ecologist from the 31 October to 1 November 2014 to broadly ground-truth the conditions and features of the site.

The history of disturbance at the East Trinity site and the ongoing restoration and management strategies has shaped the terrestrial environmental conditions that are currently present on the site; however, this will continue to be in a state of flux as the effects of rehabilitation are experienced and until stabilisation occurs. The vegetation community and habitat features at the site have been strongly influenced by the removal of tidal flushing, and the recent gradual, controlled reintroduction of tidal flushing for the treatment of ASS. Due to these historical and current land use and management practices, the current and future potential terrestrial ecosystems are considered in this chapter.

The existing terrestrial ecosystems at the site are dominated by degraded grasslands, and regrowth native vegetation communities, and a patch of remnant mangrove forest occurs to the north of the site. The site is also bordered by large areas of mangrove forest associated with Trinity Inlet. Some of the surrounding mangrove forest is likely to be disturbed in order to gain access to the site from the dredge.

Vegetation communities and flora species

There are two patches of mapped remnant Regional Ecosystems (RE) within the proposed area for dredge material placement (**Figure D.6.2.2b**). To the north of Hills Creek there is a 14 ha patch of remnant mangrove forest (RE 7.1.1). There is also a small, 2 ha sliver of mapped remnant Weeping Paperbark *Melaleuca leucadendra* (RE 7.2.8) located to the north of Magazine Creek. The riparian zones within 50 m of Hills and Firewood Creeks are mapped as regulated reef regrowth watercourse vegetation under the *Vegetation Management Act 1999*.

The actual extent and composition of vegetation communities in these patches of mapped remnant and regrowth RE would require ground-truthing to confirm the remnant status.

Based on site observations recorded during an Arup site inspection in 2013, DEHP Regional Ecosystem mapping and vegetation mapping by 3D Environmental (2009), the major, broad vegetation communities across the site at present consist of:

- Mangrove woodland and forest
- Melaleuca open forest
- Coastal vine forest and thicket
- Fernland dominated by Mangrove Fern ***Acrostichum aureum***
- Halophytic grassland, sedgeland and forbland
- Grassland and sedgelands dominated by native species, exotic species or a mixture of both.

The current extent and distribution of much these vegetation communities is in a state of change and ecological succession, due to the current management strategies involving the reinstatement of tidal flushing within the site. There are also smaller patches of regrowth dominated by ***Acacia spp***. Wattle, eucalypt species and exotic species including Guava ***Psidium guajava*** Guava and ***Hyptis capitata*** Knobweed.

Melaleuca woodland and forest areas within the site established following the land reclamation that cut off tidal flushing on the site at the expense of mangrove communities. Weeping Paperbark ***Melaleuca leucadendra*** still occurs in much of the lower, lying areas of the site around the creeks freshwater or slightly brackish swamps and wetlands.

The effect of reinstating tidal inundation on the vegetation communities within the site is areas of Melaleuca dieback around Hills, Firewood and Magazine Creeks due to increased saltwater ponding and flushing, and a return of mangrove communities. In 2009, the areas of Melaleuca dieback were mapped at different stages of succession, including mangrove, fernland and sedgeland regrowth (3D Environmental, 2009).

In areas of the site that are slightly higher in elevation, including land between Firewood Creek, Magazine Creek and Hills Creek, there are large sections of grassland and sedgeland. The condition of these communities is likely to be variable, with large patches dominated by exotic grass species. There are also patches of regrowth vine forest, thicket and woodland adjacent to the creeks, most likely in areas where local topography prevents tidal inundation.

The current vegetation community composition and structure across the site is likely to have changed since the last survey in 2009 and will likely continue to change due to management of the tidal regimes within the site until a point of stabilisation is reached. Areas that have been exposed to more frequent and greater volumes of tidal water will continue to transition to an estuarine environment and the extent of Melaleuca is likely to continue to decrease.

Results of any systematic or targeted flora surveys for threatened species, if they exist, have not been obtained for the preparation of this chapter. Aerial photograph interpretation and the 2009 vegetation mapping have been used to determine the potential habitat suitability and likely presence of threatened species on the site. Based on the vegetation mapping and incidental observations there is a known population of a single threatened plant on the site and potential habitat for three other species listed under the ***Nature Conservation Act 1992*** and the ***Environment Protection and Biodiversity Conservation Act 1999*** (**Appendix E3**).

The site is known to support a population of Ant Plant ***Myrmecodia beccarii***, which is listed as vulnerable under the ***Queensland Nature Conservation Act 1992*** and the ***Australian Environment Protection and Biodiversity Conservation Act 1999***. This epiphyte was observed on Weeping Paperbark trees within the site during the 2013 site walkover completed by an Arup ecologist. Ant Plants will also grow on mangroves.

A search of the Queensland Government Wildlife Online database has identified a single significant flora species within a two km radius of the site (**Appendix E3**). Yarrabah Wattle Acacia hylonoma is listed as vulnerable under the ***Nature Conservation Act 1992*** and is a pioneer species in patches of rainforest regrowth. There is potential marginal habitat for this species within areas of vine forest on the site.

Although not directly observed on the site and no known records exist within two km of the site, there is also the potential for Mangrove Orchid ***Durabaculum mirbelianum*** and Blue Orchid ***Durabaculum nindii*** to occur in areas of remnant and regrowth mangroves. Coastal Plain Spikerush ***Eleocharis retroflexa*** may also occur in ephemeral, freshwater or brackish swamps, sedgeland and grasslands within the site. If the current management practices aimed at restoring tidal inundation and removing exotic species are continued, it is likely that the condition and habitat features of the site will be more suitable for these threatened flora species.

Fauna and habitat

The vegetation communities and habitats within the site are likely to support threatened or significant terrestrial fauna species. There have been no systematic fauna surveys of the site, however, a review of the vegetation communities, site history and management practices can provide some detail about the habitat resources and likely presence of threatened species. A full assessment of the likelihood of occurrence of threatened fauna species identified in database searches is provided in **Appendix E4**.

Of particular note is the current and potential habitat for threatened and migratory bird species. The estuarine and freshwater wetlands on the site provide nesting, roosting and foraging resources for several species of threatened and migratory birds, listed under the Nature Conservation Act 1999 and the *Environment Protection and Biodiversity Conservation Act 1999*. Recent bird surveys (Venables, 2011) recorded 125 species utilising the site, including:

- 46 species that are listed as migratory and/or marine under the EPBC Act
- Five species that are classified as Near Threatened under the NC Act, including:
  - Eastern Curlew *Numenius madagascariensis*
  - Radjah Shelduck *Tadorna radjah*
  - Australian Swiftlet *Aerodramus terraereginae*
  - Black-chinned Honeyeater *Melithreptus gularis*
  - Black-necked Stork *Ephippiorhynchus asiaticus*
- One species that is classified as Vulnerable under the NC Act – Double-eyed Fig-parrot *Cyclopsitta diophthalma macleayana*.

There is also suitable habitat for a range of reptiles and mammal fauna; though the results of any recent surveys, if they exist, have not been made available for the preparation of this chapter. The current fauna assemblages on the site need to be better understood to appreciate the importance of the site for terrestrial species.

The previous management of the site has resulted in much of the site being covered by open grasslands, which have low, to negligible habitat value for significant fauna. The blocking of tidal flushing and the land reclamation process effectively transformed the habitat into a freshwater system. The current management regime of reintroducing tidal flushing along the estuarine wetlands will continue to change the habitat features of the site, with the potential to improve conditions for migratory birds and saltwater crocodiles.

The site is located adjacent to a large patch of contiguous, remnant native vegetation that is largely protected in the Queensland conservation estate. To the west of the site the Grey Peaks National Park and Trinity Forest Reserve extends from the site boundary across to Yarrabah. This large remnant extends southwards down the coast as far as Innisfail. Across this landscape there is a very high diversity of vegetation communities and habitat types, including vine scrub, rainforest, eucalypt forest and mangrove communities.

Much of the lowland, coastal floodplain to the west of the Grey Peaks National Park and Trinity Forest Reserve has been cleared for agriculture, predominantly sugar cane farming. This conversion from remnant habitats to agricultural uses has contributed to several degrading processes at a landscape scale including habitat fragmentation, loss of ecological connectivity and water quality impacts. The regeneration currently occurring on the East Trinity site is contributing to the restoration of these coastal lowland habitats by increasing cover of native vegetation communities.

Potential impacts

Based on this desktop assessment, known impacts to significant ecological features include:

- Removal of over 200 ha of remnant, regrowth and regenerating native vegetation communities
- Removal of marine plant habitat
- Reduction in population size of the vulnerable Ant Plant and loss of supporting habitat for this species
- Loss of habitat for threatened orchids
- Introduction and spread of exotic and pest plants
- Loss of habitat for migratory shorebirds, waders and threatened bird species
- Loss of native vegetation communities that are likely to provide habitat.

Current management of the site has contributed to an improvement in some areas of estuarine habitat across the site by reintroducing tidal inundation and flushing. As well as impacts to significant ecological features listed under State and Commonwealth, the use of the site for dredge material placement has the potential to reverse some of these improvements, particularly around Firewood and Magazine Creeks.

Further assessment required

A detailed, systematic baseline ecological survey is required across the site to collect information on the current vegetation communities, flora species composition, habitat values and fauna usage of the site. Fauna surveys will be required to target all fauna groups and should be carried out in accordance with the ***Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland*** (Eyre et al. 2012) and any other species-specific, targeted survey methodologies for threatened species.

Any current baseline information collected will require analysis to determine the potential impacts of the project in the context of the historical and current management practices on the site.

D.6.6.3 Socio-Economic

The use of the East Trinity site for disposal of dredge material would result in a number of socio-economic impacts. Residents of Water and Pine Creek Roads and East Trinity suburb are most likely to be directly impacted by the works, while people living in the Yarrabah settlement, commercial fishers, recreational users and people with views from high-rise apartments in Cairns could experience indirect impacts.

Potential impacts

To address the socio-economic impacts of this option the following people and groups need to be considered:

- **Residents of Warner and Pine Creek Roads** – There are approximately 50 groups of dwellings (groups consisting of sheds, houses and other buildings) along the sections of Warner and Pine Creek Roads that would potentially be used to transport materials and equipment to the site. People living or working on these roads would be impacted by a significant increase in heavy vehicle traffic in the order of more than 1,300 movements per day. Potential social impacts would include amenity issues (such as noise, dust) and road safety issues associated with the mix of vehicles on the roads (trucks and private cars) and possible road surface deterioration due to heavy vehicle use
- **East Trinity residents** – At the time of the 2011 Census there were 111 people living in the suburb of East Trinity which is located to the north of the site. East Trinity residents live in dwellings located on Pine Creek Road, the Esplanade, Sandpiper Street and Bluewater Street. People who live in this area would potentially experience amenity related impacts associated with noise from machinery and pumps on the site, visual impacts associated with views to the disturbed site, odour related impacts associated with the process of drying of material on the site and dust related impacts once material on the site dries. While heavy vehicles will not travel through the residential area of East Trinity, Pine Creek Road is the only access to the suburb; therefore residents would also potentially be impacted by the increase in heavy vehicle traffic along Warner Road and Pine Creek Road
- **Yarrabah settlement** – Yarrabah is a small indigenous community with a population of around 2,400 people and 97 percent of residents were Aboriginal and Torres Strait Islander people at the time of the 2011 Census. As outlined in **Chapter B9, Socio-Economic**, Yarrabah is one of Australia's most disadvantaged localities sitting in the first decile of the ABS's Socio-Economic Indexes for Areas (SEIFA) indicating low levels of income, low educational attainment, high unemployment and many dwellings without motor vehicles. Yarrabah is situated 60 km east of Cairns by road. It currently takes about 45 minutes to travel by car from the Cairns CBD to the Yarrabah community which is accessed only via Pine Creek Road. The increase in heavy vehicle traffic using sections of Pine Creek Road and Warner Road would potentially impact people using these roads to access the Yarrabah settlement
- **Commercial and recreational fishers** – As discussed in **Section D.6.2.2**, Trinity Inlet Fish Habitat Area (FHA) is an important nursery area for fish species. Habitat in this area has been improving since remediation works on the East Trinity site commenced. Commercial and recreational fishers would likely be concerned about potential impacts on fisheries nursery areas, FHAs, and species of economic significance in the event that such habitat is removed, or in the event that water quality in Trinity Inlet be impacted by the works
- **Cruise ship passengers and crew** – Passengers and crew visiting Cairns would be able to see the disturbed East Trinity site from the vessel. This could impact their initial impression of the Cairns area
- **Recreational users** – The East Trinity site is not accessible for recreational use, though it is reported by the site managers that some people do access the site for this purpose without permission. These non-permitted uses would be halted, but it is likely that people who use areas in the vicinity of the East Trinity site for boating, fishing and other recreational pursuits could continue these activities outside the site boundary

- Residents of Wharf Street and other Cairns high-rise apartments – People living, working and visiting high rise apartments along Wharf Street and residents of many other parts of Cairns would likely see the disturbed East Trinity site from these vantage points. The current 'green backdrop' to the city of Cairns would be significantly impacted by the works.

Further assessment required

To fully understand the impact that using the East Trinity site would have on the socio-economic environment, the following information is required:

- A comprehensive demographic profile of potentially affected areas
- The frequency that people who live/work on Warner Road and Pine Creek Road, in East Trinity suburb and in Yarrabah travel to and from Cairns
- Frequency of supplies being brought to the Yarrabah community
- Emergency egress routes for Yarrabah and East Trinity residents
- Potential impacts of placement at East Trinity on fish habitat values
- Estimation of time delays associated with additional heavy vehicle traffic
- More accurate count of the number of dwellings/people along Warner Road and Pine Creek Road
- Consultation with East Trinity residents, Yarrabah residents, commercial fishers, marine tourism operators, economic development bodies, Council, Queensland Government and other relevant stakeholders regarding the East Trinity site to understand issues and benefits associated with this option.

D.6.7 Noise

The current background noise levels at East Trinity are minimal given the undeveloped nature of the site and surrounding land uses. Noise sources are restricted mostly to 'natural' sources such as birds with occasional distant man-made sources from vessels in Trinity Inlet and aircraft movements.

Sensitive receptors, as defined in the ***Environmental Protection (Noise) Policy 2008*** (Noise EPP), include dwellings, libraries and educational institutions, childcare centres and kindergartens, outdoor school playground areas, medical institutions, commercial and retail activities, protected areas, marine parks and passive parks and gardens. Migratory birds and other fauna that use the site should also be considered sensitive receptors.

There are few human sensitive receptors within the vicinity of East Trinity, with the exception of a small number of residential properties along Pine Creek Road, however, there are likely to be some along the fill material haul route to the site (refer to **Section D.6.6.3** above).

D.6.7.1 Potential Impacts

Potential sources of noise from construction works include:

- Machinery used for construction of the bund wall and treatment areas
- Pumping of dredge material (e.g. booster pumps)
- Machinery used to treat the dredge material (e.g. lime dosing equipment, graders, bulldozers and trucks)
- Road traffic associated with:
  - Bringing fill to site for construction of the bund wall
  - Placement of material dredged by backhoe dredges
  - Delivering lime to site for treatment of ASS.

Once the placement of material is completed, there is likely to be occasional ongoing noise associated with machinery maintaining the site.

Noise impacts from the placement of material at the site may consist of annoyance to human comfort or sleep disturbance as well as disturbance to the typical behaviours of the sites fauna (e.g. nesting, breeding).

Noise would be generated over a period of years (up to five to 10 years depending on soil treatment methods) during site preparation, placement of material and its subsequent treatment.

D.6.7.2 Further Assessment Required

A baseline noise survey would be required at sensitive receptors at the site and along access routes. Potential construction and operational noise sources would then need to be modelled to assess the impact at sensitive receiver locations.

D.6.8 Air Quality and Odour

Ambient air quality at East Trinity is considered to be within acceptable limits (as defined by the ***Environmental Protection (Air) Policy 2008***, which sets air quality objectives for Queensland), to the extent that the DEHP does not consider monitoring of air pollutants within the Cairns region necessary. Existing sources of air pollution at East Trinity are very limited; dust may occasionally be generated from nearby agricultural lands.

Under Queensland legislation, the impacts of air quality are measured through the likely exceedance of air quality limits at sensitive receivers. This is defined under the ***State Planning Policy (2013)*** as a child care centre, community care centre, community residence, dual occupancy, dwelling house, educational establishment, health care services, hospital, hostel, multiple dwelling, relocatable home, residential care facility, retirement facility, short-term accommodation or tourist park.

Sensitive receptors in close proximity to East Trinity are limited to a small number of residential properties along Pine Creek Road. A higher number and variety of sensitive receptors would occur along haulage routes.

D.6.8.1 Potential Impacts

The placement of dredge material is likely to generate emissions from a number of sources during the transport and placement of the material. The works are likely to generate particulate and dust emissions through vehicle movements on-site and to-site via access roads, disturbance of soils, materials handling and wind erosion of exposed surfaces. Dust generated on site would be controlled with water trucks, chemical dust treatments or temporary covering of materials.

The material to be disposed will be mostly anaerobic sediment, containing hydrogen sulphide. On exposure to air during drying processes this can cause temporary nuisance odour (e.g. duration of a few days). The extent of the odour impact will be dependent on the drying method and prevailing wind conditions; winds at the site are predominantly south-easterly (Refer to **Chapter B11, Air Quality**), which would blow odours and dust away from sensitive receptors.

Further Assessment Required

Detailed air quality modelling would be required to confirm the volume and direction of air emissions that could be generated, and the impact on sensitive receivers. Odour modelling and assessment will also be required taking account of wind direction and the propensity for odour to impact populated areas of the CBD.

D.6.9 Visual Amenity

Views of the site are relatively obscured at ground level from the Cairns CBD and Trinity Inlet due to dense mangrove forest along the coastal edge of Trinity Inlet which would be largely retained during works (some clearance of this buffer area may be required to gain access to the site).

The site (and proposed works) would be visible in the distance from high rise buildings, and elevated residential areas throughout the broader Cairns area, as well as visiting cruise ships and planes. East Trinity can also be readily viewed from the western faces of the Greys Peak National Park and the hinterland west of Cairns. The site currently forms part of the green backdrop to Cairns that is part of the city's landscape amenity. Although minor parts of the site are still degraded from the release of acid (Refer to **Figure D.6.4.1a**), there has been significant improvement in the visual appeal as remediation has progressed. The draft Cairns Planning Scheme identifies the view from the Cairns CBD over East Trinity as a significant view lookout, requiring protection.

Figure D.6.9a shows Cairns from an internal road within East Trinity.

Figure D.6.9a Views from East Trinity across to the Cairns CBD

D.6.9.1 Potential Impact

The disturbance of the site would be extensive, and likely visually intrusive over a period of years when viewed from high rises or residential areas in Cairns or other elevated vantage points. Land would need to be cleared to allow site access and placement of the dredge material. During placement, machinery will be on site to manage the dredge material with particular impacts at night due to night lighting. After placement is finished, the site will consist of a raised area of marine sediment surrounded by a bund wall. Plant colonisation of the placement area is likely to be hindered for many years until salts and potential acidity have leached from the sediment.

D.6.9.2 Further Assessment Required

Visual representations of the site from public vantage points would be needed, in order to make an assessment of the significance of the impact of the altered landscape on visual amenity.

D.6.10 Cultural Heritage and Native Title

Native title is recognised and protected in accordance with the ***Native Title Act 1993*** (NTA). The NTA establishes a regime by which it can be determined whether native title exists in respect of land and waters, or whether native title has been extinguished. Indigenous cultural heritage (ICH) is protected under the ***Aboriginal Cultural Heritage Act 2003*** (QLD) and non-indigenous cultural heritage (NICH) by the ***Queensland Heritage Act 1992***.

D.6.10.1 Non-indigenous Cultural Heritage

There are no known sites of NICH at East Trinity listed on Federal or Queensland registers.

Parts of East Trinity were used by Chinese market gardeners in the late 1800s/early 1900s. Remains of an old tramway used to load produce is still evident on site. Between 1971 and 1975 the 700 ha of the estuarine wetland area at East Trinity was drained by the construction of a bund wall and floodgates at Hill and Firewood creeks in order to grow sugar cane on the resultant land. The bund wall and tramway remains may have some local heritage significance.

D.6.10.2 Indigenous Cultural Heritage

The indigenous history of the Cairns region is rich, and its environs have been extensively used by Aboriginal people and continue to hold cultural significance. Consultancies relating to the proposed East Trinity Development of 1995 note Aboriginal sites were located:

- On the sand ridges in East Trinity; Pandanus resources site, deposit of shell fragments and stone flakes and an isolated flake
- In the West Trinity area; a modern shell scatter, two contemporary fishing and crabbing sites
- On Admiralty Island (two possible sites on a chenier)
- Along the Bund Wall (five shell scatters of possible recent origin).

There is very likely to be further unrecorded cultural heritage at the site.

Further Assessment required

Further consultation with Aboriginal parties (and likely archaeological surveys and negotiation of a Cultural Heritage Management Plan) would be required to determine the significance of the potential impact and whether this can be protected from harm through the avoidance or removal of items of significance.

D.6.10.3 Native Title

The Mandingalbay Yidinji people have been granted native title over coastal land immediately adjacent to the East Trinity site; this land would need to be traversed to gain access to East Trinity, and some infrastructure installed (e.g. landing areas, pumps and pipes).

Native title has been extinguished over the placement area as it was previously designated Freehold Land when purchased by CSR Sugar in 1974 (under the Act, native title is extinguished on Freehold Land). There is an Indigenous Protected Area (IPA) over the northern part of the site. IPAs do not have a formal legal framework in place and do not impact native title rights or public access; however, they allow indigenous people to work with government agencies to manage country. Under this agreement, the Mandingalbay Yidinji people have been actively engaged in management of East Trinity. They have indicated an interest in utilising the site for the development of cultural tourism.

Further Assessment Required

An Indigenous Land Use Agreement (ILUA) would need to be negotiated to access lands over which native title has been granted to the immediate west of the site. Consultation in regards to the IPA and ongoing management of the site would also be required.

D.6.11 Transport

Existing road traffic to and from the East Trinity general area is minimal, with the road used for local access purposes only. The only road access to the site is via Pine Creek Road, which links the Yarrabah community to the Bruce Highway, just south of Edmonton. The Cairns CBD is approximately 40 minutes' drive by road.

Whilst the majority of dredge material would be delivered to site by barge and pumping, material removed by a backhoe dredger would potentially be brought to site by road transport from temporary storage at the Port of Cairns.

Heavy vehicle movements to and from site would be generated mostly by the transport of material to prepare the site for placement (e.g. bundwall, geosynthetic liner) and for treatment purposes (e.g. lime for the treatment of ASS).

A high-level assessment of movements (Refer to **Chapter A2, Dredge Material Placement Options**) estimates that a total of 475,598 vehicle trips would be required, equating to 1,312 daily vehicle movements.

D.6.11.1 Potential Impacts

There is the potential for impacts to the external traffic network from an operational and safety perspective. These include:

- Operation of existing road network, which may require upgrades to cater for the additional vehicle movements along haulage routes
- Hazard and safety impacts to road users, particularly at:
  - Bruce Highway/Warner Road intersection
  - Warner Road and Pine Creek Roads
- Amenity and nuisance, including noise and dust to sensitive receptors along haul routes, particularly those along Pine Creek Road and Warner Road where traffic movement is currently minimal.

D.6.11.2 Further Assessment Required

Surveys of the existing road network to be traversed would be required to estimate background traffic levels. A more detailed design of the placement area would need to be developed to gain a more accurate estimate of likely traffic volumes. Traffic modelling would then be undertaken to understand the impact on the existing road network and road users and for recommending any upgrades. Based on the likely sources of lime material required for the treatment of ASS, route consideration and assessment would also be required.

Detailed air and noise modelling would also be required, as discussed in **Section D.6.7** and **Section D.6.8**.

D.6.12 Climate Change and Greenhouse Gases

D.6.12.1 Climate Change

Chapter B16, Climate Change and GHGs of this EIS provides information on climate change projections for the Cairns region. Should the site remain in its current state, it would be vulnerable to sea level rise and storm surge associated with a changing climate, as illustrated in **Figure D.6.3.1a**, **Figure D.6.3.1b** and **Figure D.6.3.2a**. Changes in temperature, rainfall and evaporation would also likely have an impact on the fauna and flora composition of the site and alter the existing hydrological regime.

Potential Impact

The conceptual design for the bund wall (refer to **Section D.5**) to hold the dredge material allows for protection from present day storm surge levels. This is reasonable should the site only be used for the placement of material for a limited time. Should use of the site be ongoing (i.e. beyond a 15 to 20 year time frame) additional measures to protect the site from sea level rise and storm tide inundation would need to be considered. Inundation of the site could occur more frequently, with the potential for placed material to be eroded during an event and enter Trinity Inlet if it does not have sufficient protection.

Further Assessment Required

Detailed modelling would be required to understand if placement of material at the site is an acceptable risk. The ***State Planning Policy 2014*** (State of Queensland, 2014) and the ***Coastal Hazard Technical Guide: Determining Coastal Hazard Areas*** (DEHP, 2013) both discourage development in coastal hazard areas in most circumstances unless the development can avoid or minimise adverse impacts to coastal resources. A detailed risk assessment would be undertaken that assesses whether the siting, layout and access of the placement area can avoid potential coastal hazards and minimise the risk to:

- Personal safety
- Damage to property to the site or other properties
- An increase in the severity of the existing coastal hazard
- The release of hazard materials
- Natural processes and existing landforms and/or vegetation.

D.6.12.2 Greenhouse Gases

In its present relatively stable state, East Trinity would be contributing very minimal amounts of greenhouse gases (mostly derived from fuel use for minor maintenance activities). As vegetation coverage has increased through rehabilitation practices, the site has likely been acting as a greenhouse sink, although no quantitative assessment has been undertaken to confirm this.

Potential Impacts

The placement of material at East Trinity would contribute relatively large quantities of greenhouse gases through the following activities:

- Burning of fuel in vehicle movements to and from site (refer to **Section D.6.12**)
- Removal of vegetation
- Burning of fuel in vehicle and other equipment used to treat the material and maintain the treatment area
- Pumping of material to site
- Disturbance of soils.

Further Assessment Required

The amount of GHGs attributed to placement of material and ongoing treatment and management should be quantified to gain an understanding of volume likely to be produced. Based on this, mitigation measures would be developed, focusing on ways to reduce vehicle movements, avoid vegetation loss and minimise soil disturbance through tillage/ treatment.

D.6.13 Health, Hazards and Emergency Management

A Health Impact Assessment has been undertaken (EnRisks, 2014) to ascertain the potential risks to human health posed by the placement of material at East Trinity (refer to **Appendix F** for the full Health Impact Assessment). Potential impacts to human health can be summarised as follows:

- Risk of traffic incidents on haul roads due to increased vehicular movements
- Risk to site workers from:
  - Inhalation or contact with harmful substances, including hydrated lime used to treat ASS
  - Contact with hazardous fauna species (e.g. crocodiles, snakes, etc.)
  - Contact with mosquitoes and/or biting insects which can have a variety of health risks ranging from irritation to ongoing illness (i.e. Ross River Fever)
- Risk to public health from the effects of lighting, noise or air pollution
- Risks to worker and public safety related to dredge material consolidation stage (e.g. risk of falling into unstable material).

Most of the potential impacts can likely be effectively managed through measures such as good communication, traffic management plans, health and safety plans, etc. The risk of most concern is that of members of the public illegally entering the site and falling into unstable material. East Trinity is isolated, and its size makes it difficult to effectively restrict public access. The current site managers' report regular illegal access to the site despite signage and fencing as it is a popular location for fishing/crabbing.

D.6.14 Cumulative and Consequential Impacts

Chapter B18, Cumulative Impacts Assessment of the EIS provides details of planned or existing projects that combined with the CSD project, may cause an impact on the environment. There are no additional known projects for consideration should placement at East Trinity proceed.

D.6.14.1 Cumulative Impacts

The proposed projects that are of sufficient scale that they could potentially have a significant interaction with works at East Trinity are the Aquis Resort to the north of Cairns (refer to **Chapter B18, Cumulative Impacts Assessment** for a detailed description of the project) and the Mount Peter Masterplan.

The Aquis Resort draft EIS reports the following assessment findings:

- The construction process (including ASS, agricultural contamination, and general soil and water issues) can be adequately managed by normal construction management techniques as committed
- The protection of 99 percent of the 53 ha of natural vegetation on site and its enhancement by a further 56 ha, together with the removal of five waterway barriers, will enhance on-site habitat and the connectivity provided by the site to the GBR and its catchment
- Increased traffic will be experienced on local Yorkeys Knob roads and the Captain Cook Highway north of Cairns
- A substantial construction workforce will be required
- The use of treated sewage effluent as a potable water substitute and the adoption of water sensitive urban design techniques will remove 133 t/a of sediment and nutrients when compared with the existing cane farm
- Water quality modelling of the lake and the receiving waters shows that water quality of the discharge is expected to be superior to that of Richters Creek into which it will be discharged
- 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 offshore than Cairns CBD buildings.

Based on these assessment outcomes, the cumulative impacts from the two projects are mostly not considered to be unacceptable or additively result in any unexpected cumulative impacts. There may be some level of amenity concerns (particularly related to traffic) across the Cairns region should both projects be undergoing construction in the same timeframe.

The Mount Peter Masterplan is an area of approximately 3330 ha to the south of Cairns where the majority of urban growth for Far North Queensland is to occur in the future. Its construction would be staged over a 20-to-30 year period and provide homes for approximately 40,000 people. There is no publically available information on the potential environmental impacts of the Mount Peter Masterplan, however, the sizable area is known to provide habitat for several nationally listed fauna species (Department of Environment, Water, Heritage and the Arts, 2010) and there is also potential for impacts to water quality of the Trinity Inlet catchment. Whilst the commencement date of construction works at Mount Peter is not known, it is possible that it could occur at the same time as activities at East Trinity and cause amenity and traffic issues within the southern Cairns corridor.

While no significant cumulative impacts have been identified at this time, the potential for these to occur would be addressed in more detail should assessment of a land placement option proceed for the CSD project.

D.6.14.2 Consequential Impacts

The most immediate consequential impact of using the East Trinity site will be the need to change its reserve status from environmental reserve to use as a DMPA. This process will need to include overcoming any native title constraints, obtaining agreements with traditional owners or other Aboriginal parties and determining a management entity/trustee for the land and associated conditions and requirements of management (likely in the form of an overall plan of management for the site).

The placement of dredge material at East Trinity also has considerable consequential environmental impacts due to the long dewatering and consolidation timeframes associated with the high fine content of the dredge spoil. Without advanced land treatment techniques (surcharge, wick drains) the site will take years and perhaps decades before it is suitable for any reuse or development. During this time it will need to be actively managed in accordance with the following measures:

- Ensure adequate containment of the material including during and following coastal storm events and heavy rainfall (auditing, strengthening or replacing bunds)
- Testing and monitoring of sediment quality including ASS and PASS
- Testing, monitoring and management of water quality discharges (particularly during and after high rainfall events)
- Developing an overall stormwater management plan or strategy for the site
- Testing and monitoring of groundwater levels, movement and chemistry
- Management of dust and odour
- Maintaining security and public safety for the site.

Overall, there is considerable uncertainty around the capacity to effectively manage a dredge material placement site of this scale and magnitude, with poor quality material in a terrestrial environment (e.g. not in a sub tidal reclamation) and in a tropical high rainfall area. Similar dredge material placement sites do occur but in much smaller capacities. Dredge material placement at Port Douglas has been successful but it deals with only a fraction of the volume of the project (tens of thousands of cubic metres per year) and is predominantly sand material with negligible acid sulfate potential.

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