CAIRNS SHIPPING DEVELOPMENT PROJECT

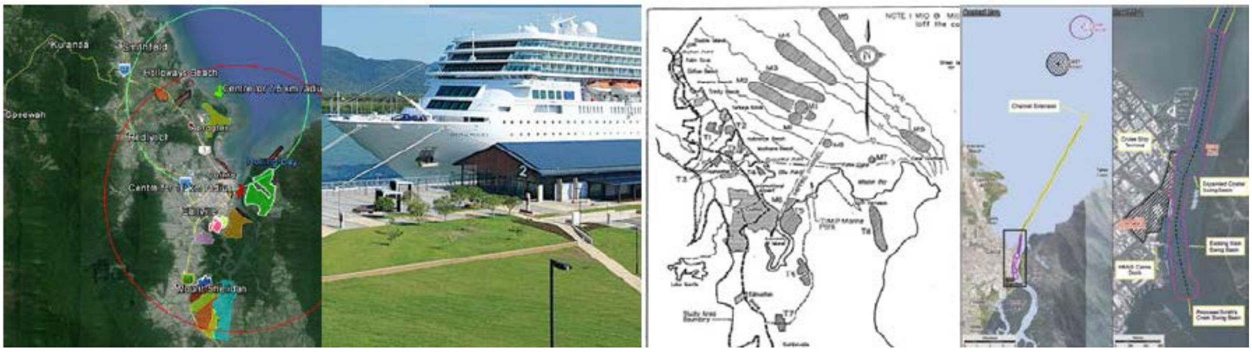
Revised Draft Environmental Impact Statement

APPENDIX I: Flanagan Consulting Group Options Study Report (2016)

CAIRNS SHIPPING DEVELOPMENT PROJECT

DREDGE MATERIAL PLACEMENT OPTIONS STUDY

MAY 2016



EXECUTIVE SUMMARY

1 PROJECT BACKGROUND

Ports North has produced a draft Environmental Impact Statement (EIS) in support of the Cairns Shipping Development Project (CSD Project). This draft EIS included an assessment of suitable placement sites for the material to be extracted from the main shipping channel to support the desired channel widening and deepening and included both terrestrial and marine placement sites.

Following a decision by the Queensland Government that placement of material from capital dredging projects in the Great Barrier Reef World Heritage Area would not be permitted, additional work was commissioned to redefine the dredging and land placement project. In particular this Dredge Material Placement Options Study was commissioned to expand the land placement site selection work documented in the draft EIS to inform the revised draft EIS proposed to be prepared for the CSD Project.

This describes the selection process used to create a preferred site (or a small group of sites) that can be assessed in detail as part of the EIS process. Four main tasks were involved:

- Site Selection (SS) – high level screening to define locations (Placement Precincts) where possible sites and types of sites could be located. The high level screening did not include existing legislative/planning constraints.
- Concept Design (CD) – preliminary concept design to produce a suite of potential sites within Placement Precincts. These are nominal sites representative of the Placement Precincts.
- Site Evaluation (SE) – evaluation of potential sites using Multi-criteria Analysis (MCA) techniques.
- Suitability Assessment (SA) – assessment of the findings of the SE task on a Placement Precinct level and further refinement through consideration of planning constraints, cost, and other considerations including strengths, weaknesses and any serious deficiencies to produce a shortlist of Placement Precincts for detailed assessment via the EIS.

2 STUDY OUTCOMES

1. Ports North identified two potential channel development options being widening only (430 000 m^3 in-situ material volume) and widening and deepening (860 000 m^3 in-situ material volume) for the first phase of the Options Study consideration. During the Options Study further work was undertaken on the channel design and it was determined that the project scope would be based on channel deepening and widening with an overall in-situ volume of 860 000 m^3.
2. These are solid measures. Placement sites need to have capacity to allow for bulking of the dredged material, as well as the substantial volumes of water associated with the dredging process (this can be up to four times the solid measure volumes). For this study, it was assumed that the bulking factor of 2.2 applies for land placement, i.e. the solid measure volume will bulk to 1.9 M m^3 and ideally all sites will be able to accommodate this volume and handle the associated water.
3. An assessment of the types of sites resulted in the following being considered:
   - existing voids (former sand quarries in the Barron River delta)
   - reclamation (beneficial reuse is required in order to comply with the *Sustainable Ports Development Act 2015* (Qld))
   - terrestrial (treatment of ASS is required on all sites and tailwater on some).

4. A site selection (SS) process was undertaken that involved a high level filtering of the Cairns district based on four attributes within the adopted 'triple bottom line + performance' hierarchy (i.e. *Cost*, *Environmental*, *Performance*, and *Social*) as identified by the corresponding prefix (i.e. E = Environmental):
   - E1 – Maximum elevation
   - E2 – Barron River flooding
   - P1 – Maximum transport distance
   - S1 – Remoteness from incompatible land use.
5. There were no *Cost* attributes as cost was not considered relevant to SS.
6. A composite map was produced showing areas where suitable placement sites could be located. This showed there are five available Placement Precincts (**Figure 1**), namely:
   - **Barron Delta.** The Barron Delta Placement Precinct is highly constrained by Barron River flooding and potentially acceptable placement options are restricted to existing voids, existing bunded areas already compliant with the flood code, and new voids.
   - **Cairns Bay.** The Cairns Bay Placement Precinct covers the protected waters adjacent to the Cairns Esplanade between the Ellie Point in the north and Bessie Point in the south. It extends seaward to approximately low water. This area contains potentially acceptable sites for various types of sub-tidal reclamation.
   - **Trinity Inlet East.** The Trinity Inlet East Placement Precinct contains land east of Trinity Inlet and bounded by Pine Creek Road. This area is locally known as East Trinity and provides opportunities for a number of possible terrestrial placement options on different types of land.
   - **Trinity Inlet West.** The Trinity Inlet West Placement Precinct includes Admiralty Island and land adjacent to Smiths Creek south of the Portsmith industrial area. This provides opportunities for both terrestrial and reclamation options.
   - **Trinity Inlet South.** The Trinity Inlet South Placement Precinct includes a suite of possible sites on cane land south of Trinity Inlet.
   - **Yarrabah.** The Yarrabah Placement Precinct includes two possible sites on unoccupied land south at Yarrabah.
7. Within these Placement Precincts, locations for placement areas of various types were identified and this resulted in 14 nominal sites consisting of (**Figure 2**):
   - two existing voids on the Barron delta
   - two existing bunded areas on the Barron delta
   - three reclamation sites, two in Cairns Bay (beneficial reuse of bird habitat) and one in Trinity Inlet (beneficial reuse as a foundation for future additional reclamation for port use)
   - seven terrestrial sites east, west and south of Trinity Inlet and at Yarrabah.
8. Some of the above sites are typical of a suite of potential sites. In particular:
   - although the two voids in the Barron Delta Placement Precinct are existing, it may be feasible to construct new voids that would be similar in performance
   - the three Trinity Inlet East sites (Sites 10, 11, 12) are three examples of many possible sites that could be located at East Trinity
   - the cane farm site (Site 13) is one of many placement sites that could be located on cane land south of Trinity Inlet at the limit of practical pumping.

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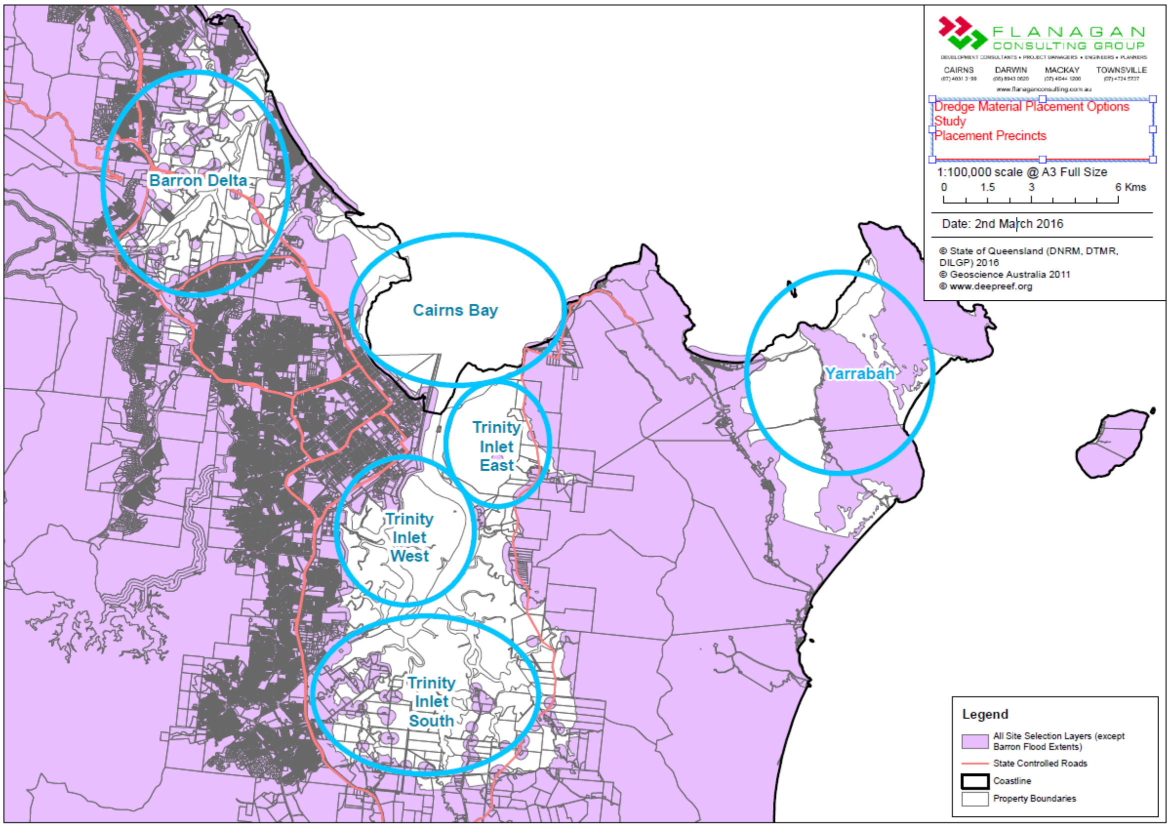

Figure 1 Placment Precincts.

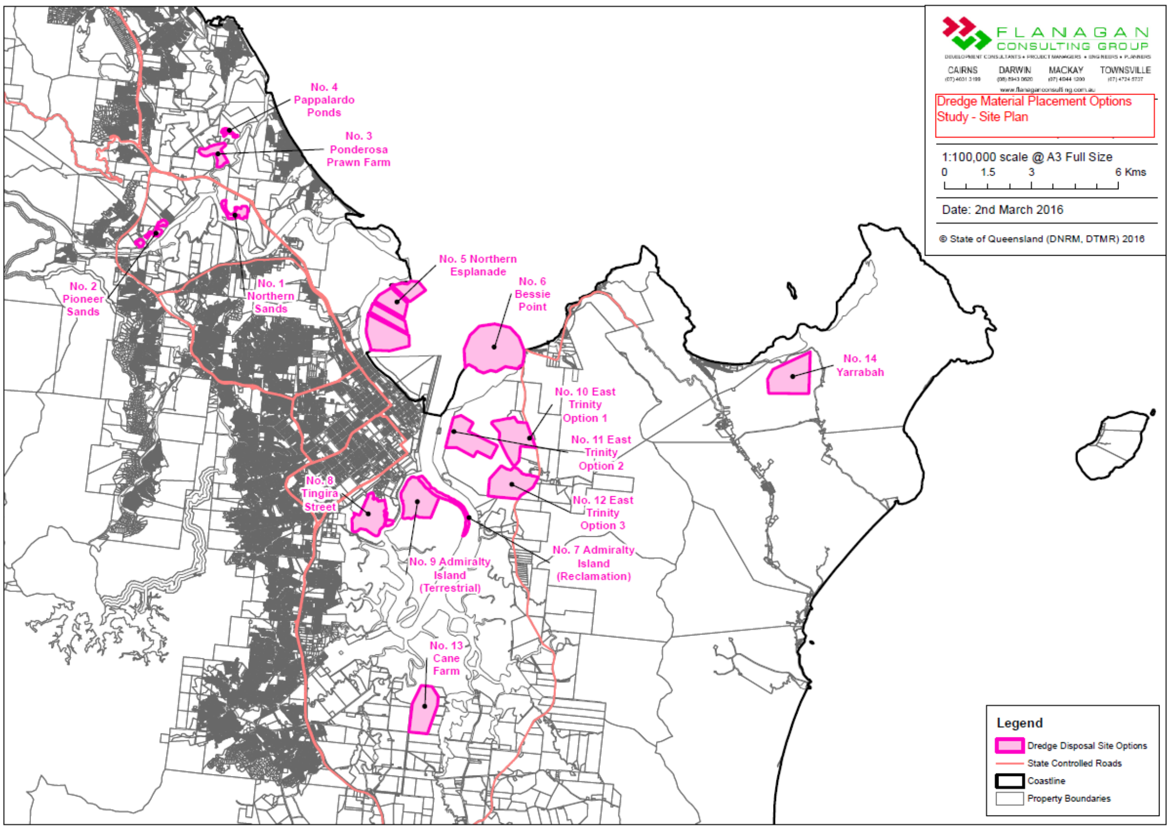

Figure 2 Site Plan.

9. Concept designs were undertaken for the purposes of identifying available placement volume, required treatment and tailwater handling areas (where required), spoil delivery and tailwater discharge infrastructure (where required) and footprint for the purposes of measuring impacts (e.g. clearing) for scoring in the site evaluation (SE) process.

10. Placement volume was not included as a site selection attribute and was measured separately. While the SC process sought to create projects on sites with the target placement volume of 1.9 M m^3, this was not always possible. There are four different situations for placement capacity:
    - Void – the volumes of existing voids are already determined. While these voids could be enlarged, this has not been considered at this time. The two voids (Site 1 Northern Sands and Site 2 Pioneer Sands) have volumes between 50% and 75% of the bulked up capacity. In the case of establishing a new void, this would be constructed such that it provided 100% of the capacity.
    - Reclamation – sites were designed to accommodate disposal of the target volume. The three reclamation sites have volumes between 52% and 100% of the bulked up capacity. The Northern Esplanade (Site 5) and Bessie Point (Site 6) sites can be constructed to provide 100% of capacity whereas the Admiralty Island reclamation (Site 7) is constrained by the presence of the adjacent waterway.
    - Terrestrial: New sites were designed to accommodate the target volume by storage of dredged material, management of tailwater, and treatment of dredged material where required. The six terrestrial sites have volumes between 53% and 100% of the bulked up capacity. Site 8 (Tingira Street) may be able to be enlarged to reach 100% and in any case may be suitable if used in combination with other sites or if placement is in stages that allow some consolidation of the initial placement before the subsequent material is added.
    - Terrestrial: The volumes of existing bunded areas on the Barron delta (Site 3 – Ponderosa Prawn Farm and Site 4 – Pappalardo Ponds) are already determined. The two sites have volumes between 10% and 13% of the bulked up capacity.

11. All sites were evaluated using the SE process. This involved the 'triple bottom line + performance' hierarchy as used in the SS process, but with an expanded suite of attributes:
    - Cost
        - C1 – Cost
    - Environmental
        - E1 – Surface Water
        - E2 – Groundwater
        - E3 – Biodiversity Values
        - E4 – Acid Sulfate Soil
        - E5 – Birdstrike
        - E6 – Coastal Hazards
    - Performance
        - P1 – Pumping Head
        - P2 – Placement Capacity
        - P3 – Tailwater Discharge
        - P4 – Ground Conditions & Stability

- Social
  - o S1 – Remoteness from Incompatible Land Use [deleted]
  - o S2 – Important Agricultural Areas
  - o S3 – Traffic
  - o S4 – Appropriate tenure (ownership).

12. Sites were scored for each attribute and raw scores were standardised to a scale of 0 to 1, where 1 represented the 'best' site (this includes cases where a high score is warranted directly by the scoring in the case of a 'benefit' attribute or where a 'cost' attribute did not apply to a site). The results were discussed on an attribute-by-attribute basis.

13. Standardised scores were accumulated on a number of levels to test sensitivity:
    - overall (unweighted)
    - by non-cost criteria (e.g. *Environment*, *Performance*, *Social*)
    - overall (criteria weighted based on a suite of technical and non-technical profiles).

14. Because many of the 14 sites were nominal projects selected within the various Placement Precincts, the Suitability Assessment considered performance on a Placement Precinct basis considering the planning constraints, costs and other considerations including strengths, weaknesses and any serious deficiencies and made recommendations as to which of these should proceed to the EIS.

3 CONCLUSIONS

The following conclusions are made:

1. The site selection process identified six placement precincts with fourteen individual sites identified within these precincts.

2. The fourteen identified sites were evaluated using Multi-Criteria Analysis techniques. Ignoring cost, existing legislative and planning constraints and without weighting the evaluation determined that:
   - Voids – the void sites on Northern Sands (Site 1) and Pioneer Sands (Site 2) scored well on most attributes with the main weaknesses being pumping head and the fact that they are in private ownership. Northern Sands does not quite have enough capacity (75% of target) to score well in this regard and, similarly, Pioneer Sands has only 50% capacity. A new void would be constructed to deliver 100% of the capacity.
   - Reclamation – As reclamation sites in seawater, Northern Esplanade (Site 5), Bessie Point (Site 6), and Admiralty Island Reclamation (Site 7) scored well on tailwater and ground-related issues and, due to close proximity to the channel, have minimal pumping head. They score poorly on several environmental attributes and coastal hazards. It was assumed that Site 7 cannot achieve the target placement capacity (52%) due to waterway restrictions.
   - Terrestrial – The Admiralty Island (Site 9) scored well on most attributes but poorly on biodiversity, acid sulfate soil and ground conditions. It is well-located with respect to pumping head and traffic and is under state control. The best East Trinity site (Site 11) scored similarly to Site 9 but, whilst being able to provide the required capacity and having favourable biodiversity and pumping head scores, its attractiveness is diminished by acid sulfate soil, ground stability, traffic, and to a lesser degree, coastal hazards.

3. Separate analyses (sensitivity testing) were undertaken with the result that the top ranking sites remained the top level sites after the sensitivity testing although the order changes depending on weighting.

4. Weighting of attributes based on technical and non-technical sensitivity profiles changed the outcome slightly but not significantly. Overall, the sensitivity testing demonstrates that the SE process is relatively robust and reveals many learnings that can be applied to the final site selection based on overall suitability. The site with the most volatility in performance was Tingira Street (Site 8) which dropped six positions from the *Technical* profile to the *Cost* profile and five for *Environment.*

5. The overall suitability of the placement precincts was assessed by considering beneficial reuse, and site feasibility and suitability. This process considered the planning constraints, costs and other considerations including strengths, weaknesses, and any serious deficiencies.

6. The suitability assessment determined that:
   - Barron River delta voids score well due to their relatively low infrastructure costs (they require simply delivering and placing material in existing holes) and are attractive in that they are not subject to Barron River flooding, are remote from storm surge and tsunami effects, and do not have existing land uses that would be deleteriously affected by placement (the 'lakes' would remain and just be shallower). Management of groundwater and tailwater would be required.
   - The nominal reclamation options considered have excellent performance due to proximity to the channel (i.e. minimal pumping head) but suffer from surface water and biodiversity impacts and coastal hazards. Beneficial reuse is a challenge in the case of the Northern Esplanade and Bessie Point sites (Sites 5 and 6) where net gain in habitat value would be difficult to achieve. Site 7 (Admiralty Island Reclamation) suffers from capacity limitations and lack of a demonstrated need for the reclaimed land.
   - The nominal terrestrial options offer opportunities in terms of placement volume but all require treatment of placed material and tailwater. Environmental performance varies depending on the site in question but in all cases land placement will replace existing values of some sort (biodiversity or agricultural) and possibly involve management of in-situ soils and groundwater.

7. The suitability assessment determined that the following precincts warranted further investigation:
   - **Barron Delta Placement Precinct**: Site 1 possibly expanded and or in conjunction with Site 2 or a new void.
   - **Trinity East Placement Precinct**: a site to be determined based on impact avoidance and minimisation and the opportunities and constraints considered in Sites 10, 11 and 12.

8. Beneficial reuse of terrestrial bunded sites is problematic in that it involves:
   - production of sites that could take 30 years to be able to be developed without surcharge or the use of piled structures
   - a land mass of perhaps 60 ha that would have little in the way of commercial yield to offset development cost
   - a revenue stream that is so far into the future as to be almost insignificant in terms of net present value
   - land that is not in a location supported by regional planning.

9. The separate analysis of cost reveals that:
   - Voids can be filled at a unit rate of around \$91-\$96 / m^3 (solid measure).
   - The corresponding figure for terrestrial sites varies widely between \$109 and nearly \$130 / m^3.
   - Based on a total volume of 860 000 m^3 to be dredged the total cost for dredging, placement and treatment is estimated to be
     - Barron Delta Placement precinct: \$80 - \$86 Million
     - Trinity Inlet East Placement Precinct: \$90 - \$100 Million

- When the cost of landside infrastructure, other project costs including design and project management and an allowance for ongoing monitoring and offsets are added to the dredging costs, the overall project costs are estimated to be:
    - o Barron Delta Placement precinct $100 - $110 Million
    - o Trinity Inlet East Placement Precinct: $110 - $120 Million

10. The analysis revealed several opportunities associated with voids, including expansion of voids, construction of new voids, staging, and the export of treated material to 'free-up' terrestrial bunded sites for reuse may be feasible but this requires:
    - investigations into underlying geology / soils
    - market research to identify potential buyers of this material
    - concept design and impact assessment.
11. A terrestrial site could have spare capacity once tailwater has been discharged and consolidation is achieved. This may be able to be exploited such that the site could be used for future placement. However, any new placement would have tailwater that also needs treatment (unless material removed by backhoe is to be considered) but perhaps the opportunity exists for a small volume to be placed in a second or subsequent stage.
12. It is possible that, following treatment, the material within terrestrial bunded areas could have some use as a low grade fill. Even if the cost-recovery value is small, the fact is that the export of treated material will allow the bunded area to be reused for further placement should staging considerations allow. This may be cheaper than creating new sites.

4 RECOMMENDATIONS

Following consideration of the channel design and dredge material characteristics and volume required to achieve the desired channel profile and the conduct of a rigorous consideration of options for dredge material placement and feasible locations, the following recommendations are made:

1. Placement Precincts that should be further considered in the EIS are:
   - Barron Delta Placement Precinct based on utilising either Northern Sands (Site 1) (with further expansion or possibly in conjunction with Pioneer Sands (Site 2)) separately or possibly in conjunction with a new void in the Barron Delta Placement Precinct. The actual placement volume should be confirmed by survey.
   - Trinity Inlet East Placement Precinct using the best features of the East Trinity Sites 10, 11, and 12. This will require a planning exercise be undertaken during the early stages of the EIS to create the 'best' East Trinity site, based on a detailed understanding of opportunities and constraints of the precinct.
2. Early investigations be undertaken to confirm geotechnical properties of the dredge material including bulking factor, the proportion of ASS / PASS material, and the proportion of clay.

EXECUTIVE SUMMARY

1 INTRODUCTION 1

1.1 PROJECT BACKGROUND 1
1.2 VOLUME OF MATERIAL 1
1.3 NATURE OF MATERIAL TO BE DREDGED 3

2 DRAFT EIS APPROACH 4

2.1 OVERVIEW 4
2.1.1 Introduction 4
2.1.2 Typology 4
2.1.3 Site Criteria 5
2.1.4 Potential Sites 7
2.1.5 MCA Methodology 11
2.2 MCA RESULTS 13
2.3 NEED FOR ADDITIONAL WORK 13

3 DREDGE MATERIAL PLACEMENT OPTIONS STUDY APPROACH 14

3.1 STEPS IN THE PROCESS 14
3.2 DREDGE MATERIAL PLACEMENT OPTIONS STUDY METHODOLOGY 14
3.3 PROCESS 15
3.4 TERMINOLOGY 15
3.5 LEGISLATION AND PLANNING 16
3.5.1 Background 16
3.5.2 Current Situation 17

4 SITE SELECTION 18

4.1 INTRODUCTION 18
4.2 TYPOLOGY 18
4.2.1 Approach 18
4.2.2 Types of Sites 18
4.2.3 Types of Post-placement Use 19
4.2.4 Types of Post-placement Treatment 19
4.2.5 Results – Potential Types of Sites 19
4.2.6 Beneficial Reuse 22
4.2.7 Discussion 22
4.2.8 Acceptability of ASS Treatment 25
4.3 SITE SUITABILITY 25
4.3.1 Draft EIS Approach 25
4.3.2 Dredge Material Placement Options Study Rules 26
4.4 DETAILS OF RULES AND APPLICATION 27
4.5 RESULTS – INDIVIDUAL ATTRIBUTES 31
4.5.1 E1 – Maximum Elevation 31
4.5.2 E2 – Barron River Flooding 32
4.5.3 P1 – Maximum Transport Distance 33
4.5.4 S1 – Remoteness from Incompatible Land Use 34
4.6 RESULTS – COMPOSITE AREA 35
4.7 DISCUSSION 35

5 CONCEPT DESIGN 37

5.1 INTRODUCTION 37
5.1.1 Overview 37
5.1.2 The Draft EIS Approach 37
5.2 PARCEL IDENTIFICATION 37
5.2.1 Methodology 37
5.2.2 Minimum Volume / Area 38
5.2.3 Allowance for Watercourses 40
5.2.4 Allowance for Existing Roads 40
5.2.5 Results 40
5.2.6 Consultation with Affected Landowners / Managers 43
5.3 PRELIMINARY CONCEPT DESIGN 43
5.4 PLACEMENT VOLUME 43

6 SITE EVALUATION 45

6.1 INTRODUCTION 45
6.2 SE METHODOLOGY 45
6.2.1 Overview 45
6.2.2 SE Rules 46
6.3 DETAILS OF RULES AND APPLICATION 47
6.4 SCORING 58
6.5 EVALUATION METHODOLOGY 58
6.5.1 Scores 58
6.5.2 Standardisation 58
6.6 EXPLANATION OF ATTRIBUTES AND SCORING 59
6.6.1 C1 – Cost 59
6.6.2 E1 – Surface Water 61
6.6.3 E2 – Groundwater 64
6.6.4 E3 – Biodiversity Value 66
6.6.5 E4 – Acid Sulfate Soil 68
6.6.6 E5 – Birdstrike 71
6.6.7 E6 – Coastal Hazards 73
6.6.8 P1 – Pumping Head 75
6.6.9 P2 – Placement Capacity 78
6.6.10 P3 – Tailwater Discharge 80
6.6.11 P4 – Ground Conditions & Stability 82
6.6.12 S1 – Remoteness from Incompatible Land Use 85
6.6.13 S2 – Important Agricultural Areas 86
6.6.14 S3 – Traffic 87
6.6.15 S4 – Appropriate Tenure (Ownership) 88
6.7 RESULTS – NON-COST CRITERIA ONLY 91
6.7.1 Methodology 91
6.7.2 Non-cost Attributes Collated Overall 93
6.8 RESULTS – ATTRIBUTES COLLATED TO CRITERION LEVEL 93
6.8.1 Methodology 93
6.8.2 Cost 93
6.8.3 Environment 95
6.8.4 Performance 96
6.8.5 Social 97

7 WEIGHTING AND SENSITIVITY ANALYSIS 98

7.1 INTRODUCTION 98
7.2 ATTRIBUTE WEIGHTING – A TECHNICAL PROCESS 98
7.2.1 Introduction 98
7.2.2 Attribute Weighting 99
7.2.3 Results 100
7.3 CRITERION WEIGHTING – A 'VALUES-BASED' PROCESS 101
7.3.1 Introduction 101
7.3.2 Draft EIS Approach 101
7.3.3 Adopted Profiles 102
7.4 RESULTS 102
7.4.1 Details 102
7.4.2 Overall Comparison 106
7.5 DISCUSSION 109

8 SUITABILITY ASSESSMENT 110

8.1 METHODOLOGY 110
8.2 BARRON DELTA PLACEMENT PRECINCT 110
8.2.1 Precinct Overview 110
8.2.2 Summary of Performance 110
8.2.3 Beneficial Reuse 111
8.2.4 Serious Deficiencies 112
8.2.5 Other Considerations 112
8.2.6 Recommendations 113
8.2.7 Precinct Summary 114
8.3 CAIRNS BAY PLACEMENT PRECINCT 115
8.3.1 Precinct Overview 115
8.3.2 Summary of Performance 115
8.3.3 Beneficial Reuse 116
8.3.4 Serious Deficiencies 116
8.3.5 Other Considerations 116
8.3.6 Recommendations 117
8.3.7 Precinct Summary 117
8.4 TRINITY INLET WEST PLACEMENT PRECINCT 117
8.4.1 Precinct Overview 117
8.4.2 Summary of Performance 117
8.4.3 Beneficial Reuse 118
8.4.4 Serious Deficiencies 119
8.4.5 Other Considerations 119
8.4.6 Recommendations 120
8.4.7 Precinct Summary 121
8.5 TRINITY INLET EAST PLACEMENT PRECINCT 121
8.5.1 Precinct Overview 121
8.5.2 Summary of Performance 121
8.5.3 Beneficial Reuse 122
8.5.4 Serious Deficiencies 123
8.5.5 Other Considerations 123
8.5.6 Recommendations 123
8.5.7 Precinct Summary 123

8.6 TRINITY INLET SOUTH PLACEMENT PRECINCT 124
8.6.1 Precinct Overview 124
8.6.2 Summary of Performance 124
8.6.3 Beneficial Reuse 125
8.6.4 Serious Deficiencies 125
8.6.5 Other Considerations 125
8.6.6 Recommendations 125
8.6.7 Precinct Summary 125
8.7 YARRABAH PLACEMENT PRECINCT 125
8.7.1 Precinct Overview 125
8.7.2 Summary of Performance 125
8.7.3 Beneficial Reuse 126
8.7.4 Serious Deficiencies 126
8.7.5 Other Considerations 126
8.7.6 Recommendations 126
8.7.7 Precinct Summary 126
8.8 SUMMARY 126

9 CONCLUSIONS AND RECOMMENDATIONS 131

9.1 CONCLUSIONS 131
9.2 RECOMMENDATIONS 133

10 REFERENCES AND DATA SOURCES 134

List of Figures

Figure 1-1 2015 Channel Widening Proposal – 100 m outer channel with bend widening. 2
Figure 2-1 Land Placement Sites and Pumping Distances. 6
Figure 2-2 Sites investigated in 1990. 8
Figure 2-3 East Trinity site (draft EIS). 10
Figure 4-1 Typology of placement options. 20
Figure 4-2 E1 – Maximum elevation. 31
Figure 4-3 E2 – Barron River flooding. 32
Figure 4-4 P1 – Maximum transport distance. 33
Figure 4-5 S1 – Remoteness from incompatible land use. 34
Figure 4-6 Composite area. 35
Figure 4-7 Placement Precincts. 36
Figure 5-1 Candidate sites for site evaluation. 42
Figure 6-1 Assumed pipeline routes. 76

List of Tables

Table 2-1 Estimated Fill Capacities 7
Table 2-2 Draft EIS MCA assessment categories and criteria 11
Table 2-3 Draft EIS MCA description of scores 12
Table 4-1 Potential sites based on typology 21
Table 4-2 Disposal and treatment options 23

Table 4-3 Site selection rules 28
Table 5-1 Production rates for treatment 39
Table 5-2 Selected sites (parcels) 40
Table 5-3 Placement volume 43
Table 6-1 Site evaluation rules 48
Table 6-2 C1 – Cost Estimates 59
Table 6-3 E2 – Groundwater 64
Table 6-4 Regional ecosystem and other data VS Class 67
Table 6-5 E4 - Acid sulfate soils 69
Table 6-6 Actions for proposed land uses near an airport 71
Table 6-7 E6 – Coastal hazards 74
Table 6-8 P1 – Pumping head 77
Table 6-9 P2 – Placement volume 79
Table 6-10 P3 – Tailwater discharge 81
Table 6-11 P3 – Ground conditions & stability 83
Table 6-12 S3 – Traffic 87
Table 6-13 S4 – Appropriate tenure 89
Table 6-14 Site evaluation findings – standardised scores (non-cost attributes) 92
Table 7-1 Attribute weighting 99
Table 7-2 Draft EIS category weighting profiles 101
Table 7-3 Sensitivity profiles 102
Table 7-4 Results based on ranking 108
Table 7-5 Summary of rank by profile 109
Table 8-1 Summary of Placement Precinct suitability 127

List of Charts

Chart 6-1 C1 – Cost. 60
Chart 6-2 E1 – Surface water. 63
Chart 6-3 E2 – Groundwater. 66
Chart 6-4 E3 – Biodiversity values. 68
Chart 6-5 E4 – Acid sulfate soil. 70
Chart 6-6 E5 – Birdstrike. 72
Chart 6-7 E6 – Coastal hazards. 75
Chart 6-8 P1 – Pumping head. 78
Chart 6-9 P2 – Placement capacity. 80
Chart 6-10 P3 – Tailwater discharge. 82
Chart 6-11 P4 – Ground conditions & stability. 85
Chart 6-12 S2 – Important agricultural areas. 86
Chart 6-13 S3 – Traffic. 88

Chart 6-14 S4 – Appropriate tenure. 90
Chart 6-15 Attributes overall (less cost). 93
Chart 6-16 *Cost* attribute only. 94
Chart 6-17 *Environment* attributes only. 95
Chart 6-18 *Performance* attributes only. 96
Chart 6-19 *Social* attributes only. 97
Chart 7-1 Technical weighting. 100
Chart 7-2 Cost profile. 103
Chart 7-3 Environment profile. 104
Chart 7-4 Performance profile. 105
Chart 7-5 Social profile. 106
Chart 7-6 Comparison of all profiles. 107
Chart 8-1 Northern Sands. 110
Chart 8-2 Pioneer Sands. 110
Chart 8-3 Ponderosa Prawn Farm. 111
Chart 8-4 Pappalardo Ponds. 111
Chart 8-5 Northern Esplanade. 115
Chart 8-6 Bessie Point. 115
Chart 8-7 Admiralty Island Reclamation. 117
Chart 8-8 Tingira Street. 117
Chart 8-9 Admiralty Island. 118
Chart 8-10 East Trinity Option 1. 121
Chart 8-11 East Trinity Option 2. 121
Chart 8-12 East Trinity Option 3. 122
Chart 8-13 Cane Farm. 124
Chart 8-14 Yarrabah. 125

APPENDIX A **ATTRIBUTE MASTER LIST (WORKSHOP 2 FEBRUARY)**
APPENDIX B **RESULTS OF SITE SECTION**
APPENDIX C **CONCEPT DESIGNS FOR SITE EVALUATION**
APPENDIX D **RESULTS OF SITE EVALUATION**
APPENDIX E **COST ESTIMATE RATES AND ASSUMPTIONS**

Abbreviations and Acronyms

TERM	MEANING
ALC	Agricultural Land Classification
CD	Concept Design (i.e. as described in this report)
CSD Project	Cairns Shipping Development Project
DoE	Department of the Environment (Commonwealth)
DSDIP	Department of State Development Infrastructure and Planning
EVNT	Endangered, Vulnerable, or Near Threatened (plants or animals)
GBRWHA	Great Barrier Reef World Heritage Area
HAT	Highest Astronomical Tide
ILUA	Indigenous Land Use Agreement
LAT	Lowest Astronomical Tide
MCA	Multi-criteria Analysis
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
MSL	Mean Sea Level
NC Act	*Nature Conservation Act 1992* (Qld)
SA	Suitability Assessment (i.e. as described in this report)
SE	Site Evaluation (i.e. as described in this report)
SPP	State Planning Policy
SS	Site Selection (i.e. as described in this report)
TIMP	Trinity Inlet Management Plan
VM Act	Vegetation Management Act 1999 (Qld)

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

Ports North has produced a draft Environmental Impact Statement (EIS) in support of the Cairns Shipping Development Project (CSD Project). This draft EIS (Ports North 2014) included an assessment of suitable placement sites for the material to be extracted from the main shipping channel to support the desired channel widening and deepening and included both terrestrial and marine placement sites.

Following a decision by the Queensland Government that placement of material from capital dredging projects in the Great Barrier Reef World Heritage Area would not be permitted, additional work was commissioned to redefine the dredging and land placement project. In particular this Dredge Material Placement Options Study was commissioned to expand the land placement site selection work documented in the draft EIS to inform the revised draft EIS proposed to be prepared for the CSD Project.

This Dredge Material Placement Options Study was commissioned to inform the revised draft EIS proposed to be prepared for the CSD Project.

It describes the selection process used to create a preferred site (or a small group of sites) that can be assessed in detail as part of the EIS process. Four main tasks were involved:

- Site Selection (SS) – high level screening to define locations (Placement Precincts) where possible sites and types of sites could be located. The high level screening did not include existing legislative/planning constraints.
- Concept Design (CD) – preliminary concept design to produce a suite of potential sites within Placement Precincts. These are nominal sites representative of the Placement Precincts.
- Site Evaluation (SE) – evaluation of potential sites using Multi-criteria Analysis (MCA) techniques.
- Suitability Assessment (SA) – assessment of the findings of the SE task at a Placement Precinct level and further refinement through consideration of planning constraints, cost, and other considerations including strengths, weaknesses and any serious deficiencies to produce a shortlist of Placement Precincts for detailed assessment via the EIS.

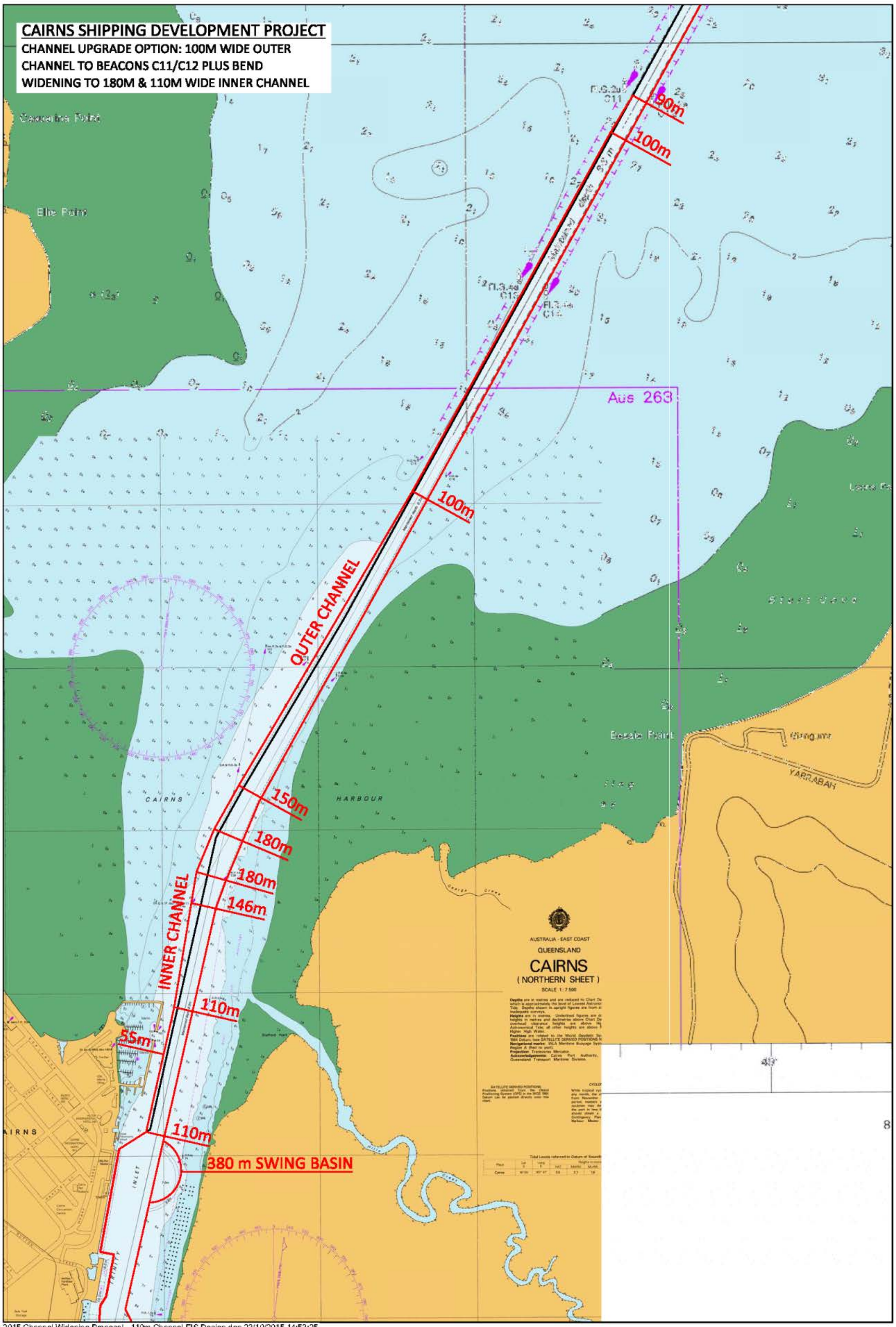
Reference is made to the draft EIS MCA process and findings. Where possible, the methodology used in this Dredge Material Placement Options Study is built upon that used in the draft EIS or adapted as necessary.

1.2 VOLUME OF MATERIAL

Ports North has determined that there are two dredging scenarios to be considered:

- Scenario 1: widening only (430 000 m^3 in-situ material volume).
- Scenario 2: widening and deepening (860 000 m^3 in-situ material volume).

Details are shown on **Figure 1-1**. These are in-situ material volumes between current maintenance target dredging depths and the enlarged channel target depths including insurance depth and appropriate minimal over-dredging allowances. Placement sites need to be sized to allow for the bulking of the dredged material, as well as the substantial volumes of water associated with the dredging process (this can be up to four times the solid measure volumes). For this study, it is assumed that the bulking factor of 2.2 applies for land placement, i.e. the solid measure volume will bulk to 1.9 M m^3 due to the disturbance of the material and addition of water at the dredge drag head and addition of water to prime and flush the shore delivery pipelines. Ideally, all sites will be able to accommodate this volume and handle the associated water.



2015 Channel Widening Proposal - 110m Channel EIS Design.dgn 23/10/2015 14:53:25

Figure 1-1 2015 Channel Widening Proposal – 100 m outer channel with bend widening.

Once tailwater is discharged, the volume reduces and so for sizing treatment areas a bulking factor of 1.0 has been assumed.

The rate of delivery of the dredged material is expected to vary and this is still under consideration. Should the dredging be undertaken in stages, then the first material placed will undergo some volume reduction by settlement before the subsequent placement. Under this circumstance, a lesser overall placement volume will be required.

1.3 NATURE OF MATERIAL TO BE DREDGED

A summary of test results of the dredged material and other geotechnical aspects has been prepared as part of this Dredge Material Placement Options Study. In summary, the report (Golder Associates 2015) reveals that:

- the soils consist of approximately 10% sand and approximately 90% silt. There are some clays present in some parts of the channel and this could represent up to 10% of the total dredge material volume.
- the material has ASS / PASS properties that in most circumstances will require lime treatment
- delivery to land placement sites will involve large volumes of water that will need to be returned to the ocean
- feasible placement options include disposal into holding ponds for subsequent drying and lime treatment, as well as reuse as controlled or 'engineered' fill for land development.

Certain aspects of the dredge material will require assessment in the EIS. These include:

- Bulking factor (assumed at 2.2 for this report).
- Proportion of ASS / PASS material. Note that there can be expected to be some self-neutralisation potential and PASS variability with material depth. Also, the nature of the material and dredging process makes PASS and non-PASS inseparable and therefore an overall lime treatment rate will need to be determined.
- Details of solid material (clay) that is unsuitable for pumping and consideration of alternative excavation methods (e.g. barge-mounted excavator or grab-bucket) and placement techniques.

2 DRAFT EIS APPROACH

2.1 OVERVIEW

2.1.1 Introduction

The CSD Project draft EIS (Ports North 2014) included a Multi-criteria Analysis (MCA) of a suite of marine and terrestrial sites. The following is a brief synopsis of the approach taken (based on Chapter A2 of the draft EIS). In general it includes direct extracts from the document.

The MCA assessment process, including derivation of criteria and adopted weightings for both land and marine placement options, was developed and agreed upon in consultation with key project stakeholders and government regulators at a two-day stakeholder workshop held in February 2014. This workshop included representatives from regulatory agencies (Great Barrier Reef Marine Park Authority (GBRMPA), Department of Environment (DoE), the Department of Environment and Heritage Protection (DEHP) and the Department of State Development, Infrastructure and Planning (DSDIP)), Ports North, and members of the study team (Arup BMT WBM).

The documentation of the process in the draft EIS proceeded on the basis of examining the properties of the 'potential' sites (i.e. those subjected to the MCA). The draft EIS states that potential sites were selected based on previous dredge material placement studies in Cairns. Five potential placement sites were identified for further assessment.

Although it is obvious that a raft of site suitability criteria was used in selecting the shortlisted potential sites, the high level screening that this involved was not specifically documented. As the methodology for this Dredge Material Placement Options Study involves a formal high level screening, the draft EIS MCA approach as described below is re-presented to tease out the high level work implicit in the earlier work.

Accordingly, the draft EIS work is described below in terms of:

- typology (i.e. the types of sites considered)
- site suitability criteria (i.e. the desirable or essential features of potential sites)
- MCA methodology
- MCA results.

2.1.2 Typology

Inherent in the above MCA was division of potential sites into a number of types and sub-types based on certain characteristics, namely (examples from draft EIS in brackets):

- placement only (East Trinity, Admiralty Island)
- future development:
  - urban use (Cane Land Development, East Trinity)
  - development (airport expansion) use (Airport)
  - land reclamation development / open space use (Esplanade, East Trinity).

Although this typology is described late in the MCA documentation (i.e. as findings), it was a fundamental part of the site selection process.

2.1.3 Site Criteria

a) *General Features*

The MCA states that each acceptable land placement site would need to be capable of providing an area to dewater material and establish associated infrastructure (including transport access). This area would be required to have the following general characteristics:

- be on relatively flat land
- be close to existing tidal drainage or creek lines to enable saline tailwater discharge
- be distant from areas subject to coastal erosion or storm surge, or capable of being otherwise engineered to be resistant to such impacts
- be within a reasonable distance (<11 km) to enable pumping of the dredged material from a mooring site (**Figure 2-1**)
- secure dewatering areas need to be fenced and made secure as there are inherent public safety issues with the soft nature of the material while it is in the process of dewatering.

The draft EIS (sA.2.8.3) states that:

> The investigation did not identify any unconstrained sites other than those above however, within reasonable proximity of the project area that could provide the required area of undeveloped land to accommodate the volume of dredge material from the Project. (A2: p22)

This implies a further two essential features:

- undeveloped land
- adequate storage area.

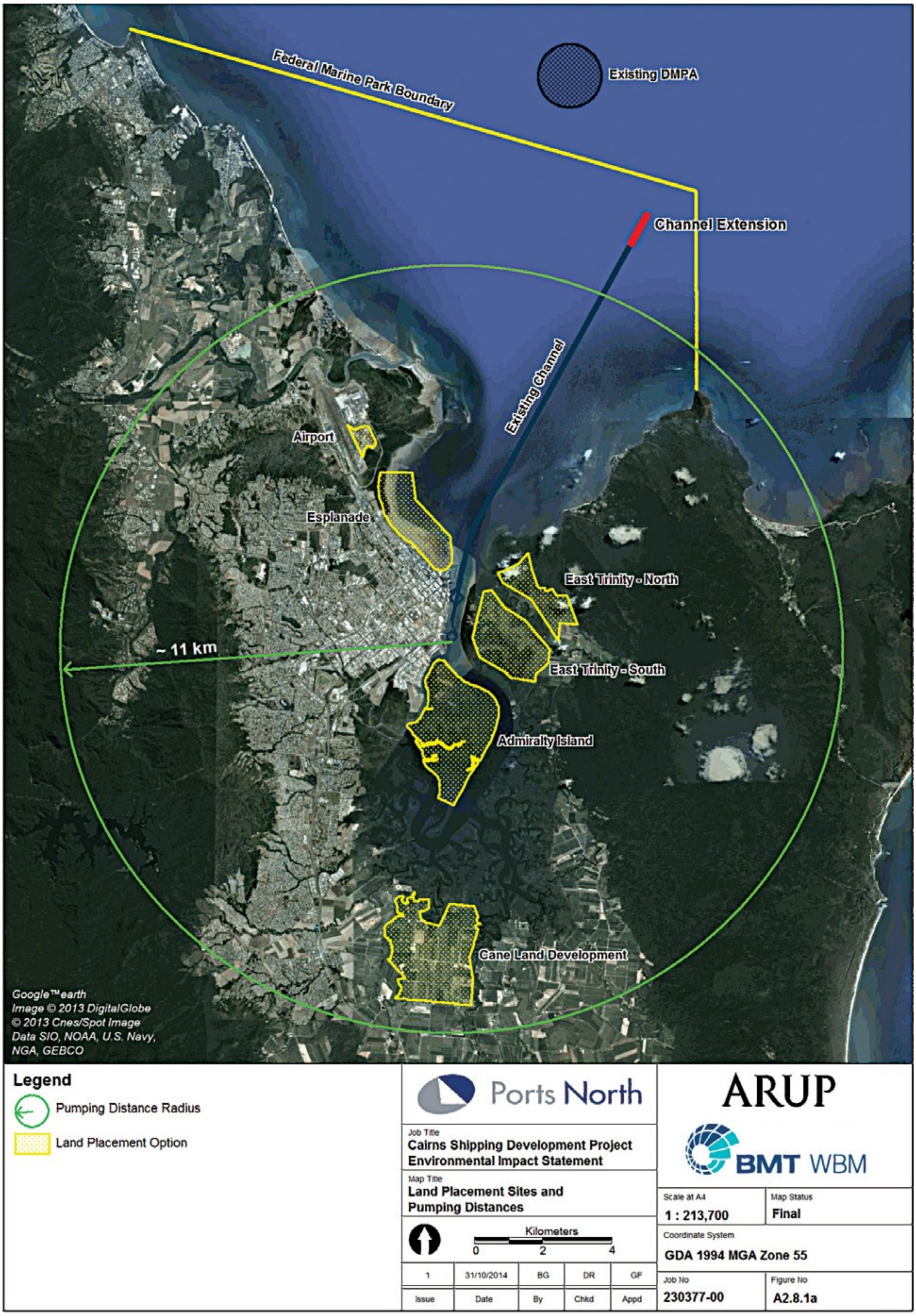


Figure 2-1 Land Placement Sites and Pumping Distances.

Source: Ports North (2014) Figure A2.8.1a.

b) Placement Site Capacity

In the draft EIS, it was assumed that there was a fixed volume of dredged material for placement. This was derived from the net channel excavation volume for the CSD Project, grossed up to reflect the large volume of water that would accompany this material as a consequence of the dredging / transport operation. In total, 4.4 M m^3 in-situ material was proposed to be dredged, comprised of:

- 3.57 M m^3 of very soft to soft clays and silts
- 0.46 M m^3 of firm clays
- 0.32 M m^3 of stiff clays.

The additional volume of accompanying water was assumed to vary depending on pumping distance. The assumed volumes are shown in **Table 2-1**.

Table 2-1 Estimated Fill Capacities

Site	Material	Volume (m^3)
East Trinity, Admiralty Island, Esplanade	Very soft to soft clay	3,570,495
	Process water for very soft to soft clay	3,570,495
	Firm clay	459,405
	Process water for firm clay	939,111
	Water for flushing	1,179,951
	Stiff clay	320,100
	Total	**10,039,557**
Cane Land Development	Fill volume at other sites	10,039,557
	Additional water for longer pump distance	4,800,000
	Total	**14,839,557**

Source: Ports North (2014) Table A2.8.3.1a.

This analysis shows that, with a contingency allowance (based on the above figures this was 15%), the following site fill capacities were required:

- East Trinity, Admiralty Island, and the Cairns Esplanade: 12 M m^3
- Cane Land Development: 17 M m^3.

For the MCA assessment, the Airport site option includes placement of the stiff clay dredge material only at the airport site (0.3 M m^3) and the remainder of material (4.1 M m^3) placed at the Esplanade site.

c) Environmental and Planning Criteria

Environmental and planning constraints were not specifically used to select potential sites – rather they were used in the scoring process (i.e. as per **Table 2-2**).

2.1.4 Potential Sites

The draft EIS included reference to previous reports and in particular Connell Wagner (1990, 1992). This included two of the sites ultimately selected for the draft EIS MCA. Refer **Figure 2-2**.

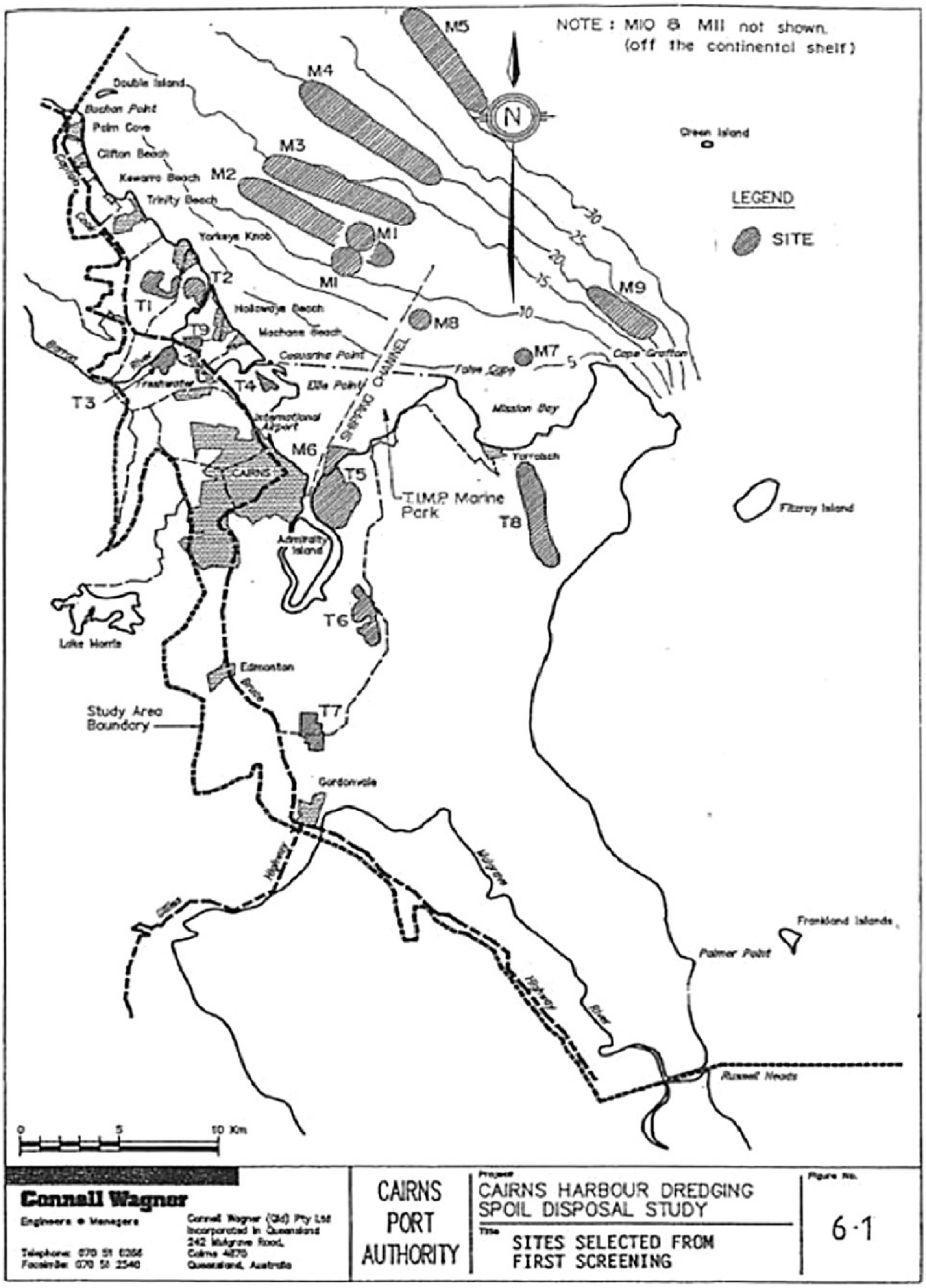


Figure 2-2 Sites investigated in 1990.

Source: Connell Wagner (1990).

After consideration of the limitations imposed by treatment / end use considerations, five potential placement sites were identified for further assessment. Each of the five placement sites, shown on **Figure 2-1**, could potentially be used for either 'disposal' or 'future development' purposes.

The EIS project team assessed the most appropriate end use for each of the sites below and the concept design for each site was developed accordingly:

- East Trinity Site – Connell Wagner site T5 – potential for both a placement-only site or a future development (urban use) site
- Cane land development near to Connell Wagner site T7 – most suitable for future urban use
- Admiralty Island – most suitable for 'placement only' site. Future development of this site would require major geotechnical improvements which would be a separate project
- Airport – potential for future expansion of existing development area
- Esplanade – potential for land reclamation for future development or use as public open space.

Thus the EIS considered five sites and development / placement sub-options for two, leading to seven options overall.

It should be noted that the assessment process outlined below could potentially be applied to other sites that meet the site characteristics, i.e. the cane land development site also represents potential placement areas with similar characteristics.

However, the investigation did not identify any unconstrained sites other than those above within reasonable proximity of the project area that could provide the required area of undeveloped land to accommodate the volume of dredge material from the Project.

In order to understand the spatial requirements for each site, a concept design for each of the five land placement areas was developed. An example is provided as **Figure 2-3**.

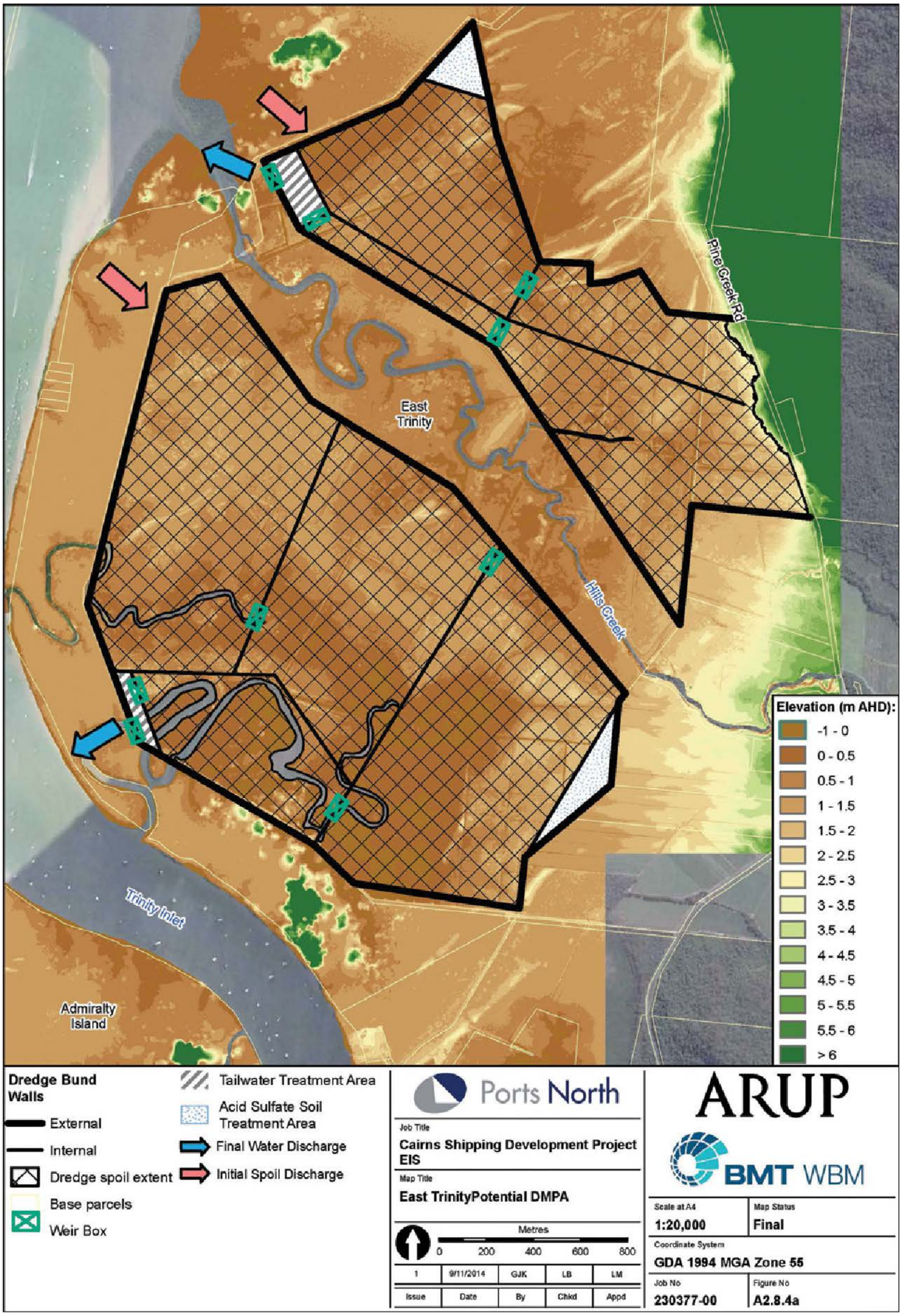


Figure 2-3 East Trinity site (draft EIS).

Source: Ports North (2014) (Figure A2.8.4a).

2.1.5 MCA Methodology

a) Categories and Criteria

The broad assessment categories used for land and marine placement options were similar (environmental, social, legislative/planning, economic/logistical). However, the criteria within these categories differed slightly as some are applicable to land options but may not be applicable to marine options, and vice versa. The draft EIS MCA was undertaken separately for marine and terrestrial sites. Categories and criteria used for land and marine options are presented in **Table 2-2**.

Table 2-2 Draft EIS MCA assessment categories and criteria

MCA Category	MCA Criteria	
	Land Placement	Marine Placement
Environmental	Water quality impacts (tailwater and groundwater) Habitat values/habitat loss, Acid Sulfate Soil (ASS) issues, Air/noise/ odour impacts, Pest introduction/attraction	Water quality impacts/Re-suspension potential Sensitive ecological receptors and world heritage values Seabed substrate and benthic ecology
Social	Cultural heritage/native title Traffic Community benefit Amenity issues	Fisheries Amenity and tourism
Legislative/Planning	Land use planning/approvals/tenure	Marine Park Planning
Economic/Logistics	Area available/volume able to be accepted Pumping equipment and distance Impact on length of dredge campaign Costs	Bathymetry/capacity Shipping and navigation Distance from dredge area Costs

Source: Ports North (2014) Table A2.2.1.1a.

b) MCA Scoring

The MCA process assessed a range of options by assigning scores and weightings to criteria, with the weightings representing the importance of each criterion. The objective was to identify a preferred land placement site and a preferred marine placement site.

The scoring involved a semi-quantitative/qualitative ratio scoring system that assigns scores to each option based on the performance against the other options. That is, a score of 4 indicates that the option is two times better than an option with a score of 2. This is in contrast to an ordinal scoring method, which simply assigns a ranking of options (e.g. 1, 2, 3, 4, 5, etc.). Where possible, quantitative data was used to derive scores for each option. Where quantitative data was not available, a qualitative assessment was undertaken to derive scores.

The scoring method assigned scores between one and six depending on performance. A score of one represents the worst possible performance while a score of six represents excellent performance. The scoring system provided three scores in the poor performance range and three scores in the good performance range. That is, scores of 1 to 3 generally represented poor performance where adverse impacts are likely and not easily managed, while scores of 4 to 6 generally represented good performance where any adverse impacts are either minimal or readily managed. Descriptions of these scores are provided in **Table 2-3**.

Table 2-3 Draft EIS MCA description of scores

Score	Description of Scores
1	Worst possible performance – e.g. unacceptable, unmanageable adverse impacts on criterion.
2	Very poor performance – e.g. long-term adverse major impacts on criterion, not easily managed
3	Poor performance – e.g. short-term adverse impacts on criterion, not easily managed
4	Sound performance – e.g. manageable short-term adverse impacts on criterion
5	Good performance – e.g. minor short-term adverse impacts on criterion
6	Excellent performance – e.g. no impacts on criterion

Source: Ports North (2014) Table A2.2.1.1b.

Although the specific description of scores in **Table 2-3** varied slightly for each criterion, the rating will remain consistent, i.e. 1 = worst performance and 6 = excellent performance. In regards to economic criteria where costs were assessed, each option was scored based on the relative economic performance compared to other options. For example, the most cost-effective solution was scored high, while the least economical option was scored low.

In general, scoring was separated between terrestrial and marine sites, although in some cases there was cross-fertilisation. An example was length (duration) of dredging campaign where the score of 6 was assigned to the marine option on the basis that this was shorter than all terrestrial options, and this was the measure by which terrestrial options were scored (the best was scored at 5).

MCA scoring was initially undertaken by technical experts from the core EIS project team. The MCA process and scoring was presented and discussed at the two day stakeholder workshop. Prior to this workshop, participants were provided with the presentation material and feedback was sought and received from participants during the workshop.

Once the workshop was complete, and final scores had been assigned, the weighted scores were calculated based on category and criteria weightings. Feedback on criteria weightings were received from stakeholders during the two day workshop mentioned above. Finally, a sensitivity analysis was undertaken with different category weightings to determine whether this has any significant effect on the final ranking of options. This is discussed further in **Chapter 7**.

2.2 MCA RESULTS

The draft MCA describes the scoring process for each MCA criterion (**Table 2-2**) for terrestrial sites and a sensitivity analysis based on even weighting and four category-based weighting profiles. It concludes that, depending on the weighting given to each category, the following options were preferred:

- Even weighting: East Trinity (develop and placement options).
- Environment: East Trinity (develop).
- Social: East Trinity (develop).
- Legislative/Planning: East Trinity (develop and placement options).
- Economic/Logistics: East Trinity (placement).

The sensitivity analysis shows that the East Trinity development option still scores well regardless of weighting. The exception to this is when the weighting is biased towards the economics category, where the East Trinity placement option scores slightly better due to its lower treatment costs.

2.3 NEED FOR ADDITIONAL WORK

The draft EIS concluded that, overall, marine placement was preferred to the best of the land placement options. However, sea dumping of capital dredge spoil was subsequently ruled out by legislation and further work ordered by Ports North on land placement.

The balance of this report addresses land placement in more detail.

3 DREDGE MATERIAL PLACEMENT OPTIONS STUDY APPROACH

3.1 STEPS IN THE PROCESS

The methodology used for this Dredge Material Placement Options Study is adapted from (and is largely informed by) the draft EIS approach, with some subtle differences. It involves four main steps:

- Site Selection (SS) – high level screening to define types of sites and possible locations for these (described as Placement Precincts).
- Concept Design (CD) – definition of a suite of nominal / representative types of sites located throughout the SS area (equivalent to the draft EIS 'potential sites'). This required sufficient preliminary concept design to produce 'projects' in the sense that they include the necessary works on the selected sites and key external infrastructure (spoil delivery and tailwater pipelines etc.).
- Site Evaluation (SE) – evaluation of potential sites / projects using MCA techniques to produce a shortlist for further consideration in the EIS.
- Suitability Assessment (SA) – assessment of the findings of the SE task at a Placement Precinct level and further refinement to produce a shortlist of Placement Precincts for detailed assessment via the EIS.

This approach is designed to follow the draft EIS methodology as much as possible to avoid wasted effort, while recognising that now that the preferred sea disposal options have been ruled out, a greater rigour is required to find a prudent and feasible land placement site (or a small number of sites) that can be further examined by a future assessment under a continuation of the existing EIS process. It is relevant to note that in this Dredge Material Placement Options Study a significantly lesser placement volume is assumed and this opens up opportunities for additional sites.

3.2 DREDGE MATERIAL PLACEMENT OPTIONS STUDY METHODOLOGY

The methodology adopted for this study was as follows:

- examine the <u>types</u> of sites that could be investigated (e.g. voids, reclamation, bunded landfill)
- consider all possible (prudent) <u>screening / evaluation rules</u> (starting with those explicit or implicit in the draft EIS and then adding new matters based on the technical analysis also being undertaken as part of the Dredge Material Placement Options Study) and determine the suitability of each rule for the SS and SE process (some may apply to both, some to none, some only to one), and some to a later stage in the process (i.e. impact assessment / environmental management / detailed design)
- consider how the rules might be applied (i.e. metrics and scoring)
- to the greatest extent possible, consider:
  - what are the <u>distinctives</u> involved when comparing sites?
  - how <u>important</u> are these?
- undertake sensitivity testing
- consider the findings of the site evaluation process and apply learnings to a final assessment of site suitability.

3.3 PROCESS

The process followed was:

- develop screening rules for each stage as above – all study team members contributed to this based on their expertise
- workshop these with the whole team and Ports North (2 February 2016)
- refine based on workshop feedback and further investigations
- undertake SS to identify suitable Placement Precincts
- develop an appropriate MCA methodology for use in the SE process
- workshop outcomes (SS and SE methodology) with the whole team (24 February 2016)
- refine based on workshop feedback and subsequent analysis
- undertake CD
- undertake SE at a site level
- undertake SA at a site level.

3.4 TERMINOLOGY

As noted above, it was considered desirable that the SS and SE processes be as consistent as possible in terminology and approach. The model used throughout this Dredge Material Placement Options Study employs the following MCA hierarchy for assessment:

- <u>criteria</u> are broad high level 'packages' that conveniently encapsulate the main issues of concern to stakeholders and decision-makers (such as people + planet + profit + performance)
- <u>attributes</u> are sub-criteria that can be measured.

The criteria used are:

- Cost
- Environmental
- Performance
- Social.

Examples of attributes of *Performance* could be:

- transport distance for pumping
- ground stability
- tailwater discharge.

In some cases it is appropriate to further split attributes into <u>elements</u>. For example, an attribute such as *Groundwater* has two elements (sub-attributes), namely:

- groundwater depth (deep groundwater for terrestrial sites is desirable as it is less likely to be impacted)
- groundwater salinity (salinity as close as possible to the tailwater is desirable).

These can be considered separately and combined to produce a single score for the groundwater attribute.

It is the attributes against which each option is directly measured (scored) and these results can be 'collapsed' to yield scores at the criterion level later in the process.

This hierarchy is generally consistent with that used in the draft EIS (although the Dredge Material Placement Options Study *Cost* and *Performance* criteria are considered in draft EIS as a combined *Economic / Logistics* 'category'. The draft EIS also included a *Legislative / Planning* category which is not recommended for the reasons set out below.

3.5 LEGISLATION AND PLANNING

3.5.1 Background

As previously noted, it is assumed that possible sites in this placement site assessment are not necessarily constrained (or at least not fatally so) by existing legislation or planning. In the preparation of these instruments, large scale land placement of dredged material was not contemplated as the status quo has always been sea dumping. Hence these instruments must be open to review now that sea dumping has been ruled out. This does not mean that land placement must be accommodated at any cost, just that a new resource allocation may be needed and a new sustainability assessment made.

For example, many of the current land management instruments were selected following the resource allocation exercise undertaken in the creation of the draft Trinity Inlet Management Plan (TIMP) (Environment Science & Services 1991a). The context report prepared to support TIMP (Environment Science & Services 1989) notes that (at the time of writing):

- maintenance dredging volumes had remained stable over the 1980s
- future dredging needs for the 1990s were identified as a continuation of maintenance dredging (i.e. peaking at around 300 000 t (dry weight) pa (it is noted that a major capital dredging program was carried out in 1990)
- no change to the sea dumping regime was foreshadowed
- consequently, land placement was neither contemplated nor accommodated.

Based on these (and other assumptions), TIMP included a resource allocation to accommodate a set of assumed future land uses and manage values. For example, there was little competition for the conservation values of Trinity Inlet and accordingly, TIMP included:

- designation of the waters of Trinity Inlet as a marine park (to manage use)
- designation of the waters of Trinity Inlet and much of its surrounding catchment as a Fish Habitat Area (to manage habitat)
- port and urban uses more or less where they were at the time.

The consideration of terrestrial placement options undertaken by Environment Science & Services (1991b) for the 1992 Connell Wagner Phase 2 Spoil Disposal Study (Connell Wagner 1992) and referred to in the draft EIS, tested potential sites against TIMP requirements. However, it specifically did not examine the pros and cons of off-shore vs terrestrial disposal and did not review the resource allocation decision that underlay TIMP.

Other planning undertaken since the adoption of TIMP has been characterised by the assumption that sea dumping would continue for most of the maintenance dredge spoil and all of the capital dredge spoil when capital projects are proposed.

This is true for both Cairns Port Authority / Ports North planning and that of all Queensland Government agencies. Commonwealth agencies (notably GBRMPA and what is now the Department of the Environment) have until recently requested that land disposal be considered as an alternative to marine placement but have ultimately issued permits for sea dumping. Queensland Government agencies have traditionally resisted land placement and preferred sea dumping. This was the case in consultation on the draft EIS.

3.5.2 Current Situation

Thus, land placement needs have not been seen as a competing use for resource allocation decisions such as the following (there are many more):

- preservation of good quality agricultural land
- designation of urban footprint and other land use planning work
- allocation of land to the conservation estate (e.g. national park, marine parks, fish habitat areas).

Because of the above, planning and environmental legislation that, in its current form, might be seen as fatal to certain sites has not adopted as an absolute constraint in the SE process. However, it is considered in terms of the subsequent suitability assessment.

4 SITE SELECTION

4.1 INTRODUCTION

Site selection involved two main steps:

- typology (determine the types of placement solutions that could be considered)
- site suitability (determine the location of all areas where various types of placement solutions could be feasibly situated).

The site selection (SS) process involves identifying characteristics that all possible sites 'must have' – i.e. reject an area if any attribute is not met (or in some cases, include when met).

4.2 TYPOLOGY

4.2.1 Approach

For the Dredge Material Placement Options Study, it was desired to 'cast the net wide' and explore a range of site options before ruling any out. Accordingly, an initial matrix was produced that contains all possible permutations and combinations of the following parameters:

- types of sites
- types of post-placement use
- types of post-placement treatment.

4.2.2 Types of Sites

Site types can comprise:

- (terrestrial) voids, either existing or created, whereby dredged material is deposited below (fresh or brackish) water
- sub-tidal or inter-tidal marine sites adjacent to land, of one of three sub-types, whereby dredged material is deposited below (sea) water and:
    - the reclamation does not rise above lowest astronomical tide (LAT)
    - the reclamation rises above LAT but not above Highest Astronomical Tide (HAT) (or Mean High Water Spring (MHWS) as appropriate)
    - the reclamation rises above HAT
- terrestrial sites above HAT.

Possible sub-tidal or inter-tidal marine sites adjacent to land could include contained or uncontained placement such as adjacent to the Esplanade, providing that these involve beneficial reuse as defined by the *Sustainable Ports Development Act 2015* (Qld) (see **Section 4.2.6**).

4.2.3 Types of Post-placement Use

Once filled, possible sites can have one of the following uses:

- no (beneficial) end use (i.e. the filled void option above or a an option where material is simply paced on land without remediation – ultimately this will be 'used' as a habitat by species that will naturally colonise it, but the option involves no effort to accelerate or guide this process)
- beneficial reuse for habitat / open space (a variation of the above where active efforts are made to guide the natural processes with a view to producing useful sustainable habitat or open space)
- beneficial reuse for development (e.g. residential, industrial, specific port-related use)
- reuse as a placement site (i.e. material would be placed, treated, and then exported, leaving the site to be used for further placement and treatment, either on a 'perpetual' cycle or with some specific end-use in mind after several cycles).

Each end use requires different forms of treatment / management. However, the issues involved are considered to be too detailed to be addressed in this Dredge Material Placement Options Study and will need to be addressed in the EIS.

4.2.4 Types of Post-placement Treatment

In some cases, treatment is required to improve environmental and / or engineering properties as follows:

- under-water placement options in general require no environmental treatment as ASS / PASS conditions will not arise
- all terrestrial placement will require placement in bunds to facilitate dewatering (typically the material as dredged will contains four parts water to one part solids) and this could be supplemented by:
  - no allied chemical treatment
  - future treatment with lime / quicklime.

No structural improvement is proposed. An initial geotechnical assessment for this project by Golder Associates (2015) reveals that:

> *There is a perception that with time dredged materials will consolidate and increase in strength to create a 'platform' for later development. Technically this is feasible and the process can be quickened by surcharging with imported fill materials and further quickened with the installation of wick drains if the layer of material is thick enough.*
>
> *Our experience at Tingira Street Portsmith indicates that although the dredged material was placed as a relatively thin layer (less than 1m) the material still has the properties of soft marine clays after more than 30 years, even though parts of the site have been surcharged with more than 2m of imported fill materials.*
>
> *The thickness of dredged material created using this approach would depend on the area available; however a thickness of about 3 m is envisaged. Without surcharging with imported fill this material would not increase in strength enough to allow development even after 30 years. With surcharging, development may be feasible with appropriate engineering to accommodate settlements after a period of about 2 years. Use of wick drains to quicken consolidation is not technically viable for the relatively shallow thickness of dredged material envisaged.* (pp 8,9)

4.2.5 Results – Potential Types of Sites

Figure 4-1 below shows some of the above diagrammatically. Note that there are many permutations and combinations / variations available when treatment and end-use options are considered. A more detailed analysis is shown in **Table 4-1**.

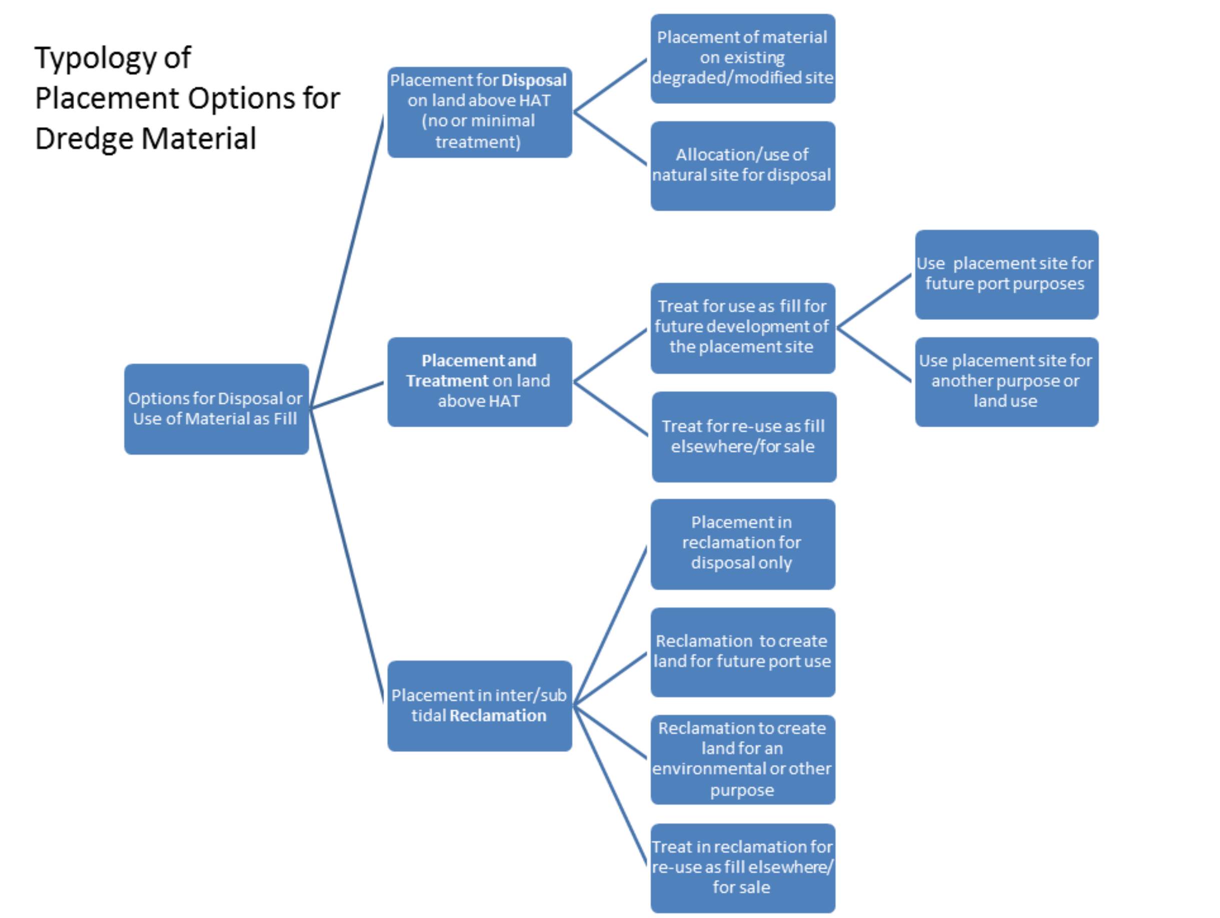


Figure 4-1 Typology of placement options.

Source: Study team compilation.

A matrix based on these variables as shown in **Table 4-1** below.

Table 4-1 Potential sites based on typology

Site Type	Sub-type	Treatment				Intermediate use	End use				Retention		Notes	Future Management			Draft EIS Site	Other possible examples
		Burial (below water)	Inter-tidal (no treatment)	Ponds (no treatment)	Ponds (lime treatment)		Nil	Habitat	Development	Re-use	Not required	Required		Little to nil	Occasional	On-going		
Void	Existing	X				Nil	X				X		Void 'consumed'	X				Existing void from previous sand extraction
Void	Existing - re-use	X				Export after treatment				X	X		Void can be reused after export		X			Existing void from previous sand extraction
Void	New	X				Nil	X				X		Void 'consumed'	X				New void from future sand extraction
Void	New - reuse	X				Export after treatment				X	X		Void can be reused after export		X			New void from future sand extraction
Sub-tidal <LAT	Placement only	X				Nil	X					X	Below LAT	X				Sub-tidal site in location with suitable coastal processes (< LAT)
Intertidal <MSL	Habitat		X			Nil		X				X	Below MSL	X				Suitable intertidal area with limited existing values
Intertidal > MSL	Habitat		X			Nil			X			X	Above MSL		X			Suitable intertidal area with limited existing values
Intertidal > MSL	Development		X			Nil			X			X	Above MSL			X		Suitable intertidal area with limited existing values
Intertidal > MSL	Placement and re-use		X			Export after treatment				X		X	Above MSL		X			Suitable intertidal area with limited existing values
Terrestrial	Placement only			X		Nil	X					X			X		East Trinity Admiralty Island Esplanade	
Terrestrial	Habitat / Open Space			X		Nil		X				X				X	Esplanade	Other coastal sites
Terrestrial	Habitat / Open Space				X	Nil		X				X				X	Esplanade	Other coastal sites
Terrestrial	Development			X		Nil			X			X				X	East Trinity Cane land near T7 Airport Esplanade	Admiralty Island Other cane land Other coastal
Terrestrial	Development				X	Nil			X			X				X	East Trinity Cane land near T7 Airport Esplanade	Admiralty Island Other cane land Other coastal
Terrestrial	Re-use			X		Export after treatment				X		X	Site can be reused after export			X		Admiralty Island Other cane land
Terrestrial	Re-use				X	Export after treatment				X		X	Site can be reused after export			X		Admiralty Island Other cane land

Source: Study team compilation.

4.2.6 Beneficial Reuse

Under the *Sustainable Ports Development Act 2015* (Qld) section 36(2), any subtidal placement options or reclamation of land options within the Great Barrier Reef World Heritage Area (GBRWHA) will need to meet the 'beneficial reuse' test as follows:

> ***36 Condition for approvals for particular capital dredging***
>
> *(1) This section applies to an approval given by an approving authority for development that is, or relates to, capital dredging if the capital dredging is carried out—*
>
> *(a) for the purpose of establishing, constructing or improving a port facility in a priority port's master planned area; or*
>
> *(b) in the inner harbour of the Port of Cairns for the purpose of establishing, constructing or improving a port facility for the port.*
>
> *(2) The approval is taken to include a condition that material generated from the capital dredging must not be deposited, or disposed of, in a restricted area unless the material is beneficially reused. Examples of ways in which the material may be beneficially reused—*
>
> - *for land reclamation*
> - *for beach nourishment*
> - *for environmental restoration purposes, such as creating or restoring wetlands or nesting islands*

Some important issues are that:

- The above section also applies to the CSD Project while the current EIS is still in progress.
- Under the Act, a *restricted area* means an area that is within the GBRWHA but outside the Commonwealth Marine Park. This applies to reclamation proposals considered under this Dredge Material Placement Options Study: that is that any placement in the GBRWHA (i.e. anything seaward of low water) must have a beneficial reuse.
- The examples listed above are not stated as being the only beneficial reuse solutions. The properties of the channel material make it unsuitable for beach replenishment.

Accordingly, beneficial reuse in reclamation situations for the CSD Project is restricted to either habitat or new land for development of some type.

4.2.7 Discussion

Not all possible permutations and combinations are acceptable (i.e. feasible and prudent), as the following table prepared by the study reveals. Acceptability is based largely on ASS handling matters (see **Section 4.2.8**).

Table 4-2 Disposal and treatment options

TYPE	SUB-TYPE	COMMENTS	ACCEPTABLE?
Void	Existing	• Area as required for disposal and tailwater management. • Could be multiple sites.	✓
Void	Existing - reuse	• Unlikely to be viable as would require re-dredging and then treatment.	X
Void	New	• Area as required for disposal and tailwater management. • Could be multiple sites. • Could be excavated in the dry as per Bluewater. • Could be excavated underwater.	✓
Void	New - reuse	• Unlikely to be viable as would require re-dredging and then treatment.	X
Sub-tidal <LAT (lowest astronomical tide)	Placement only	• Area as required for disposal. Area would need to be 'contained'. • Beneficial reuse is required. • Unlikely to be suitable due to difficulty in creating beneficial reuse.	X
Intertidal < MSL (mean sea level)	Habitat	• Area as required for disposal. Area would need to be 'contained'. • Beneficial reuse is required.	✓
Intertidal > MSL	Habitat	• Area as required for disposal. • Area would need to be 'contained'. • Material above MSL would need to be non ASS or treated ASS. • Additional terrestrial land area required for treatment processes. • Beneficial reuse is required.	✓
Intertidal > MSL	Development	• Area as required for disposal. • Area would need to be 'contained'. • Material above MSL would need to be non ASS or treated ASS. • Surcharging and/or piling required for development. • Additional terrestrial land area required for treatment and development processes. • Beneficial reuse is required.	✓

(Continued over)

TYPE	SUB-TYPE	COMMENTS	ACCEPTABLE?
Intertidal > MSL	Placement and reuse	• Area as required for disposal. • Area would need to be 'contained'. • Material above MSL would need to be non ASS or treated ASS. • Reuse unlikely to be viable as would require re-dredging and then treatment • Beneficial reuse is required.	**✓ / X (i.e. marginal)**
Terrestrial	Placement only	• Area as required for disposal and tailwater management. • Disposal area would need to remain permanently inundated. • Could be multiple sites. • Would not meet current ASS management guidelines [see **Section 4.2.8**].	**X**
Terrestrial	Habitat (without treatment)	• Area as required for disposal and tailwater management. • Habitat area would need to remain permanently inundated (e.g wet land). • Could be multiple sites. Would not meet current ASS management guidelines	**X**
Terrestrial	Habitat (with treatment)	• Area as required for disposal and tailwater management, plus for treatment. • Treatment by land farming.	✓
Terrestrial	Open Space (without treatment)	• Area as required for disposal and tailwater management. • Open space area would need to remain permanently inundated (e.g lake or water feature). • Could be multiple sites. • Would not meet current ASS management guidelines.	**X**
Terrestrial	Open Space (with treatment)	• Area as required for disposal and tailwater management, plus for treatment. • Treatment by land farming.	✓
Terrestrial	Development	• Area as required for disposal and tailwater management, plus for treatment. • Treatment by land farming. • Presumably overall development site area large enough to accommodate disposal treatment areas (e.g Bluewater).	✓
Terrestrial	Reuse	• Area as required for disposal and tailwater management, plus for treatment. • Could be multiple sites. • Treatment area depends on production rates required (i.e. 1 year, 3 years, 10 years).	✓

Source: Study team compilation.

4.2.8 Acceptability of ASS Treatment

As noted above, some options do not meet current ASS management guidelines (Dear *et al.* 2014). The guidelines indicate that where ASS avoidance cannot be achieved then (from a risk perspective) the preferred management strategies are:

- neutralisation of ASS
- hydraulic separation
- strategic reburial of PASS at least 1 m below the permanent water table or several metres below permanent standing water.

The Guidelines identify the following management strategies as higher risk:

- stockpiling ASS
- strategic reburial of soils with existing acidity (i.e. AASS)
- large scale dewatering or drainage
- vertical mixing

The Guidelines identify the following management strategies as unacceptable risk:

- above ground capping
- hastened oxidisation
- seawater neutralisation
- offshore disposal of ASS without specific approval.

The two last points do not apply to currently approved offshore disposal of material from maintenance dredging as it is the subject of specific approvals. The same would apply for future projects that receive approvals.

The guidelines state that these latter strategies 'have been shown to carry unacceptably high environmental risk, or to be generally ineffective, and/or lack scientific data to support their sustainability'.

This analysis reveals restrictions to the types of sites to be considered during the concept design process. It also provides information that was used to guide the site screening work.

4.3 SITE SUITABILITY

4.3.1 Draft EIS Approach

There are certain features that all sites must have in order to be considered. They are fundamental to suitability and not necessarily desirability. As noted in **Section 2.1.3a)**, the draft EIS concluded that to be considered, sites must have the following properties:

1. Be on relatively flat land.
2. Be close to existing tidal drainage or creek lines to enable saline tailwater discharge.
3. Be distant from areas subject to coastal erosion or storm surge, or capable of being otherwise engineered to be resistant to such impacts.
4. Be within a reasonable distance (<11 km) to enable pumping of the dredged material from a mooring site.
5. Secure dewatering areas need to be fenced and made secure as there are inherent public safety issues with the soft nature of the material while it is in the process of dewatering.

6. Have sufficient area to be able to store the required volume of material. (This was also used in the MCA to distinguish between sites, but as all sites had been pre-selected to meet this condition, all complied.)
7. Be on undeveloped land.

Site placement capacity requirements (i.e. Rule 6 above) have potentially changed due to the nature of this Dredge Material Placement Options Study (i.e. smaller sites may now be suitable due to smaller volumes overall or staging of delivery of material for placement).

Inherent in the draft EIS MCA scoring methodology is a range of other matters that could be used as screening rules (i.e. to remove sites that would do poorly in a subsequent scoring of site suitability). These are listed in **Table 2-2** and described in detail in the draft EIS. This is a complex issue: while it is desirable to remove sites with fatal flaws, not all 'serious' constraints are necessarily fatal and may be able to be mitigated or managed, even if this makes the site less desirable than others.

4.3.2 Dredge Material Placement Options Study Rules

a) Process

The draft EIS rules (i.e. used in both the implicit site selection process and in the MCA) as outlined above were collated and added to by the study team on an individual basis to form a master list. This master list was then the subject of the 2 February team workshop attended by senior representatives from Ports North. At this workshop, each rule was investigated in terms of:

- suitability for one or more of the following project phases:
  - site selection
  - site evaluation
  - a matter for future detailed assessment / design / management
- relevance for the different types of sites established in the typology assessment:
  - voids
  - reclamation
  - terrestrial
- information needs and broad measurement and scoring considerations.

This amended master list was then further analysed and converted to adopted rules. The adopted master list is included as **Appendix A**. During this analysis process, the names of the attributes were amended slightly as required.

b) Adopted Attributes

Adopted SS attributes were broken down into the adopted hierarchy described in **Section 3.4** (i.e. *Cost*, *Environmental*, *Performance*, and *Social*) as identified by the corresponding prefix (i.e. E = Environmental):

- E1 – Maximum elevation
- E2 – Barron River flooding
- P1 – Maximum transport distance
- S1 – Remoteness from incompatible land use.

There were no *Cost* attributes as cost was not considered relevant to SS. The reasoning for not considering other attributes is summarised in the master list in **Appendix A**.

4.4 DETAILS OF RULES AND APPLICATION

Table 4-3 below is a summary of the adopted rules.

The SS criteria are ‘must have’ – i.e. reject if any attribute is not met (or in some cases, include when met). In this table:

- Rationale. This is why the attribute is important.
- Type (Void, Reclamation (sub-tidal, inter-tidal, supra-tidal), Terrestrial). Attributes may apply to all or some types, and may be dealt with differently in some cases.
- Measurement. How the attribute was measured.
- Exclusion / Inclusion Rule: How the measurements were used to rule land ‘in’ or ‘out’.
- Notes: As required to explain any important points.

This is a summary only and further explanation on some matters follows the table.

Table 4-3 Site selection rules

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	EXCLUSION / INCLUSION RULE	NOTES
		Void	Reclamation	Terrestrial			
E1 – Maximum elevation	The practical pumping distance depends on both pipe friction (a function of length from the pump to the delivery point – see P1) and static head. In rough terms, 10 m of head is equivalent to 1 km of length. There is a need therefore to reduce static head as much as possible. In addition, suitable terrestrial sites are ideally on land with gentle slopes and these tend to be at the lower elevations (i.e. below about 10 m AHD).	✓			The 10 m AHD contour from the Queensland Digital Elevation Model was selected as the basis of this attribute.	Exclude all areas above the 10 m contour.	Is not a necessary attribute for existing voids as they are all on the Barron delta and are below 10 m AHD.
			✓		The MSL contour (1.5 m to chart datum) from the Cairns Harbour Chart was selected as the basis of this attribute.	Include only sites that are currently below MSL.	Exclude sites that conflict with navigation, and the channel itself. Investigate minimum contour based on seagrass cover.
				✓	As for Voids.	As for Voids.	

(Continued over)

ATTRIBUTE	RATIONALE	TYPE: Void	TYPE: Reclamation	TYPE: Terrestrial	MEASUREMENT	EXCLUSION / INCLUSION RULE	NOTES
E2 – Barron River flooding	CairnsPlan's Flood Management Code requires that development should not result in adverse flooding impacts on off-site areas, namely: • afflux (a rise in water level upstream of an obstruction due to damming effect) outside the property boundaries • higher velocities or adverse flow paths outside the property boundaries. Bunded solutions will result in afflux. Although it is possible to engineer a solution that compensates for the effect of bunds, experience has shown that this requires large sites with substantial parts not developed and dedicated to compensatory waterways.			✓	CairnsPlan's Barron – Smithfield District Plan Flood Inundation (ARI 100 year) Overlay was used as the basis of this attribute.	Exclude all areas within the mapped area that require bunds (Terrestrial sites only).	Sites with existing bunds may be used (e.g. Ponderosa Prawn Farm, abandoned aquaculture ponds on Pappalardo Farm. Does not apply to existing or new voids in the Barron Delta as these are not expected to cause off-site flooding effects.
P1 – Maximum transport distance	As for E1, the practical pumping distance depends on both pipe friction (a function of length from the pump to the delivery point) and static head. The practical maximum distance adopted is 11 km which requires up to 3 inline booster stations.	✓	✓	✓	The locus of all feasible pumping locations was plotted and from these points an envelope of11 km distant was plotted to define a maximum pumping distance.	Exclude all areas outside the maximum pumping distance.	Maximum distance measured from -7.5m CD marine contour level (nearest connection point to pipeline – assuming no dredging to get closer to shoreline) and running down channel as far as Admiralty Island.

(Continued over)

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	EXCLUSION / INCLUSION RULE	NOTES
		Void	Reclamation	Terrestrial			
S1 – Remoteness from incompatible land use	Placement activities can involve undesirable amenity issues (e.g. dust, odour, noise, visual impact, land transport activities) that could have unacceptable impacts on certain land uses. It is desirable to provide appropriate buffers to these land uses. Note regarding rule for voids – this rule applies for new voids only on the basis that existing voids are already accepted land uses.	✓	✓	✓	The location of dominant land uses based on CairnsPlan was mapped and stratified by:	Exclude all areas within the following land uses and additional buffer distance:	Buffers calculated from lot boundaries.
					• Residential & Tourism	• 200 m	Retain a generous separation distance to residential properties.
					• Recreation	• 100 m	More compatible land use due to no long term occupation of the recreational use.
					• Commercial & Industrial (Light)	• 100 m	Commercial and light industry uses generate different ambient noise levels. Air quality and odours do occur and thus landfill is a more compatible and acceptable land use.
					• Industrial (Noxious)	• 50 m	Compatible land use.
					• Rural (residences).	• 200 m	Retain a generous separation distance to residential properties.

Source: Study team compilation.

4.5 *RESULTS – INDIVIDUAL ATTRIBUTES*

4.5.1 E1 – Maximum Elevation

a) Detailed Explanation

As per **Table 4-3**. While this attribute is designed to screen out sites that are too elevated for practical pumping, it also recognises that the desirable flat or gently sloping sites are likely to be at the lower elevations (i.e. below about 10 m AHD).

b) Results

The land not rejected by this attribute is shown on **Figure 4-2** below.

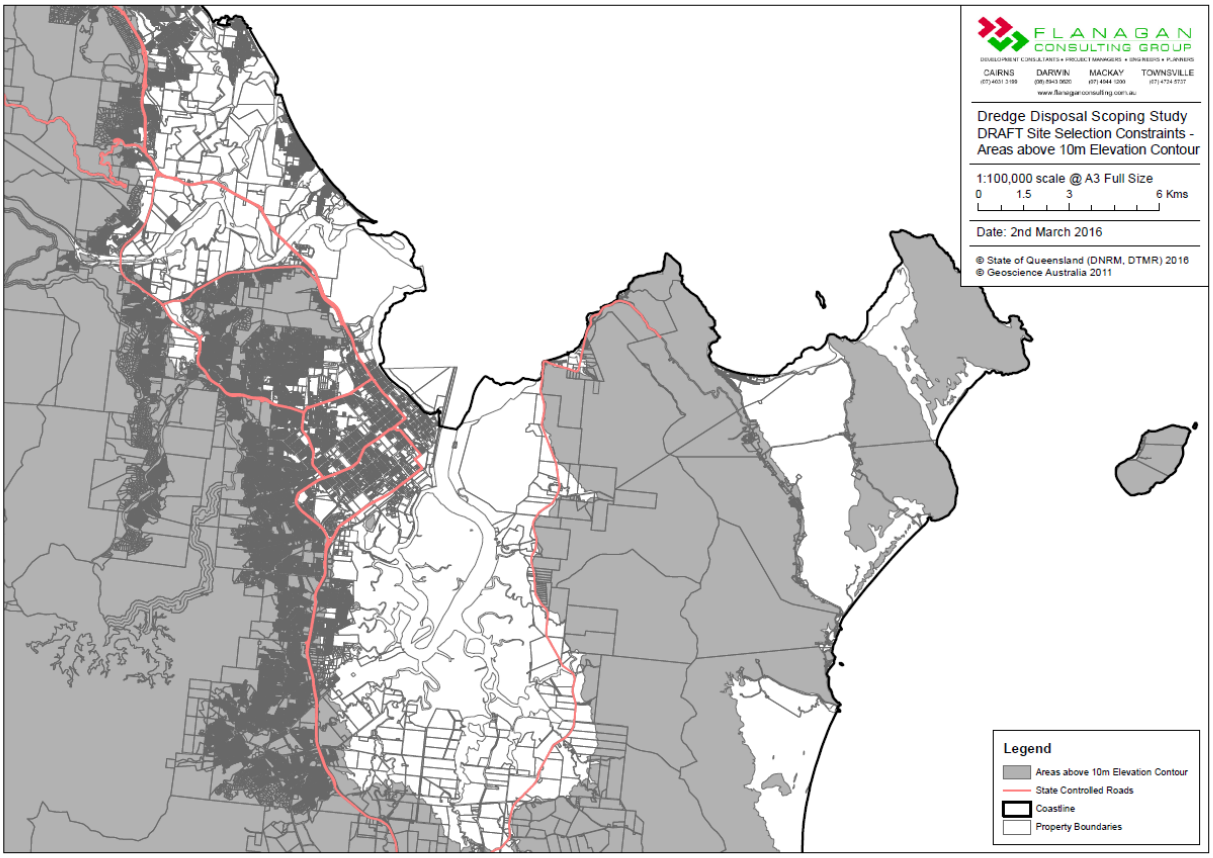


Figure 4-2 E1 – Maximum elevation.

See **Appendix B** for a larger version of this map.

4.5.2 E2 – Barron River Flooding

a) Detailed Explanation

- Voids: Not applicable – all existing voids involve placement below groundwater and will not add to afflux.
- Reclamation: Not applicable – reclamation sites are not proposed to be located in the Barron – Smithfield District.
- Terrestrial: Exclude all areas within the mapped area that require bunds. Note that there are some existing bunded areas in the Barron – Smithfield District. These have already been subjected to an assessment of flooding and are potentially feasible placement sites.

b) Results

The land not rejected by this attribute is shown on **Figure 4-3** below.

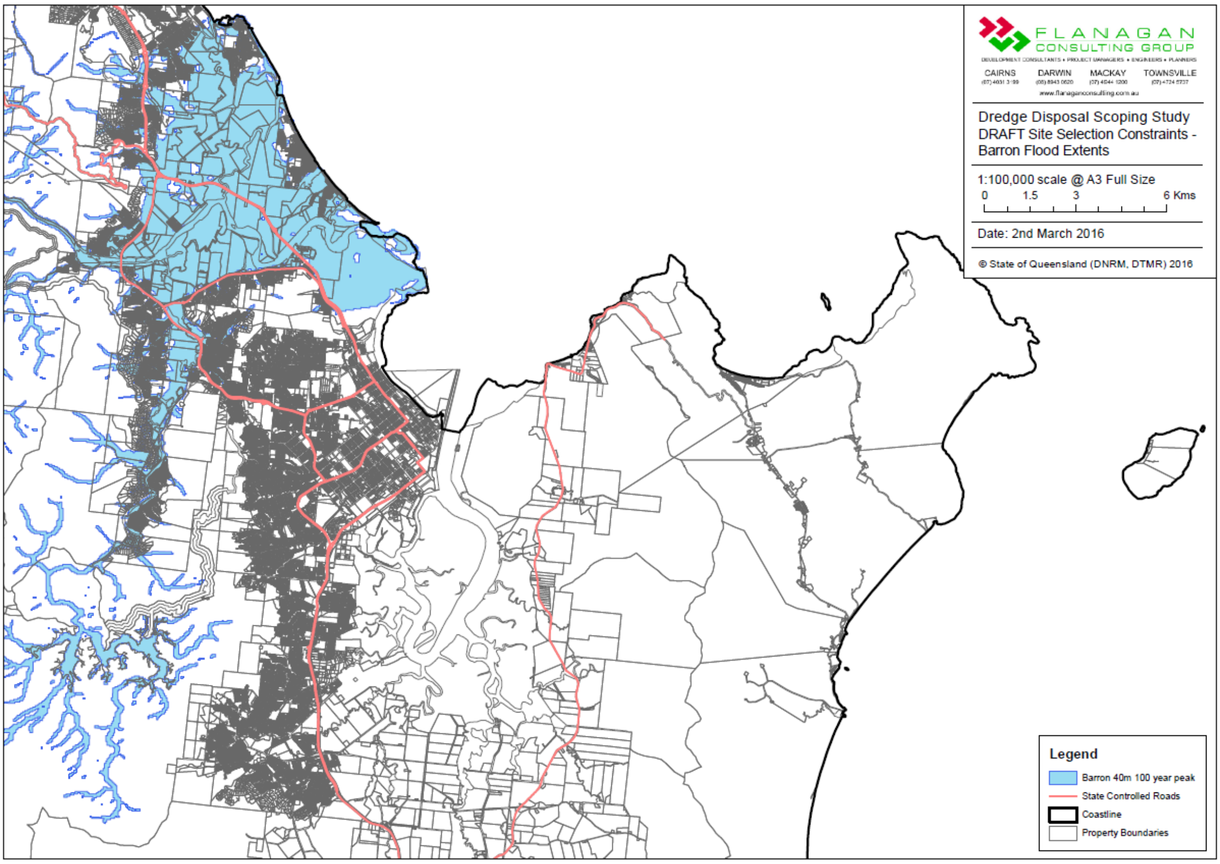


Figure 4-3 E2 – Barron River flooding.

See **Appendix B** for a larger version of this map.

4.5.3 P1 – Maximum Transport Distance

a) Detailed Explanation

Data for use in applying this attribute was created by the study team as follows:

- Determine the locus of all possible locations where a dredge with a nominal maximum loaded draft of 6.5 m could safely be deployed as close as possible to placement sites. This was generally seaward of the 7.5 m chart datum and clear of the channel. The selected maximum draft related to the ability to effectively dredge the shallow bank material in the widened sections of the channel, and the ability to position the pipeline connection point as close as possible to the final disposal site to minimise overall pumping distance.
- Define a maximum pumping distance from these pumping locations. This was determined to be based on (BMT JFA Consultants 2016):
  - maximum pumping distance of 11 km
  - the maximum practical number of boosters is three.

b) Results

The land not rejected by this attribute is shown on **Figure 4-4** below.

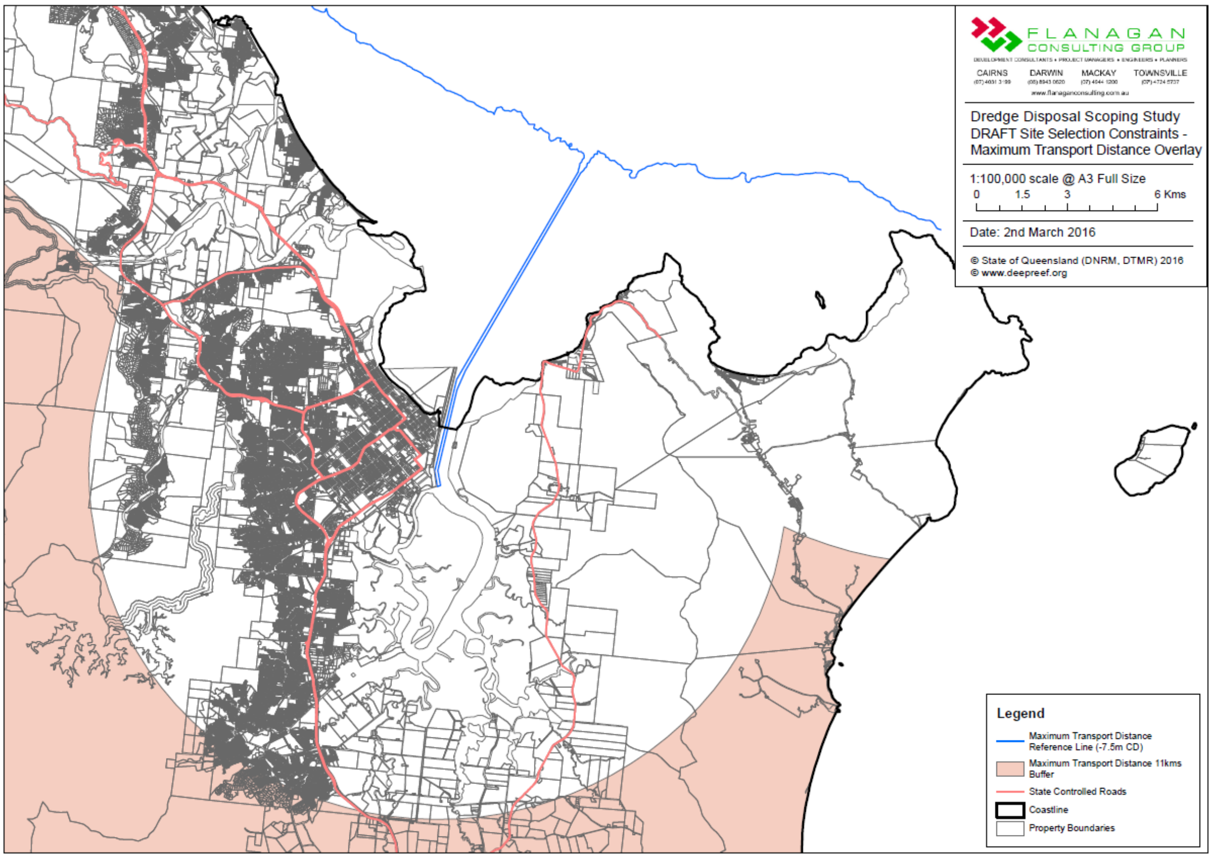


Figure 4-4 P1 – Maximum transport distance.

See **Appendix B** for a larger version of this map.

4.5.4 S1 – Remoteness from Incompatible Land Use

a) Detailed Explanation

As per **Table 4-3**.

Note regarding rule for voids – this rule applies for new voids only on the basis that existing voids are already accepted land uses.

b) Results

The land not rejected by this attribute is shown on **Figure 4-5** below. Note that that the extent of the study area was limited by P1 prior to the application of this rule.

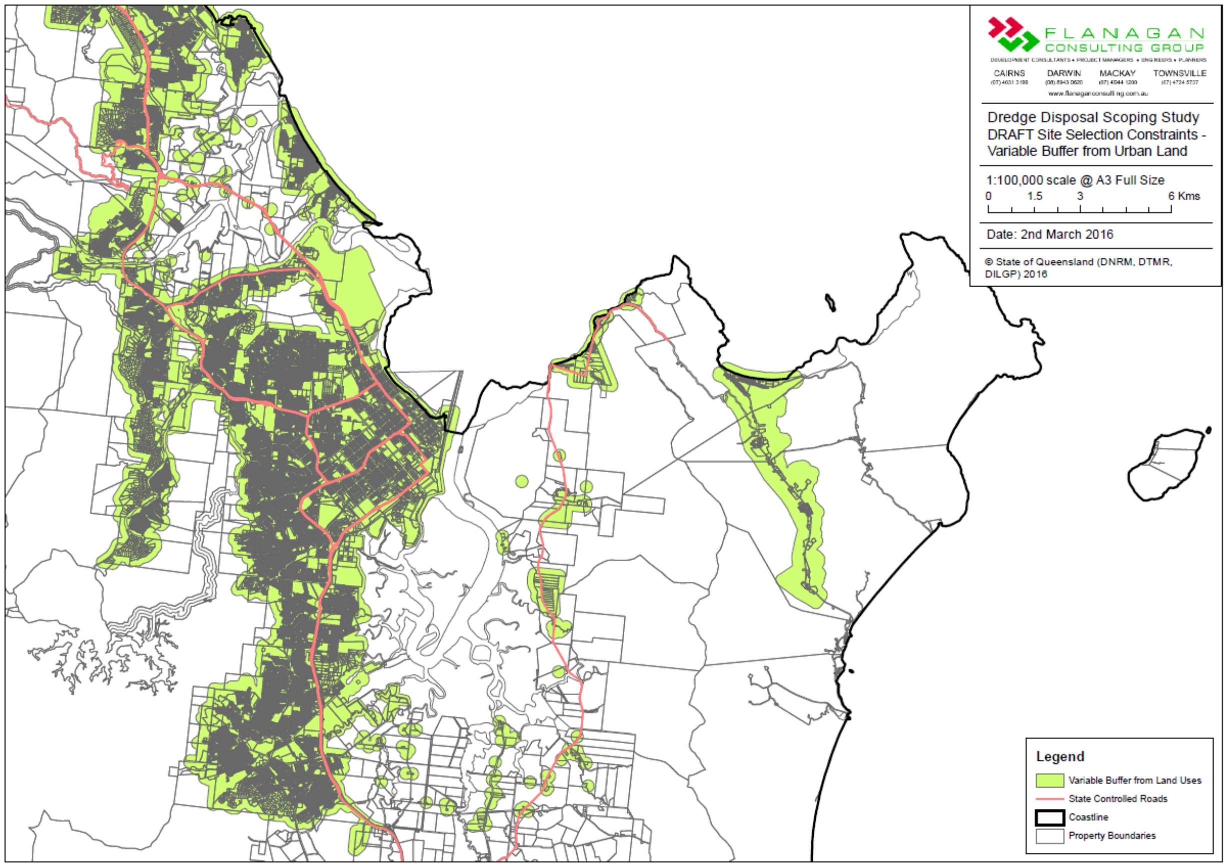


Figure 4-5 S1 – Remoteness from incompatible land use.

See **Appendix B** for a larger version of this map.

4.6 RESULTS – COMPOSITE AREA

The above figures were combined to produce a composite area in which land placement sites could be located.

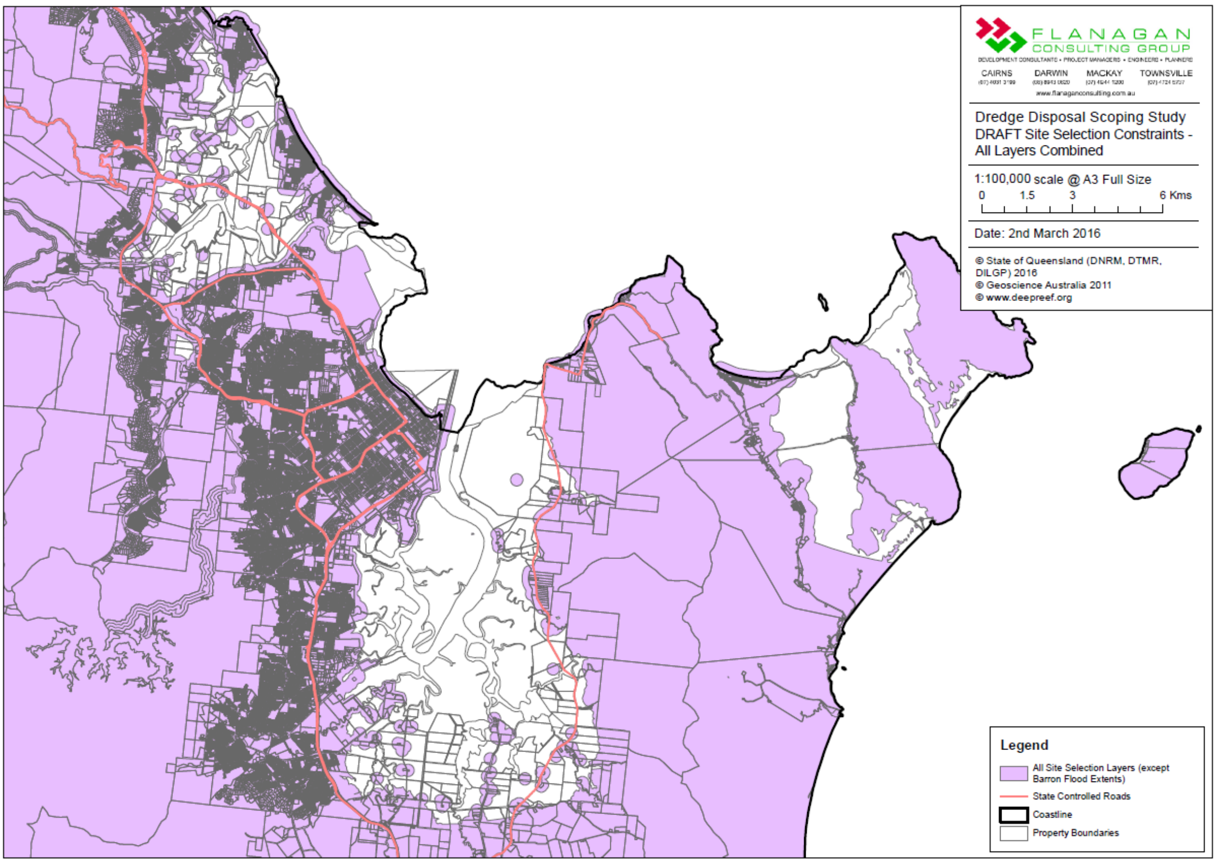


Figure 4-6 Composite area.

See **Appendix B** for a larger version of this map.

Larger versions of the individual and composite maps are shown in **Appendix B**.

4.7 DISCUSSION

Inspection of the above SS maps reveals that there are six available placement areas ('Placement Precincts') as follows (see **Figure 4-7**):

- **Barron Delta.** The Barron Delta Placement Precinct is highly constrained by Barron River flooding and potentially acceptable placement options are restricted to existing voids, existing bunded areas already compliant with the flood code, and new voids.
- **Cairns Bay.** The Cairns Bay Placement Precinct covers the protected waters adjacent to the Cairns Esplanade between the Ellie Point in the north and Bessie Point in the south. It extends seaward to approximately low water. This area contains potentially acceptable sites for various types of sub-tidal reclamation.
- **Trinity Inlet East.** The Trinity Inlet East Placement Precinct contains land east of Trinity Inlet and bounded by Pine Creek Road. This area is locally known as East Trinity and provides opportunities for a number of possible terrestrial placement options on different types of land.

- **Trinity Inlet West.** The Trinity Inlet West Placement Precinct includes Admiralty Island and land adjacent to Smiths Creek south of the Portsmith industrial area. This provides opportunities for both terrestrial and reclamation options.
- **Trinity Inlet South.** The Trinity Inlet South Placement Precinct includes a suite of possible sites on cane land south of Trinity Inlet.
- **Yarrabah.** The Yarrabah Placement Precinct includes two possible sites on unoccupied land south at Yarrabah. Of these, the eastern site is not further considered as it has no land access.

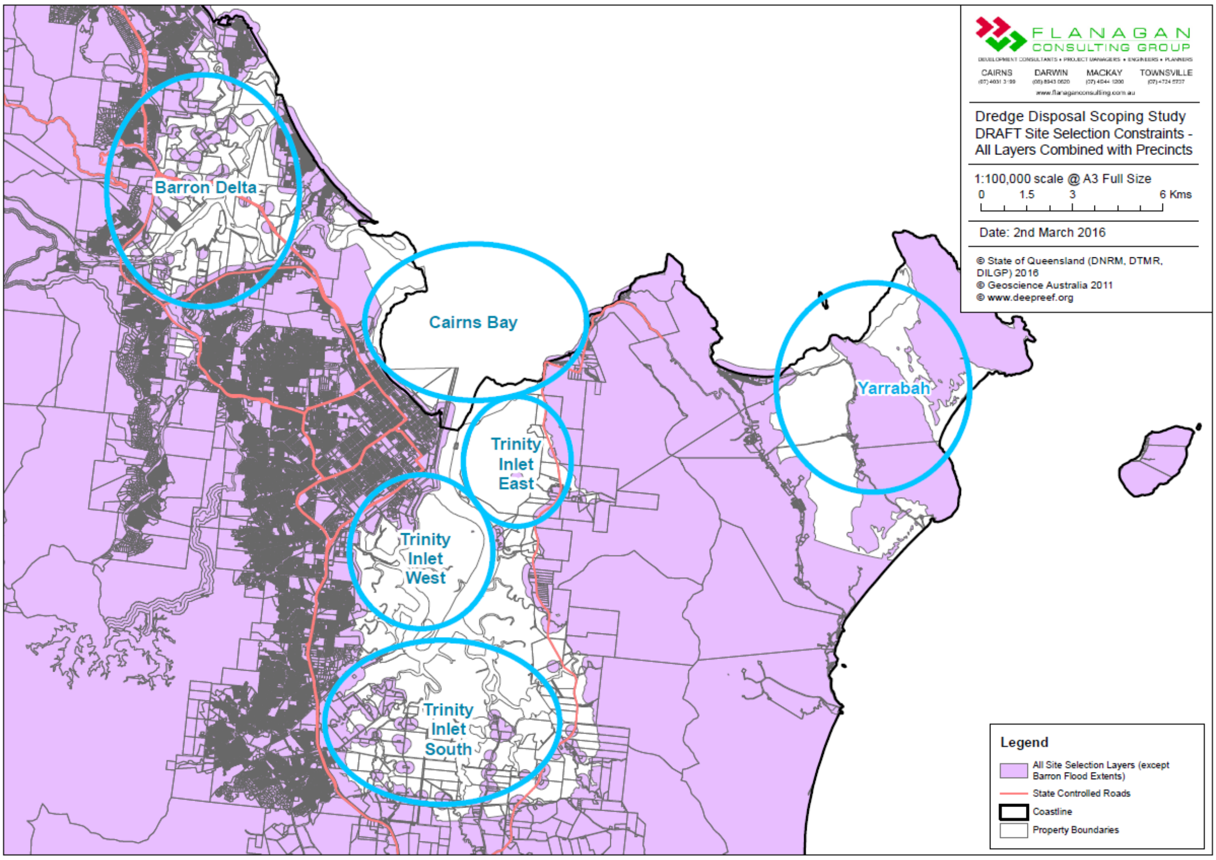


Figure 4-7 Placement Precincts.

See **Appendix B** for a larger version of this map.

These Placement Precincts are a useful planning tool as they cover areas in which many alternative placement projects could possibly be developed. This is especially true of the Barron Delta, Trinity Inlet East and Trinity Inlet South precincts.

Specific projects evaluated in the balance of this report are in many cases typical of many similar developments that could also be considered within the above Placement Precincts.

5 CONCEPT DESIGN

5.1 INTRODUCTION

5.1.1 Overview

The SS process has determined the areas of land potentially suitable for placement sites for each of voids, reclamation, and terrestrial types. In order to be able to select sites within the Placement Precincts, preliminary concept designs of nominal projects were prepared for assessment via SE. This required two tasks:

- parcel identification (i.e. identifying specific areas of land for placement)
- concept design of specific nominal projects for subsequent SE.

As noted above, specific projects evaluated in the balance of this report are in many cases typical of many similar developments that could also be considered.

5.1.2 The Draft EIS Approach

a) Parcel Identification

The draft EIS did not include a parcel identification task as the MCA candidate sites were selected from previous studies.

b) Concept Design

The draft EIS included a concept design of each of the candidate sites. This included:

- consideration of site placement capacity (dredge spoil and associated water)
- concept bund design (or rock containment in the case of reclamation sites)
- allowance for treatment areas
- indicative spoil discharge and tailwater discharge points
- buffer areas and other broadscale allowance for site constraints (e.g. creek lines and areas of intact natural vegetation).

An example from the draft EIS (the East Trinity site) has been shown previously (**Figure 2-3**).

5.2 PARCEL IDENTIFICATION

5.2.1 Methodology

a) Voids

Existing voids were identified and adjacent land included in the parcel as required for treatment of tailwater.

The creation of new voids is an opportunity that could be considered. In order to evaluate this method for placement the following tasks would need to be undertaken:

- identification of potential areas (i.e. as determined by the SS process)
- investigations into underlying geology / soils on the assumption that an economic use needs to be found for the material to be extracted
- market research to identify potential buyers of this material
- concept design and impact assessment.

Expanding existing voids is also a possible future opportunity and would require the same methodology as that suggested for existing voids.

b) Reclamation

Potential reclamation sites not excluded by the SS process were identified in Cairns Bay and Trinity Inlet. Concept design assumed the following:

- minimum level – LAT (although deeper areas could be considered)
- maximum reclamation level – MSL (to deal satisfactorily with acid sulfate soil)
- maximum separation from incompatible land use.

c) Terrestrial

Parcels of land (i.e. land on one or more title that could be aggregated to form a land area suitable for constructing a placement / treatment area) were identified within the SS area. Typical site aspects include the following (these varied for each type of site):

- minimum area (derived from dredged material volume (with allowance for bulking) and treatment considerations)
- allowance for watercourses (i.e. parcels may include watercourses but site development should avoid them)
- allowance for existing roads etc. (i.e. parcels may include existing roads or major infrastructure (e.g. powerlines, water mains) but site development should avoid such infrastructure.

These are described below.

5.2.2 Minimum Volume / Area

For a site to be suitable, it needs to be able to accommodate all (or as much as possible) of the bulked material dredged for Scenario 1 and Scenario 2 (see **Section 1.2**), plus the management of the associated tailwater, and allow for necessary treatment and other infrastructure. However, some smaller sites may still be suitable if used in combination or if they are otherwise desirable.

The minimum site area depends on the type of end use and is influenced by, for new sites:

- the volume of material delivered by the pipeline (bulked solids and water)
- the practical maximum height of bunding for terrestrial options
- the time over which settlement to a certain standard is required (for reuse sites)
- on-site constraints (e.g. watercourses, natural vegetation to be avoided (including buffers)
- treatment considerations (see below).

For existing sites (voids or bunded areas) the placement volume is essentially already determined. However, treatment still needs to be considered.

a) Treatment Considerations

As noted in **Section 2.1.3b)**, the associated water content (this depends on the dredging methodology and the delivery mechanism / transport distance) does not substantially change the size of the reclamation area. It only affects the amount of water to be discharged as tailwater.

Assumed production rates (based on the draft EIS) were used to estimate the likely size of treatment areas as summarised in **Table 5-1**.

Table 5-1 Production rates for treatment

DREDGED VOLUME (WITHOUT BULKING CONSIDERATION) (m^3)	PRODUCTION RATE REQUIRED (m^3 /day)	TREATMENT AREA REQUIRED (INCLUDING 20% ALLOWANCE FOR BUNDING AND STOCKPILING) (ha)
430 000	~2600	6.3
860 000	~5200	12.6

Source: Study team compilation.

Empty sections of the holding pond could be used to provide additional stockpiling capacity.

b) Minimum Site Areas

For the purposes of site creation, the following assumptions were made regarding size of sites:

- Voids:
  - placement area – ideally, a volume below groundwater of 1.9 M m^3 is required but as these are existing voids, there is no control over this
  - treatment area – not required
  - provision for tailwater treatment – subject to preliminary concept design.
- Reclamation:
  - placement area – a contained volume below MSL of 1.9 M m^3 is required (actual dimensions depend on topography)
  - treatment area – cells within placement area
  - provision for tailwater treatment – subject to preliminary concept design.
- Terrestrial:
  - placement area 60 ha (i.e. 1.9 M m^3 stored 3 m deep)
  - treatment area 30 ha (bulking factor of 1.0 assumed once tailwater has been discharged) provision for tailwater treatment – subject to preliminary concept design (the 30 ha area is based on the 12.6 ha figure quoted in **Table 5-1** above with an additional allowance for rainfall and variations in the delivery rate)
  - typical total site area for placement and treatment of 1.9 M m^3 material was assumed to be 90 ha.

5.2.3 Allowance for Watercourses

All land for potential terrestrial sites within the SS area was inspected to determine parcels of the desired size or greater that did not involve straddling watercourses with ponds or other major infrastructure to obtain the required area. This rule was adopted in order to avoid fragmenting sites to accommodate projects that would need to preserve such watercourses.

5.2.4 Allowance for Existing Roads

Similarly, development ideally should not straddle existing roads or major infrastructure (e.g. powerlines and water mains) on the basis that this could require relocation or other undesirable mitigation. However, it may still be practical to develop land on either side of minor roads as long as they do not impose unacceptable constraints on handling operations.

5.2.5 Results

The following table provides details of all parcels selected by the above process. These were subsequently subjected to preliminary concept design. Refer to **Figure 5-1**.

Table 5-2 Selected sites (parcels)

No	TYPE	NAME	LOCATION	DETAILS
Barron Delta Placement Precinct				
1	Void	Northern Sands	Barron Delta 5/SP245573 + 2/RP712954	Existing void created for sand extraction.
2	Void	Pioneer Sands	Barron Delta 125/C157314 + 57/C157314 + 4/SP284222 + 2/SP173007 +?	Existing void created for sand extraction.
3	Bunded area on Barron Delta	Ponderosa Prawn Farm	Walkers Road, Yorkeys Knob 2/RP894172 + 16/USL9940	Existing bunded area (current prawn farm ponds).
4	Bunded area on Barron Delta	Pappalardo Ponds	Pappalardo Farm 1/RP800898	Existing bunded area (abandoned aquaculture ponds).
Cairns Bay Placement Precinct				
5	(Sub-tidal) Reclamation	Northern Esplanade	Cairns Esplanade adjacent to Ellie Point near the Cairns airport	Reclamation to MSL. Will create wading bird habitat as a beneficial end use.
6	(Sub-tidal) Reclamation	Bessie Point	Bessie Point east of Trinity Inlet	Reclamation to MSL. Will create wading bird habitat as a beneficial end use.

(Continued over)

No	TYPE	NAME	LOCATION	DETAILS
Trinity Inlet West Placement Precinct				
7	(Sub-tidal) Reclamation	Admiralty Island Reclamation	Admiralty Island (eastern edge)	Reclamation to MSL adjacent to Admiralty Island. Could form the foundation for future land reclamation for port purposes as a beneficial end use.
8	Terrestrial	Tingira Street	4/SP218291 + 3/SP218291	Vacant land south of the existing industrial area.
9	Terrestrial	Admiralty Island	Admiralty Island (northern part) 92/NR3051	Part of the draft EIS Admiralty Island site.
Trinity Inlet East Placement Precinct				
10	Terrestrial	East Trinity Option 1	3/RP722816 + 158/NR5877 (part only of some lots)	Part of the draft EIS East Trinity site on current cane land.
11	Terrestrial	East Trinity Option 2	158/NR5877 (part)	Part of the draft EIS East Trinity site on former cane land now used for low intensity horticulture.
12	Terrestrial	East Trinity Option 3	11/SP232030 + 10/SP232030 + 1/RP730979 + 1/RP734280 (part only of some lots)	Part of the draft EIS East Trinity site on former degraded cane land now being rehabilitated.
Trinity Inlet South Placement Precinct				
13	Terrestrial	Cane Farm	18/N157190 + 9/N157190 + 10/N157190 + 11/N157190	Part of draft EIS Cane Farm.
Yarrabah Placement Precinct				
14	Terrestrial	Yarrabah	900/SP265165 (part)	Part of the former Yarrabah DOGIT.

Source: Study team compilation.

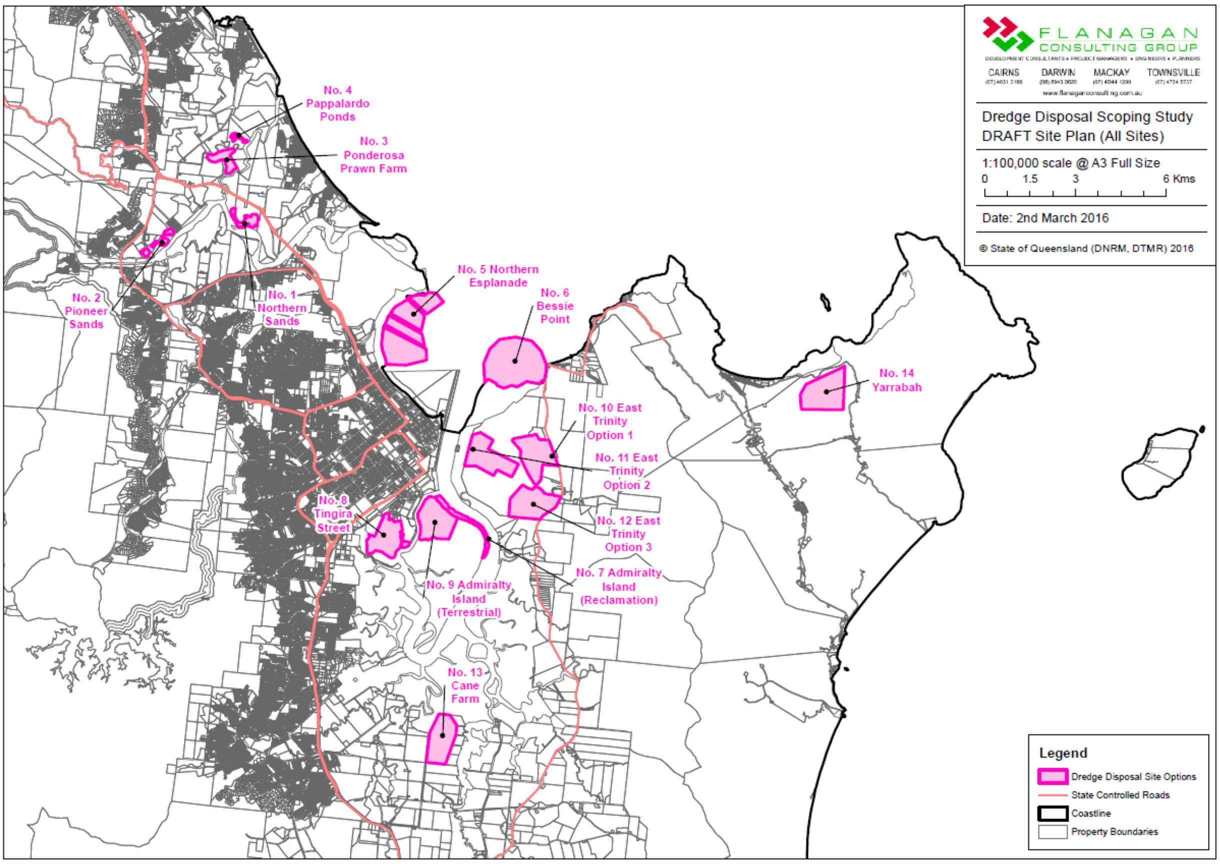


Figure 5-1 Candidate sites for site evaluation.

See **Appendix C** for a larger version of this map.

Overall, this list of 14 sites includes:

- two existing voids in the Barron Delta Placement Precinct
- two existing bunded areas in the Barron Delta Placement Precinct
- three reclamation sites in the Cairns Bay Placement Precinct and Trinity Inlet East Placement Precinct
- seven terrestrial sites east, west, and south of Trinity Inlet and at Yarrabah in the Trinity Inlet East, Trinity Inlet West, Trinity Inlet South and Yarrabah Placement Precincts.

As noted previously, some of the above sites are typical of a suite of potential sites. In particular:

- new voids could conceivably be created in the Barron delta
- the two Cairns Bay reclamation sites (Sites 5 and 6) could possibly be modified or additional sites created
- the three east trinity sites (Sites 10, 11, 12) are just three examples of many sites that could be located at East Trinity
- the cane farm site (13) is one of many placement sites that could be located on cane land south of Trinity Inlet at the limit of practical pumping.

The Yarrabah site (Site 14) is considered to be the only feasible site within the Yarrabah Placement Precinct as land to the east has no land access.

5.2.6 Consultation with Affected Landowners / Managers

No consultation has been undertaken with the owners or managers of any of the affected properties listed.

5.3 PRELIMINARY CONCEPT DESIGN

A preliminary concept design was completed for each site, with details varying depending on the type of site (void, reclamation, terrestrial) and the specifics of the site. The key design details were:

- minimum storage volume as described above wherever possible
- the area corresponding to this volume as described above, allowing for:
  - handling areas for incoming spoil and discharged tailwater
  - treatment areas
  - other site needs (e.g. allowance for machinery storage, offices)
- route section and major details of spoil delivery hardware (i.e. pumps, boosters, pipelines)
- land transport access (e.g. for delivery of lime and export of treated material if appropriate).

All concept designs are shown in **Appendix C**.

5.4 PLACEMENT VOLUME

While the CD process sought to create projects on sites with the target placement volume of 1.9 M m^3, this was not always possible. There are four different situations for placement capacity:

- Void – the volumes of existing voids are based on an assumed depth, meaning that there is uncertainty in the actual volume available. Should voids be further considered, their actual volume would need to be confirmed, along with any opportunities to enlarge them or create new voids.
- Reclamation – sites were designed to accommodate disposal of the target volume.
- Terrestrial: New sites were designed to accommodate the target volume by storage of dredged material, management of tailwater, and treatment of dredged material where required. Smaller sites may still be suitable if used in combination with other sites or if placement is in stages that allow some consolidation of the initial placement before the subsequent material is added.
- Terrestrial: The volumes of existing bunded areas on the Barron delta are already determined.

The following table summarises the initial estimate of available storage for each site.

Table 5-3 Placement volume

SITE	TYPE	NAME	VOLUME (M m^3)	% OF REQUIRED VOLUME	REMEDY TO INCREASE VOLUME
1	Void	1 Northern Sands	1.42	75%	Actual volume to be determined. This void may be able to be expanded.
2	Void	2 Pioneer Sands	0.95	50%	As above.
3	Bunded area on Barron Delta	3 Ponderosa Prawn Farm	0.25	13%	Nil.

SITE	TYPE	NAME	VOLUME (M m^3)	% OF REQUIRED VOLUME	REMEDY TO INCREASE VOLUME
4	Bunded area on Barron Delta	4 Pappalardo Ponds	0.19	10%	Nil.
5	(Sub-tidal) Reclamation	5 Northern Esplanade	~1.90	100%	N/A.
6	(Sub-tidal) Reclamation	6 Bessie Point	~1.90	100%	As above
7	(Sub-tidal) Reclamation	7 Admiralty Island	~1.00	52%	Unlikely to be possible to expand (link to Site 9)
8	Terrestrial	8 Tingira Street	1.01	53%	May be possible to expand onto Port land and / or link to Site 7.
9	Terrestrial	9 Admiralty Island	~1.90	100%	N/A
10	Terrestrial	10 East Trinity Option 1	~1.90	100%	N/A
11	Terrestrial	11 East Trinity Option 2	~1.90	100%	N/A
12	Terrestrial	12 East Trinity Option 3	~1.90	100%	N/A
13	Terrestrial	13 Cane Farm	~1.90	100%	N/A
14	Terrestrial	14 Yarrabah	~1.90	100%	N/A

This table shows that most sites can provide the ultimate yield. As noted later, the smaller sites may still be suitable if used in combination with other sites or if placement is in stages that allow some consolidation of the initial placement before the subsequent material is added. Other considerations relating to placement capacity are:

- it is possible that site survey will confirm that the existing voids are larger than assumed
- existing voids may be able to be enlarged
- construction of new voids may be feasible
- the assumed 2.2 bulking factor may be conservative (should a lower figure be appropriate then smaller sites will have a greater ability to contain dredge material).

This can be addressed on ultimately selected sites during the EIS process.

6 SITE EVALUATION

6.1 INTRODUCTION

Unlike the SS attributes that are ‘must have’, SE attributes are more about matters of degree (relative preference). This requires the use of MCA techniques including mapping of data, measuring performance, scoring the measured values, and standardising the raw scores to aid analysis.

The SS / CD process yielded 14 sites that, based on the adopted rules, may be suitable for land placement. As this number is too large for assessment in the EIS, MCA techniques were required to reduce this to a more manageable number.

Continuing on from the SS process previously described in **Section 4.3.2a)**, the Master List of attributes (**Appendix A**) was reviewed for attributes appropriate to the SE process and consideration given to information needs, broad measurement, and scoring rules. As part of this process, the names of the attributes were amended slightly as the issue was examined in more detail.

6.2 SE METHODOLOGY

6.2.1 Overview

The adopted site evaluation methodology described below was based initially on a review of available decision support systems prepared for the Department of Transport and Main Roads by the late Professor Geoff McDonald, then Head of Department of Geographical Sciences and Planning at the University of Queensland. In his paper, McDonald (2000) details the process of choosing an appropriate evaluation model, and concludes that MCA is the superior method. The interpretation of MCA recommended by McDonald is one that can assist in making choices between discrete alternative solutions or combinations of alternatives based on meeting multiple criteria, derived from a project’s Project Charter (should one exist) or, in the absence of such a charter, by what is now referred to as the ‘quadruple bottom line’ that uses four ‘pillars’ of modern civilisations. The first three of these ‘pillars’ (the old ‘triple bottom line’ (TBL)) consist of social equity, environmental, and economic factors), sometimes simplified as 'people, planet, and profit’.

The fourth ‘pillar’ denotes a future-oriented approach (future generations, intergenerational equity, etc.) and is a long-term outlook that sets sustainable development and sustainability concerns apart from previous social, environmental, and economic considerations. In most practical applications of MCA, however, long term considerations can be built into the other three and a TBL approach is justified.

It is common to introduce a fourth criterion, namely *Performance* to enable technical matters to be evaluated, even though they sometimes are not independent of other criteria (usually *Cost*).

Other guidance is provided by a seminal reference titled *GIS and Multi-criteria Decision Analysis* developed by Malczewski (1999). References to these various works are provided below where appropriate.

In summary, MCA is a comparative tool that requires, when the resources required to follow this model exist):

- clear project objectives (i.e. the criteria against which to compare options)
- spatial coverages that map the criteria and sub-criteria (including any variations in quality within each criterion or sub-criterion)
- project alternatives whose performance can be quantitatively measured for their effect on the criteria and sub-criteria
- a weighting and sensitivity analysis to test the relative importance of various criteria and investigate weighting profiles that simulate the normal political process.

A useful feature of MCA is that lessons learned during the measurement phase can be used to improve the 'best' option (i.e. by optimising its performance) and thereby develop an even better solution. This is a task that is best left to the EIS.

6.2.2 SE Rules

Appropriate SE rules from the Master List (**Appendix A**) were broken down into the adopted hierarchy described in **Section 3.4** (i.e. *Cost*, *Environmental*, *Performance*, and *Social*) as identified by the corresponding prefix (i.e. E = Environmental):

- *Cost*
  - C1 – Cost
- *Environmental*
  - E1 – Surface Water
  - E2 – Groundwater
  - E3 – Biodiversity Values
  - E4 – Acid Sulfate Soil
  - E5 – Birdstrike
  - E6 – Coastal Hazards
- *Performance*
  - P1 – Pumping Head
  - P2 – Placement Capacity
  - P3 – Tailwater Discharge
  - P4 – Ground Conditions & Stability
- *Social*
  - S1 – Remoteness from Incompatible Land Use [deleted]
  - S2 – Important Agricultural Areas
  - S3 – Traffic
  - S4 – Appropriate tenure (ownership).

6.3 DETAILS OF RULES AND APPLICATION

Table 6-1 below is a summary of the adopted SE rules. This is similar in many ways to **Table 4-3** except that whereas the former uses each attribute for excluding or including areas of land (i.e. Exclusion / Inclusion Rules), the latter is concerned with scoring (i.e. measuring the degree of suitability).

In this table:

- Attribute ID and Name: often identical to SS but sometimes different (derived from the Master List).
- Rationale. This is why the attribute is important. Similar to SS but in this case the focus is on projects on sites, rather than identifying suitable land.
- Type (Void, Reclamation (sub-tidal, inter-tidal, supra-tidal), Terrestrial). Attributes may apply to all or some, and may be dealt with differently in some cases. As for SS.
- Measurement. How the performance of the project for attribute will be measured or in any way evaluated.
- Scoring: How the measurement is used to derive a score in whatever units are appropriate. This could be cost (in $) or a derived metric consisting of the product of say area and a weighting based on value category, while in other cases it may be an ‘index’ requiring qualitative assessment. The score can use any units / scale as these are standardised later.
- Notes: As required to explain any important points.

This table is a summary only and further explanation on all attributes follows the table.

Table 6-1 Site evaluation rules

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	SCORING	NOTES
		Void	Reclamation	Terrestrial			
C1 – Cost	The cost of a project is an important aspect of project viability. This cost needs to be net present cost (NPC) in order to take into account the time series of operational costs (if relevant) and the present value of any future income.	✓	✓	✓	Based on the features of a site and the concept design, an initial estimate was made of capital and ongoing cost. Capital cost included land acquisition, construction of storage and treatment works, and offsets / mitigation (if relevant). Operational costs over the life of the site were estimated and an overall NPC calculated. The value of the site for its ultimate beneficial reuse was estimated.	Score based directly on unit cost ($).	Cost is included in the detailed SE process but is also discussed separately due to its critical important to the CSD Project.
E1 – Surface Water	As part of dewatering of the dredge material, tailwater will be discharged from the placement site. While the discharge of tailwater would be strictly controlled to ensure it is maintained within acceptable quality standards, different sites may have different inherent risks.	✓	✓	✓	Concept designs were developed for each site and these include indicative locations for tailwater discharge. Salinity of receiving water was estimated.	Score involves an index based on qualitative assessment of risk (likelihood x consequence). Consequence includes consideration of the value of environmental receptors and flushing behaviour.	Technical aspects of tailwater discharge for each type of site will differ but the same metrics can be used.

(Continued over)

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	SCORING	NOTES
		Void	Reclamation	Terrestrial			
E2 – Groundwater	Placement in voids and terrestrial sites may release seepage and/or tailwater to groundwater. This could have an adverse effect on the quality of adjacent groundwater with environmental impacts.	✓		✓	The DNRM bore database was used to identify likely groundwater conditions at each site in terms of: • depth to groundwater • salinity of groundwater • environmental aspects.	Score involves considering sliding scale of desirable attributes: • depth to groundwater (shallower groundwater is preferable) • salinity (saline groundwater is preferable).	In non-saline groundwater environments: • assessment is required of salt in tailwater and pore water leaching to groundwater (and the impacts of this) • need for mitigation measures such as liner and re-pumping of tailwater to marine/saline discharge point • ability to win bund materials from site impacted by high groundwater table • consideration of mitigation measures can be tied to salinity (score).

(Continued over)

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	SCORING	NOTES
		Void	**Reclamation**	**Terrestrial**			
E3 – Biodiversity Values	Construction of the projects could involve the loss of biodiversity values through clearing for bunded areas, treatment infrastructure, and the delivery pipeline.		✓	✓	Indicators of biodiversity value were mapped and stratified by value. Elements used were: • remnant vegetation (other than mangroves) stratified by Biodiversity Status • remnant vegetation (mangroves) un stratified • seagrass • Groundwater Dependant Ecosystems / wetlands. Areas of clearing were measured.	Scores were calculated based on the product of cleared area and the stratified value.	Stratified value is described in **Section 6.6.4b)**.

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	SCORING	NOTES
		Void	Reclamation	Terrestrial			
E4 – Acid Sulfate Soil	Soils that are actual acid sulfate soil / potential acid sulfate soil (AASS / PASS) have the potential to release undesirable runoff under some circumstances when disturbed. This runoff can provide a risk to the environmental values of the receiving environment. While management is required in these cases, this makes such sites less desirable than those not requiring management. The construction of new voids and/or bunded terrestrial sites could disturb such soils. Note that this attribute covers ASS on the placement site, not that of the dredged material. Filling on sites were AASS is present may cause settlement/displacement of AASS back below the water table and result in acid release and mobilisation of heavy metals.	✓		✓	Special Acid Sulfate Soils Map – Cairns Area (Acid Sulfate Soils of Cairns, North Queensland, DERM, 2009) 1:50,000 Scale was used to assess areas underlain by AASS and/or PASS. Avoid known/mapped areas of AASS.	Scores were calculated based on the risk of disturbing ASS.	Statutory ASS mapping is considered too coarse to use (essentially covering all land < 20 m AHD).
E5 – Birdstrike	Placement sites near to the Cairns airport have the potential to attract birds and that could be a hazard to aircraft operations. The Australian Aviation Wildlife Hazard Group (2012) includes recommendations for buffer distances to reduce or mitigate risk. These recommendations are included in CairnsPlan in the form of mapped Areas and associated management actions.	✓	✓	✓	The CairnsPlan Bird and Bat Strike Hazard Map delineates (management) Areas (based on proximity to the airport) and was used for this attribute.	Scores were assigned based on mapped area in which a site lies. All sites outside the mapped area received a zero raw score (i.e. no constraint).	

(Continued over)

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	SCORING	NOTES
		Void	Reclamation	Terrestrial			
E6 – Coastal Hazards	Low-lying land in the vicinity of the coast is at risk from coastal hazards (storm tide and tsunami). These events can cause serious impacts in terms of inundation and physical forces. In addition, long term effects from shoreline erosion can place coastal structures at risk.	✓	✓	✓	AGSO mapping delineates exposure profiles and was used for part of this attribute. DEHP mapping was used to delineate land that is within the erosion prone and storm tide hazard areas with SLR. Tsunami risk was based on the 6 m AHD contour (CRC hazard planning).	Scores were assigned based on mapped level of exposure zone with a check for consistency with the 6 m AHD contour.	The applicability of the sea level rise (SLR) metrics will also depend on the practical design life of the reclamation or bunded area – a temporary facility may be sited and designed differently from a more permanent facility.
P1 – Pumping Distance	The practical pumping distance depends on both pipe friction (a function of length from the pump to the delivery point) and static head (elevation difference between dredge and disposal site).	✓	✓	✓	A concept pumping design was completed for each site to determine pumping head (based on elevation and distance).	Scores were assigned based on the combined assessment of the pumping distance plus elevation.	Elevation was incorporated by way of approximating 1 m elevation increase being equivalent to a 1 km increase in pipe length.

(Continued over)

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	SCORING	NOTES
		Void	**Reclamation**	**Terrestrial**			
P2 – Placement Capacity	For a site to be suitable it needs to be able to store all (or as much as possible) of the material dredged for Scenario 1 and Scenario 2. However, some smaller sites may still be suitable if used in combination or if they are otherwise desirable. Future allowance could be made for smaller sites where export of treated material is possible (as this increases the overall long term placement capacity) or where staged placement allows for consolidation and hence 'extra' volume.	✓			The placement capacity of existing voids was estimated based on available storage volume (no allowance for consolidation).	Scores were assigned based on the placement capacity.	No export assumed. The concept of 'Export' involves removing settled material some years after placement and reuse off site. This would free the placement area to accept more dredge material if required.
			✓		The placement capacity of reclamation sites was estimated based on available storage volume (no allowance for consolidation).	Scores were assigned based on the placement capacity.	No export assumed.
				✓	The placement capacity of <u>existing bunded areas</u> was estimated based on available storage volume (no allowance for consolidation).	Scores were assigned based on the placement capacity.	No export assumed.
				✓	The long term placement capacity of <u>new bunded areas</u> was estimated based on available storage volume (no allowance for consolidation).	Scores were assigned based on the long term placement capacity.	Export assumed in some cases.

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	SCORING	NOTES
		Void	Reclamation	Terrestrial			
P3 – Tailwater Discharge	All placement activities will require the need to discharge saline tailwater to the receiving environment. It is assumed that this will ultimately be the ocean. Reclamation sites are already in the ocean and all that is required is management of turbidity. For voids and bunded sites, tailwater will ideally be discharge to adjacent watercourses (assuming that this can be done sustainably) or at worst, pumped back to the ocean.	✓		✓	Sites were assessed for the engineering feasibility of direct discharge. Engineering factors include the distance to discharge waterbodies, the need or otherwise for pump assisted discharge, the need for additional discharge channels or pipes, the volumetric capacity and hydrology of the receiving waterbody (i.e. the extent to which the discharge would change the hydrology of the waterbody and/or cause overtopping or scour. Concept designs of alternative solutions were undertaken in cases where engineering feasibility could not be achieved.	Scores were assigned based on a qualitative index derived from an assessment of the extent of works required to achieve sustainability.	

(Continued over)

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	SCORING	NOTES
		Void	Reclamation	Terrestrial			
P4 – Ground Conditions & Stability	New voids will need to be constructed with stable side slopes. It is preferable that the material to be excavated from void is suitable for offsite reuse/sale to avoid onsite stockpiling.	✓			Sites were assessed based on geological maps to consider potential for materials for reuse (for bund construction or void export) and the presence of any likely foundation issues.	Scores were assigned based on a qualitative index derived for: • expected suitability of excavated materials for offsite reuse/sale • potential issues with foundations/stability.	Will need to consider in the scoring the importation of bund material for intertidal (terrestrial) sites. The construction approach for these mangrove areas would likely be to cut the mangroves at the base and then fill over the top of the intact root matrix with dredge material. There will not be in situ material from the cleared site that can be used so will have to be imported.
	Terrestrial placement sites need to be stable and suitable for the construction of bunds and the storage of up to 3 m depth of dredged material. Ideally, bunds can be constructed from material won from the site.			✓		Scores were assigned based on a qualitative index derived for: • expected suitability of materials for use in bund construction • potential issues with foundations/stability.	Scoring rules are described in **Section 6.6.11**.

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	SCORING	NOTES
		Void	Reclamation	Terrestrial			
S1 – Remoteness from incompatible land use	[Deleted]						As the SE process proceeded it was realised that although placement activities can involve undesirable amenity issues, sites that were considered to be too close to such areas were excluded by the SS process (S1 – Remoteness from incompatible land use). No additional evaluation was considered useful.
S2 – Important Agricultural Areas	Important Agricultural Areas (formerly described as Good Quality Agricultural Land) are a recognised resource that has been given protection due to its inherent natural resource and economic values.			✓	DSDIP mapping was used to delineate areas based on the Agricultural Land Classification (ALC).	Scores were calculated based on the product of cleared area and the stratified ALC for Class A and Class B land.	
S3 – Traffic	Although dredged material will be deliver to each site by pumping, treatment and general site activities will generate road traffic, with the main activities being delivery of lime and fuel and carting of exported treated material (if appropriate) and in some cases, the importation of material from which to construct bunds. This traffic has the potential to create impacts on the road network and the general community.	✓	✓	✓	Concept designs were developed for each site and these included estimates of traffic generation (number of trick movements) and likely routes.	Scores were assigned based on a semi-quantitative index derived from the combined effect of truck numbers and routes taken.	It is unlikely that bund material will be available within some of the terrestrial sites (e.g. Tingira St and Admiralty Island) and will need to be imported. Consideration will also have to be given to road transport of bucket-dredged stiff clays.

ATTRIBUTE	RATIONALE	TYPE			MEASUREMENT	SCORING	NOTES
		Void	Reclamation	Terrestrial			
S4 - Appropriate Tenure (Ownership)	An important consideration is the ability to acquire the land needed for the various sites (or the ease of such acquisition). It is assumed that land in public ownership will be easier to acquire than private land, especially land with advanced planning for development. This is not a price consideration (allowed for in C1) but rather a measure of ease of acquisition.	✓		✓	The DCDB was used to map tenure in the SE area and this was stratified into the following groups: • State Freehold • State Reserve • Water (i.e. for reclamation options) • Private.	Scores were assigned based on an assessment of the relative ease of acquisition.	It is assumed that land for reclamation does not fit into any of these tenures.

Source: Study team compilation.

6.4 SCORING

For each attribute, scores were assigned for each project as described in the following section. For some attributes the most desirable option has the highest value (a 'benefit' attribute) while for others it has the lowest (a 'cost attribute). As described in **Section 6.5.2**, this situation can be easily accommodated by the standardisation process to ensure consistency.

6.5 EVALUATION METHODOLOGY

6.5.1 Scores

For each attribute, scores were assigned for each project as described above. As noted, these could be 'benefit' attributes (where the highest raw score is the 'best') or 'cost' attributes (where the lowest raw score would be 'best'). As long as the subsequent standardisation process takes this into account (see below), both types can be accommodated in the one analysis.

6.5.2 Standardisation

a) Adopted Standardisation

Raw scores for each attribute (which could be in a range of units including hectares of habitat, dollars, months of placement etc.) were transformed (standardised) to a scale of 0 to 1. The method used provides both the relative ranking of options and some idea of the magnitude of the comparative performance of options for each criterion. This method allows for the simultaneous use of 'benefit' attributes (where the highest raw score is the 'best') and 'cost' attributes (where the lowest score is 'best'), as long as a suitable transformation is used. In both cases a standardised score of 1 would be awarded. This makes it easy to compare projects with both benefit and cost attributes. Examples are:

- benefit attributes: placement capacity, stability
- cost attributes: cost, (clearing of) biodiversity values, (clearing of) important agricultural areas.

In this analysis, it is considered desirable that the 'benefit' attribute approach be used such that the most desirable options scores 1. 'Cost' type attributes were transformed during standardisation by using the inverse of scores as recommended by Malczewski (1999). This ensures that:

- the 'best' outcome always has a standardised score of 1
- the worst outcome could theoretically have a standardised score of 0 but will more likely be greater than that
- the relative order and magnitude of the standardised scores remains equal to that of the raw scores (although the transformed 'cost' attributes are not linearly distributed).

b) Possible Alternative Approach

When applied to 'cost' attributes, there are two options available for the application of the adopted standardisation approach to sites where the attribute is not relevant. An example is the effect of transport associated with lime deliveries to sites where lime is not required (e.g. the reclamation sites). Using this as an example, the two options are:

- Option 1: because the attribute is not relevant to reclamation sites, it could be argued that these sites score well with respect to this attribute (i.e. should receive a standardised score of 1) when compared with sites that generate traffic.
- Option 2: the alternative is to award a score of zero on the basis that the attribute is not relevant. The problem with this approach is that a score of zero corresponds to the worst result. This is a confusing outcome.

Based on the above discussion it was decided to use the Option 1 approach – that is, to award the highest possible score for 'cost' attributes that are not applicable to a site.

6.6 EXPLANATION OF ATTRIBUTES AND SCORING

6.6.1 C1 – Cost

a) *Detailed Explanation*

The cost of developing and using placement sites is an important aspect of viability of the CSD Project. Based on the features of a site and the concept design, an initial estimate was made of capital and ongoing cost. These should be used for comparing the sites, and not preparation of detailed project budgets. Cost estimates include:

- **Preliminaries** – planning and approvals cost including EIS, project management, design, management and supervision.
- **Dredging** – establishment, dredging and pumping costs and demobilisation.
- **Containment** – site acquisition, environmental and agricultural land offsets, site establishment, construction of storage bunds including earthworks and liners, imported fill, supply and installation of sheet piling, site rehabilitation costs.
- **Water Management** – construction of tailwater races, pumping and pipelines, tailwater control
- **Treatment** – cost of neutralisation of ASS/PASS material.
- **Operations** – ongoing environmental monitoring, security and site management until placement site has been stabilised.
- **Contingency** – allowance for estimate risk based on preliminary and high level estimates and concept level design.

Details of the assumptions and adopted rates for the high level assessment are attached in **Appendix E**. Given the different capacities of each site, the appropriate measure for comparison of costs is the total unit cost / m^3 for dredging treatment and disposal.

b) *Scoring*

This is a 'cost' attribute as the most desirable outcome has the lowest score. It applies to voids, reclamation, and terrestrial types.

Table 6-2 shows the high level cost estimates revealed the following relative cost for each site.

Table 6-2 C1 – Cost Estimates

SITE	NAME	AMOUNT OF SOLID DREDGED MATERIAL PROCESSED (m^3)	TOTAL COST ($)	RATE ($ /m^3)
1	Northern Sands	645,000	58,567,292	91
2	Pioneer Sands	430,000	41,260,602	96
3	Ponderosa Prawn Farm	189,200	28,382,283	150
4	Pappalardo Ponds	86,000	17,375,543	202
5	Northern Esplanade	860,000	55,743,790	75
6	Bessie Point	860,000	50,523,575	68
7	Admiralty Island Recl.	860,000	47,174,900	63

SITE	NAME	AMOUNT OF SOLID DREDGED MATERIAL PROCESSED (m^3)	TOTAL COST ($)	RATE ($ /m^3)
8	Tingira Street	430,000	74,689,708	174
9	Admiralty Island	860,000	77,965,813	113
10	East Trinity Option 1	860,000	94,425,999	110
11	East Trinity Option 2	860,000	94,573,079	110
12	East Trinity Option 3	860,000	94,998,366	110
13	Cane Farm	860,000	93,345,655	109
14	Yarrabah	860,000	111,964,540	130

c) Evaluation

The raw scores were standardised, with the results as shown on the following chart.

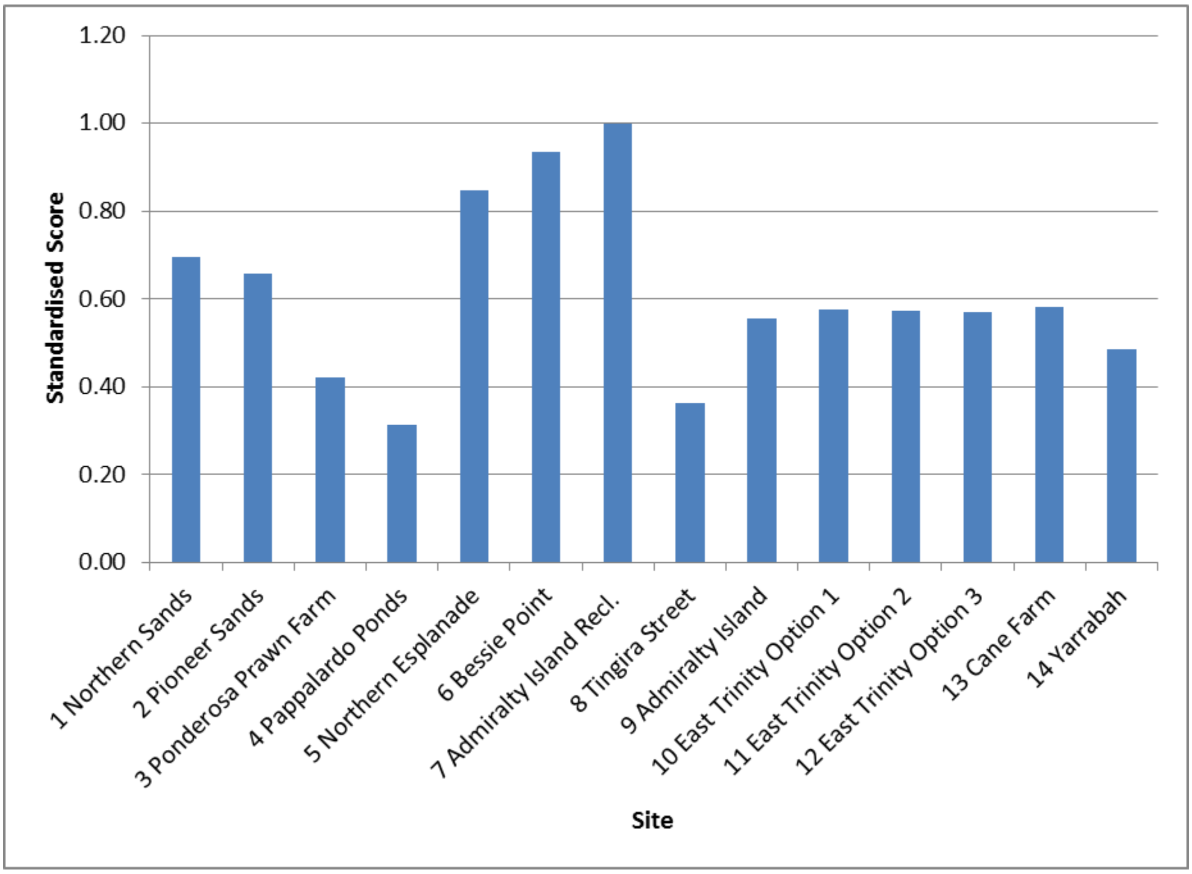


Chart 6-1 C1 – Cost.

This shows that:

- The three reclamation sites (Sites 5, 6, and 7) all score best by a considerable margin due to their relative close proximity to the dredge resulting in lower pumping cost and avoidance of ASS/PASS Treatment costs .
- The two voids (Sites 1 and 2) feature high pumping cost due to their distance from the dredge. However, this is offset by the fact that voids do not need ASS/PASS treatment.
- The six terrestrial sites other than Site 8 (Sites 9 to 14) all score similarly, at about 0.5 to 0.6.
- The worst sites for cost are the two Barron delta bunded sites (Sites 3 and 4) as their small volumes lead to high unit costs.
- Site 8 features high costs due to high clearing costs, environmental offsets, and requirement for imported fills to form the bunds.

6.6.2 E1 – Surface Water

a) Detailed Explanation

Placement of the fine material generated during capital dredging will most likely involve hydraulic placement from a trailing suction hopper dredge.

The management of dredge tailwater will principally focus on the control of fine sediments from the void options, terrestrial options, or from a subtidal reclamation.

Turbidity impacts from tailwater release are of principal concern to seagrass and corals and can include elevated turbidity levels (reducing light required for growth and maintenance) or smothering where fine material settles on the habitat.

It is assumed that acidity issues affecting surface water (acidity or alkalinity) will be managed irrespective of the site location (see E4).

The other important water quality aspect to note is the characteristics of the dredge intake water (collected at the discharge point) and the ambient salinity of the receiving environment at the tailwater discharge point – similarity in the salinity characteristics is desirable to minimise water quality impacts.

b) Scoring

Note that there are two elements for this attribute. Scores were assigned based on inspection of mapping as follows:

- Tailwater (turbidity on seagrass) – proximity of discharge to mapped seagrass (envelope of historic coverage – refer E3)
- Tailwater (salinity) – likely salinity regime of receiving water body.

This is a ‘benefit’ attribute as the most desirable outcome has the highest raw score for each element. It applies to voids, reclamation, and terrestrial types.

Table 6-3 E1 – Surface Water

ELEMENT	TYPE: Void	TYPE: Reclamation	TYPE: Terrestrial	DESCRIPTION	SCORE
Tailwater – turbidity on seagrass	✓	✓	✓	Proposed tailwater discharge point from the site is directly within or in close proximity (< 50 m) to a mapped seagrass area. Mapping rule – intersecting or within 50 m of mapped seagrass.	-2
				The turbidity plume generated from tailwater discharge considered likely to affect mapped area of seagrass. Mapping rule – between 50 and 200 m of mapped seagrass.	-1
				The turbidity plume generated from tailwater discharge considered possible to affect mapped area of seagrass through either elevated turbidity levels or smothering (so within 200 to 1 km). Mapping rule – between 200m and 1km of mapped seagrass.	0
				The turbidity plume generated from tailwater discharge Is greater than 1 km from the nearest mapped seagrass (unlikely to impact). Mapping rule – greater than 1 km from mapped seagrass.	1
Tailwater - salinity	✓		✓	The receiving waterbody for tailwater has limited tidal flushing and has significantly different ambient salinity to the dredge intake water. Mapping rule – the tailwater discharge waterbody is freshwater waterbody or watercourse that is well upstream of the tidal limit.	-2
				The receiving waterbody for tailwater has measurably different ambient salinity to the dredge intake water but can likely assimilate the temporary impact (e.g. within the bounds of natural variability). Mapping rule – the tailwater discharge waterbody is brackish waterbody that is at or near the tidal limit of the waterbody or otherwise in a very poorly flushed environment.	-1
Tailwater (Salinity) – Reclamation options		✓		The default rating for reclamation options. The receiving waterbody for tailwater has similar/identical water quality to the intake water. Mapping rule – the tailwater discharge waterbody is an open water body or otherwise fully flushed tidal waterway.	1

As this table shows, there are two elements for tailwater:

- turbidity effects on seagrass and corals
- salinity effects of tailwater on the receiving environment.

These were assessed for each concept design and converted to a score as per the previous table. Scores were added to create a composite score for the attribute.

In application, these two elements were often found to be countervailing in that a poor score in one could be offset (numerically) by a good score in the other.

c) Evaluation

The raw scores were standardised, with the results as shown on the following chart.

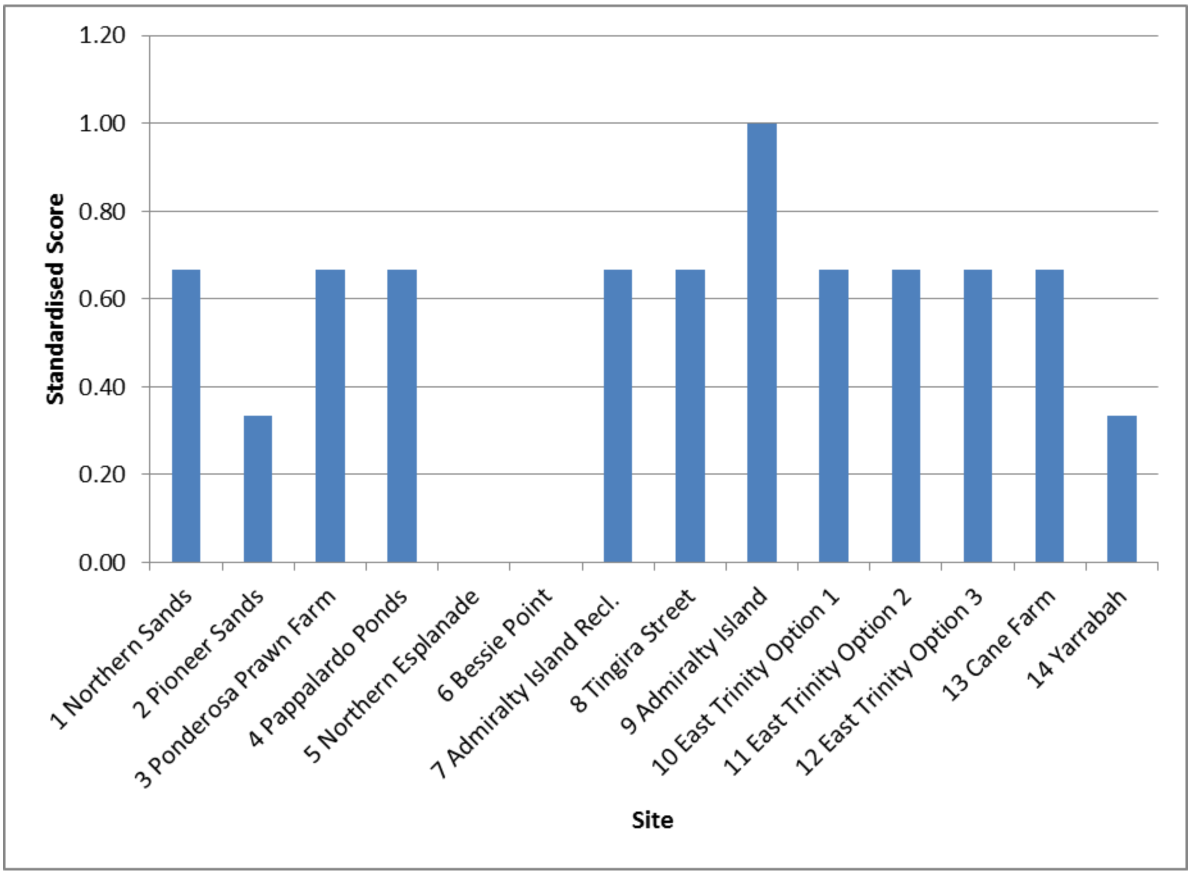


Chart 6-2 E1 – Surface water.

This shows that:

- Site 9 performs best for this attribute as its discharge is remote from seagrass beds and the receiving waters (Trinity Inlet) will be same salinity as the tailwater.
- The two Cairns Bay reclamation sites (Sites 5 and 6) score worst due to the proximity of seagrass beds. Although there is seagrass in Trinity Inlet, it is not in the area selected for Site 7 and therefore does not score as poorly as the Cairns Bay sites.
- Site 2 scores quite poorly due to potential salinity impacts (the receiving waters are largely fresh).
- Site 14 is not preferred from a tailwater perspective as Mission Bay is a Conservation Park (Yellow) Zone of the marine park and therefore has recognised conservation values.
- The remaining sites score equally with a moderate value as they have suitable distance from seagrass beds but receiving waters are likely to be less saline than the discharge.

- The three East Trinity sites (10, 11, and 12) all have identical scores but this is because of the countervailing issue described above. In particular,
    - Sites 10 and 12 score 1 for the first element as the discharge is remote from seagrass and -1 for salinity effects due to the brackish nature of the receiving waters (i.e. = 0)
    - Site 11 scores 0 for the first element as the discharge is moderately remote from seagrass and 0 for salinity effects due to the more saline nature of the receiving waters (i.e. = 0).

6.6.3 E2 – Groundwater

a) *Detailed Explanation*

Placement in voids and terrestrial sites may release tailwater and/or seepage to groundwater. This could have an adverse effect on the quality of surrounding groundwater with environmental impacts.

Assessment of the potential for saline water to leach to groundwater (and the impacts of this) is required. Consideration of mitigation measures can be tied to the depth to groundwater plus groundwater salinity (e.g. for terrestrial disposal in shallow freshwater to brackish environments deposition and tailwater facilities will probably need to be lined).

The DNRM bore database was used to identify likely groundwater conditions at each site. The assigned scores were determined based on an assessment of the depth to groundwater and the groundwater salinity. That is, two elements were used.

b) *Scoring*

Note that there are two elements for this attribute. Scores were assigned based on inspection of the groundwater database as follows:

- groundwater depth – estimated depth to groundwater
- groundwater salinity – likely salinity regime of the groundwater at or near the site.

This is a 'benefit' attribute as the most desirable outcome has the highest raw score for each element. It applies to voids and terrestrial types only.

Table 6-3 E2 – Groundwater

ELEMENT	TYPE			DETAILS	NOTES	SCORE
	Void	Reclamation	Terrestrial			
Groundwater depth	✓			Groundwater depth 0-2 m Groundwater depth 2-5 m Groundwater depth >5 m	Shallower depth is preferable for deposition in voids. Tailwater is as per Terrestrial.	3 2 1
		✓		N/A	N/A	
			✓	Groundwater depth 0-3m Groundwater depth >3 m	Greater depth is preferable.	1 2

(Continued over)

ELEMENT	TYPE			DETAILS	NOTES	SCORE
	Void	Reclamation	Terrestrial			
Groundwater salinity	✓			EC <1000 uS/cm EC 1001 to 5000 uS/cm EC 5001 to 15000 uS/cm EC>15000 uS/cm	Saline groundwater is preferable.	0 1 2 3
		✓		N/A	N/A	
			✓	EC <1000 uS/cm EC 1001 to 5000 uS/cm EC 5001 to 15000 uS/cm EC>15000 uS/cm	Saline groundwater is preferable.	0 1 2 3

c) *Evaluation*

The depth and salinity was assessed for each concept design and converted to a score as per the previous table. As this table shows, there are two elements for groundwater:

- depth
- salinity.

The composite attribute score for each site was obtained by adding together the scores for each element.

The raw scores were standardised, with the results as shown on the following chart.

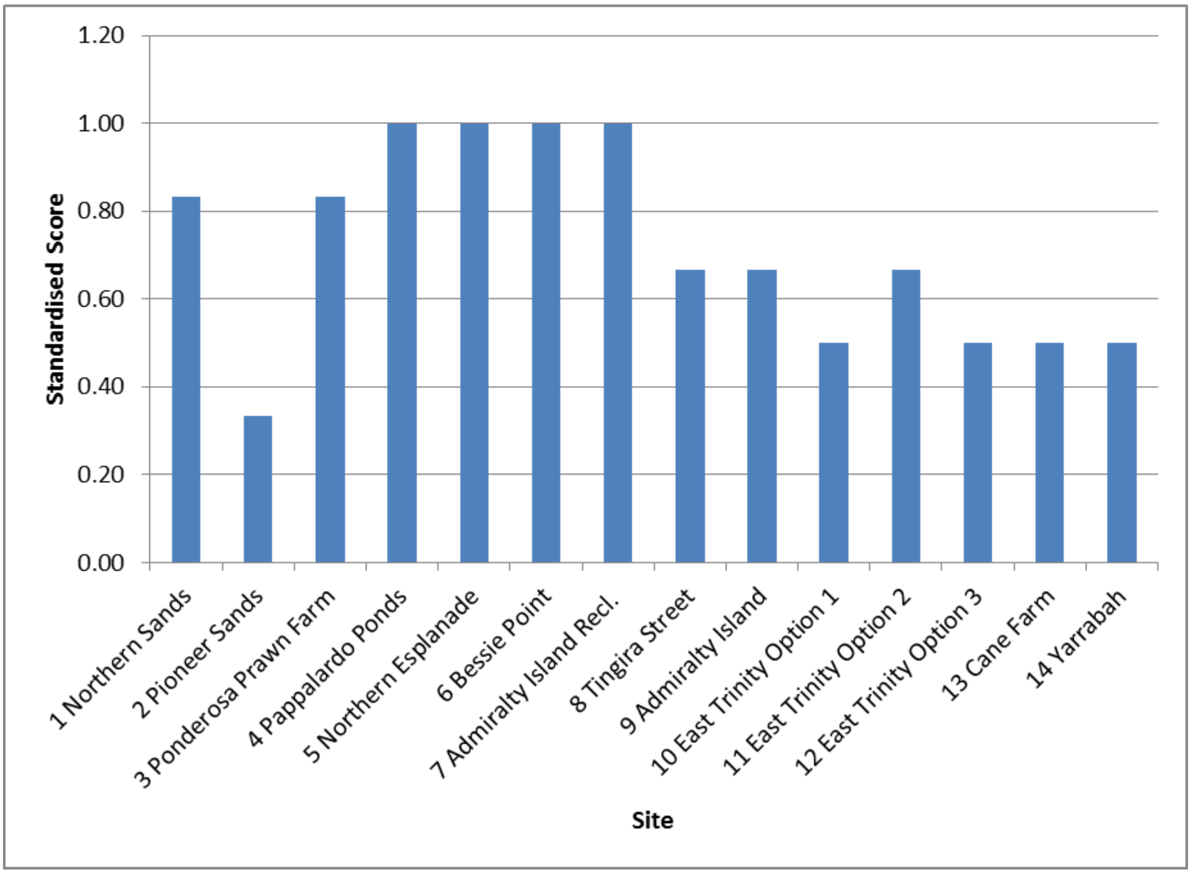


Chart 6-3 E2 – Groundwater.

This shows that:

- Site 4 performs best for this attribute as it has deep groundwater (desirable for a terrestrial site) and this groundwater is saline.
- The three reclamation sites (Sites 5, 6, and 7) all score well as groundwater issues are not relevant (and are hence awarded a nominal score of 1).
- Site 2 performs worst as it has deep groundwater (undesirable for a void) and this is brackish to fresh.
- The remaining sites score more or less equally with a moderate value as they have moderately desirable combinations of groundwater depth and salinity (although in some cases the two elements tend to even the other out).

6.6.4 E3 – Biodiversity Value

a) Detailed Explanation

Areas of natural vegetation within the SS area were identified based on NRM mapping of regional ecosystems (REs). Each polygon was assigned a class based largely on the RE's 'biodiversity status'. 'Biodiversity status' usually (but not always) correlates with the VM Act status. The biodiversity status is based on an assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of a regional ecosystem which is used to determine its class under the VM Act. According to the EHP website, the biodiversity status is used for a range of planning and management applications. It is considered to be the better measure of value for the purposes of this report.

Because of their association with fisheries values, REs that are marine plants (mangrove and saltmarsh communities) were treated differently.

Although seagrass data exists for both historic coverage (where seagrass has grown in the past and may be recovering) and the current extent and coverage of seagrass assemblages (Jarvis *et al.* 2015), it was decided to use an envelope approach adopted in the draft EIS. This envelope covers all areas where seagrass has grown in the period 1984 to 2014 (i.e. potential habitat).

b) Scoring

The assigned score was determined based on an assessment of relative biodiversity value. This is a 'cost' attribute as the most desirable outcome has the lowest raw score.

It applies to voids, reclamation, and terrestrial types as appropriate to the mapping coverage / class.

Table 6-4 Regional ecosystem and other data VS Class

COVERAGE	CLASS	DETAILS	NOTES	SCORE
Regional Ecosystems (VM Act mapping)	A	Endangered REs (ex-marine plants) (Category A or B areas that are an *endangered* regional ecosystem, less 7.1.x)	Based on 'Biodiversity status'. '7.1.x' refers to all REs whose codes start with '7.1' – these are all mangrove types.	3
	B	Of Concern REs (ex-marine plants) (Category A or B areas that are an *of concern* regional ecosystem, less 7.1.x)	Based on 'Biodiversity status'.	2
	C	No Concern at Present REs (ex-marine plants) (Category A or B areas that are a *no concern at present* regional ecosystem, less 7.1.x)	Based on 'Biodiversity status' (note different <u>status</u> terminology) All mangrove REs start with '7.1'.	1
	D	Marine plants (mangrove and saltmarsh communities) (7.1.x)	All mangrove and saltmarsh REs start with '7.1'.	2
Seagrass	E	Seagrass	Based on envelope of historic coverage and current extent.	2
Groundwater Dependent Ecosystems	F	Groundwater Dependent Ecosystems or Wetlands	BoM Atlas of Groundwater Dependant Ecosystems. Wetland inventory.	3

c) Evaluation

The area of clearing for each of the above classes was measured for each concept design and converted to a score as per the previous table. This score was entered into the master table (**Table 6-14**) and further analysed.

The raw scores were standardised, with the results as shown on the following chart. Note that an alternative standardisation process was used for this attribute to accommodate the huge range of scores. Using the normal inverse rule appropriate for 'cost' attributes, low non-zero scores tend to have very low (i.e. undesirable) standardised values. In this situation, the standardised score was obtained by subtracting the weighted area from that of the maximum value and dividing by the maximum. A review of the results suggests that this presents a more realistic outcome.

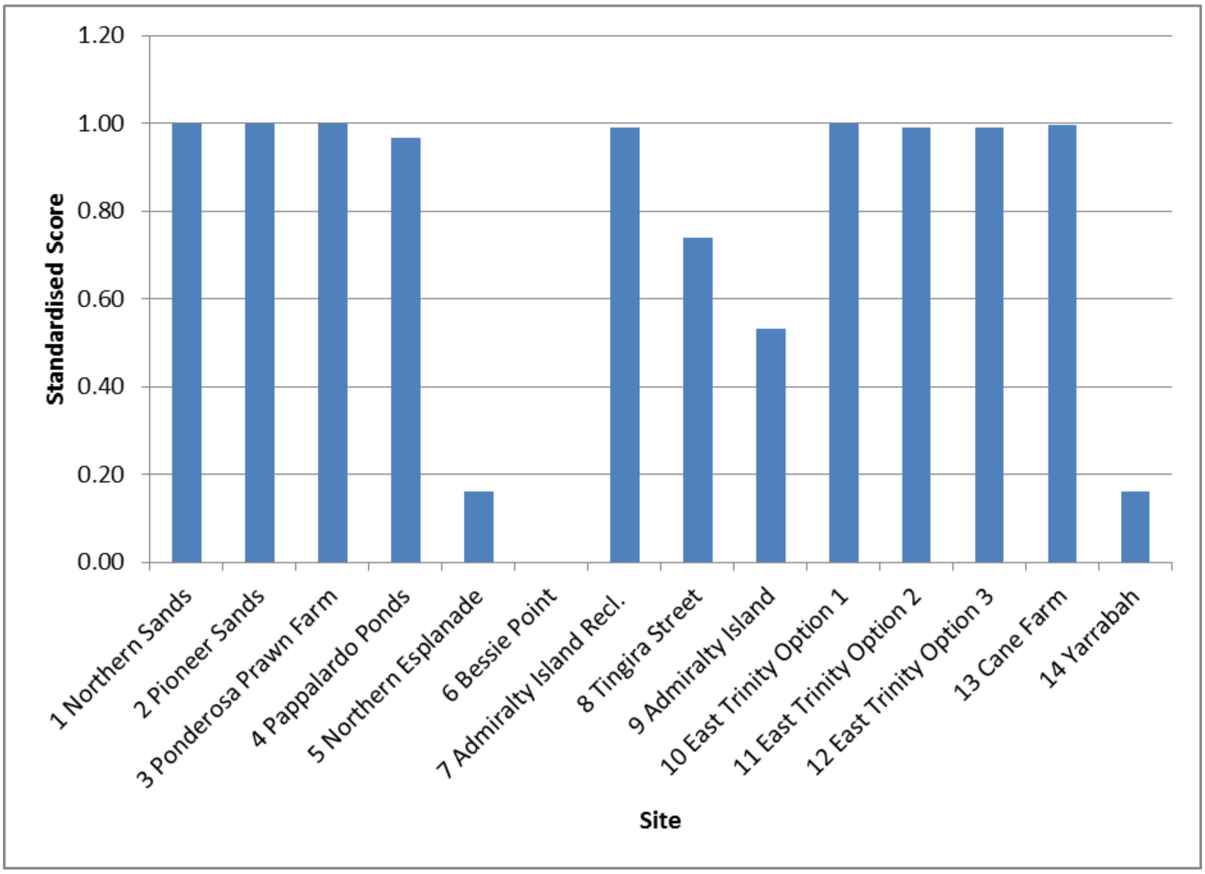


Chart 6-4 E3 – Biodiversity values.

This shows that:

- Sites 1 to 4, 7, and 10 to 13 perform best for this attribute as they are essentially devoid of natural vegetation with biodiversity values.
- The remaining sites all perform poorly due to the need for extensive clearing of valuable vegetation.

6.6.5 E4 – Acid Sulfate Soil

a) Detailed Explanation

Soils that are actual acid sulfate soil / potential acid sulfate soil (AASS / PASS) have the potential to release undesirable runoff under some circumstances when disturbed. This runoff can provide a risk to the environmental values of the receiving environment. While management is required in these cases, this makes such sites less desirable than those not requiring management.

The construction of new voids and/or bunded terrestrial sites could disturb such soils. Filling on sites where AASS is present may cause settlement/displacement of AASS back below the water table and result in acid release and mobilisation of heavy metals.

The Special Acid Sulfate Soils Map – Cairns Area (Acid Sulfate Soils of Cairns, North Queensland – DERM 2009) 1:50 000 Scale was used to assess areas underlain by AASS and/or PASS, noting that known/mapped areas of AASS need to be avoided. The assigned scores were determined based on the risk of disturbing ASS.

b) Scoring

The assigned score was determined based on an assessment of relative ASS / PASS potential. This is a 'benefit' attribute as the most desirable outcome has the highest raw score. It applies to voids and terrestrial types only.

Table 6-5 E4 - Acid sulfate soils

ELEMENT	TYPE			DETAILS	NOTES	SCORE
	Void	Reclamation	Terrestrial			
Acid Sulfate Soils	✓			Presence of AASS PASS < 0.5 m PASS from 0.5 m to >5 m No AASS or PASS	For new voids plus tailwater facilities for new and existing voids.	0 1 2 3
		✓		N/A	N/	
			✓	Presence of AASS PASS < 0.5 m PASS from 0.5 m to >5 m No AASS or PASS	For both deposition and tailwater facilities.	0 1 2 3

c) Evaluation

The risk of disturbing ASS was assessed for each concept design and converted to a score as per the previous table.

The raw scores were standardised, with the results as shown on the following chart.

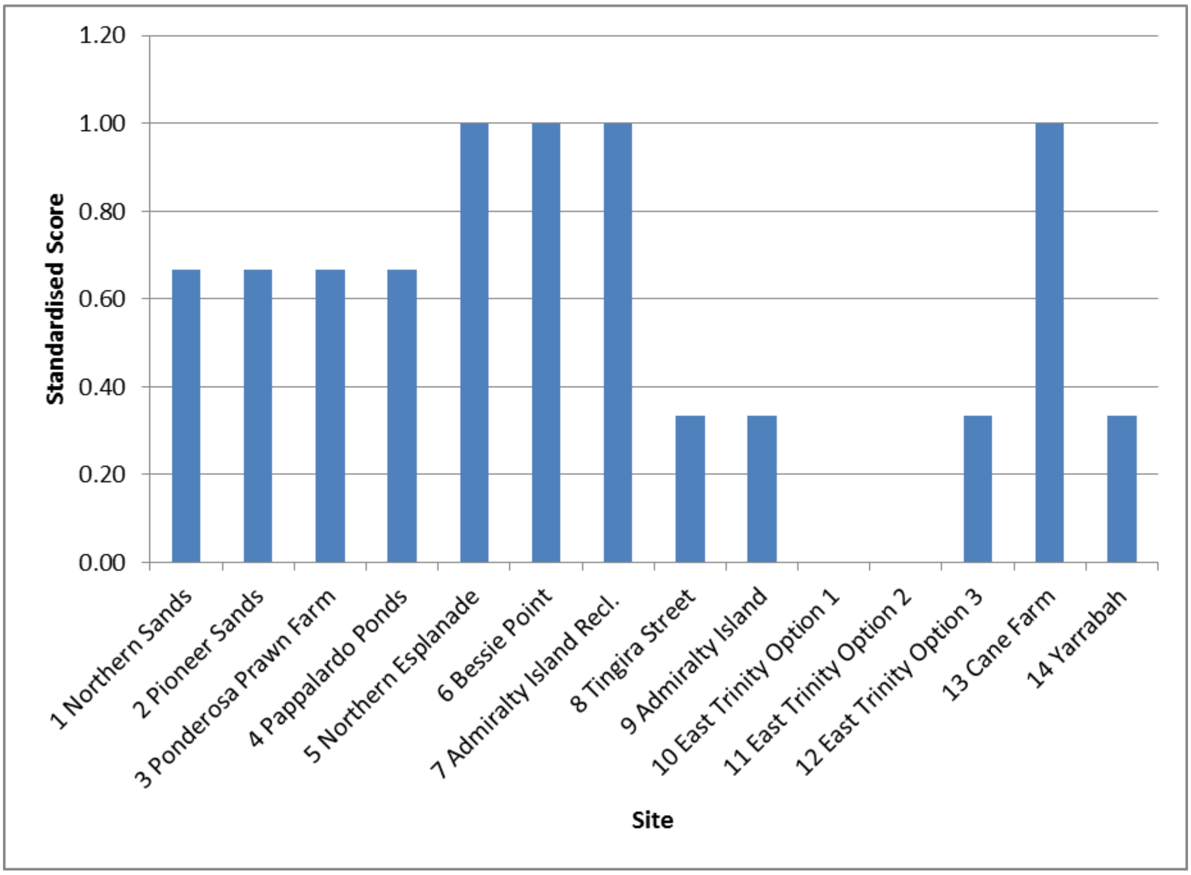


Chart 6-5 E4 – Acid sulfate soil.

This shows that:

- Site 13 and the three reclamation sites (Sites 5, 6, and 7) perform best for this attribute as they have no AASS or PASS problem.
- Sites 8 and 9 perform worst as they have PASS within 0.5 m of the surface.
- The remaining sites score more or less equally with a moderate value as they have deeper PASS (i.e. from 0.5 m to >5 m).

6.6.6 E5 – Birdstrike

a) Detailed Explanation

Placement sites near the Cairns airport have the potential to attract birds and that could be a hazard to aircraft operations. The Australian Aviation Wildlife Hazard Group (2012) includes recommendations for buffer distances to reduce or mitigate risk. These recommendations are included in CairnsPlan in the form of mapped Areas and associated Management Actions.

The CairnsPlan Bird and Bat Strike Hazard Map (2016) delineates (management) Areas (based on proximity to the airport) in three ranges:

- AREA 1: 0 - 3 km
- AREA 2: 3 - 8 km
- AREA 3: 8 - 13 km.

The table below presents actions recommended for proposed land uses relevant to this project at varying distances from an airport and is aligned with international benchmarks set by the International Civil Aviation Organisation. Placement sites are considered to align with ‘Wildlife sanctuary / conservation area – wetland’ whose risk assessment is listed.

b) Scoring

Scores were assigned based on mapped area in which a site lies. This is a ‘benefit’ attribute as the most desirable outcome has the highest raw score. It applies to voids, reclamation, and terrestrial types.

Table 6-6 Actions for proposed land uses near an airport

LAND USE	WILDLIFE ATTRACTION RISK	3 km RADIUS FROM AIRPORT (AREA 1)	8 km RADIUS FROM AIRPORT (AREA 2)	13 km RADIUS FROM AIRPORT (AREA 3)	> 13 km RADIUS FROM AIRPORT
Wildlife sanctuary/conservation area – wetland	High	Incompatible	Mitigate	Monitor	No action
Score (study team)	N/A	0 – reject site based on this non-conformance (‘exclusion rule’).	1	2	3

Source: Row 1: Australian Aviation Wildlife Hazard Group (2012) (The Australian Aviation Wildlife Hazard Group is a combined industry and government discussion panel for aviation wildlife hazard management.)
Row 2: Study team score.

This table is consistent with the 2016 CairnsPlan (Wildlife Hazard Zone) for the land use ‘Conservation Estate (e.g. wetland)’.

c) Evaluation

The raw scores were standardised, with the results as shown on the following chart.

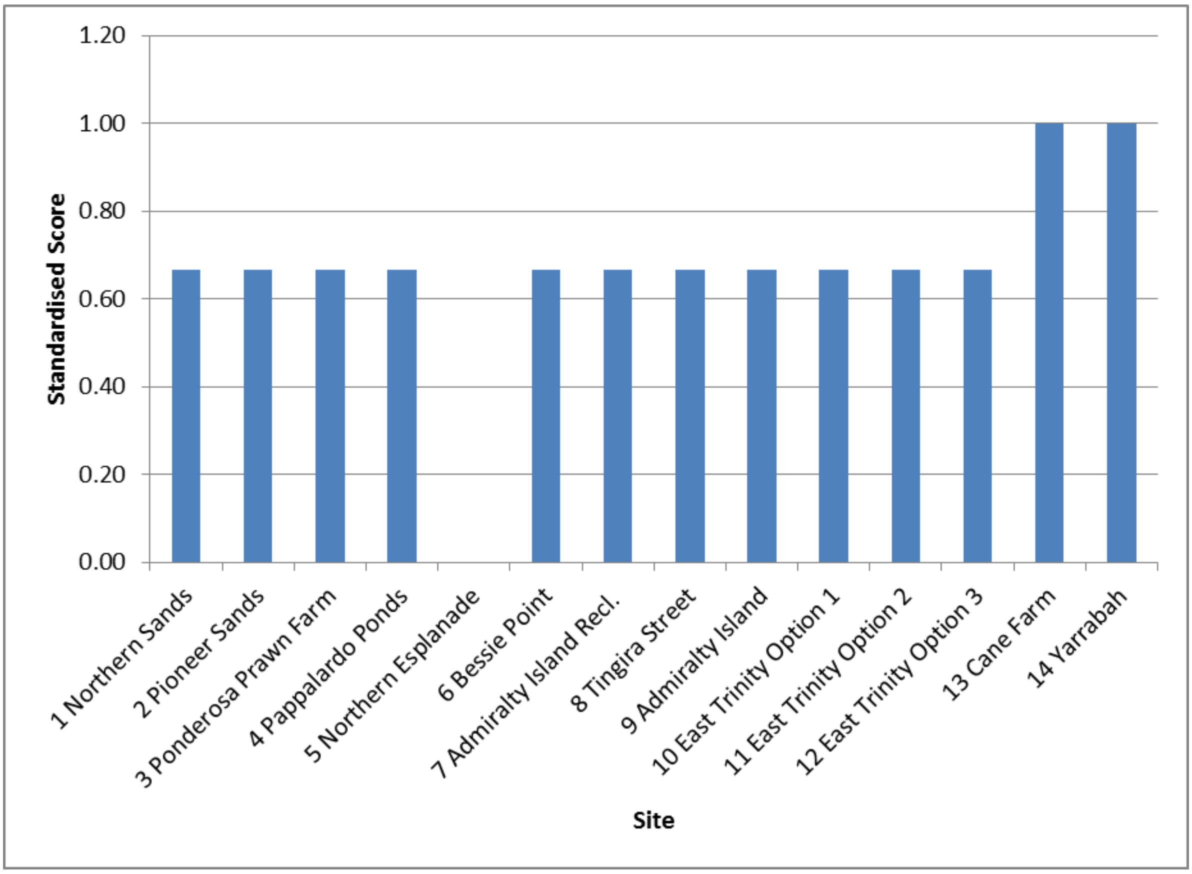


Chart 6-6 E5 – Birdstrike.

This shows that:

- Sites 13 and 14 perform best for this attribute as they are outside the area covered by airport restrictions (under CairnsPlan no action is required).
- Site 5 scores worst (see comment below).
- the remaining sites score equally as they are all in Area 3 (under CairnsPlan birdstrike risk would need to be monitored).

Because the proposed use in Area 1 is considered by the risk assessment to be 'incompatible', any sites with a score of 0 should be considered for rejection in the suitability assessment. This applies to Site 5.

6.6.7 E6 – Coastal Hazards

a) Detailed Explanation

Low-lying land in the vicinity of the coast is at risk from potentially catastrophic coastal hazards (storm tide and tsunami). These events can cause serious impacts in terms of inundation (extreme water level) and physical forces. A risk assessment of storm tide for the Cairns area was undertaken by the Australian Geological Survey Organisation AGSO (Granger *et al.* 1999) and more recent work completed for the Queensland coast (documented in CRC's Storm Tide Evacuation Guide (CRC no date)). The AGSO Storm Tide Exposure Map is useful for site evaluation as it delineates four exposure profiles (zones) ranging from High to Low and this provides a basis for scoring exposure.

Tsunami risk is a complex matter and is dealt with locally in terms of hazard response rather than design. In Cairns, tsunami risk is based on the 6 m AHD contour (CRC hazard planning – CRC 2007). Land below this level is considered to have some degree of risk.

In addition to these catastrophic and short duration effects, long term impacts can occur to coastal structures from shoreline erosion. DEHP mapping was used to delineate land that is within the erosion prone and storm tide hazard areas with sea level rise (SLR). The applicability of the SLR metrics will depend on the practical design life of the reclamation or bunded area – a temporary facility would be immune from long term effects that would have to be considered for a more permanent facility.

b) Scoring

Note that there are two main elements for this attribute. Scores were assigned based on the relevant mapping as follows:

- extreme water level:
  - storm tide – Exposure Profile (Granger *et al.* 1999)
  - tsunami – based on mapped level of exposure zone with a check for consistency with the 6 m AHD contour
- coastal erosion – within or outside erosion prone area (EPA) as determined by EHP mapping.

This is a 'cost' attribute as the most desirable outcome has the lowest raw score for each element. It applies to voids, reclamation, and terrestrial types.

Table 6-7 E6 – Coastal hazards

ELEMENT	MEASURE	NOTES	SCORE
A1 – Extreme water level (storm tide)	Exposure profile = High	As mapped by AGSO.	4
	Exposure profile = Significant	As mapped by AGSO.	3
	Exposure profile = Moderate	As mapped by AGSO.	2
	Exposure profile = Low	As mapped by AGSO.	1
	Exposure profile = Nil	All other land.	0
A2 – Extreme water level (tsunami)	Tsunami zone (< 6m AHD)	For any site whose level is under 6 m AHD, scoring assigns Exposure profile = High regardless of AGSO profile.	See note
B – Coastal erosion	EHP mapping was used to determine if a site was within or outside the EPA.	In EPA Not in EPA	1 0

As this table shows, there are two elements for coastal hazard:

- extreme water level (storm tide, hazard elevated is site is also subject to tsunami exposure)
- coastal erosion.

These were assessed for each concept design and converted to a score as per the previous table. Scores were added to create a composite score for the attribute. Although it is possible to design for the above extreme water levels, sites where this is not necessary are preferred to those that where it is. This is not just a cost aspect (captured in C1 – *Cost*) as there is residual risk regardless of armouring.

c) Evaluation

The raw scores were standardised, with the results as shown on the following chart.

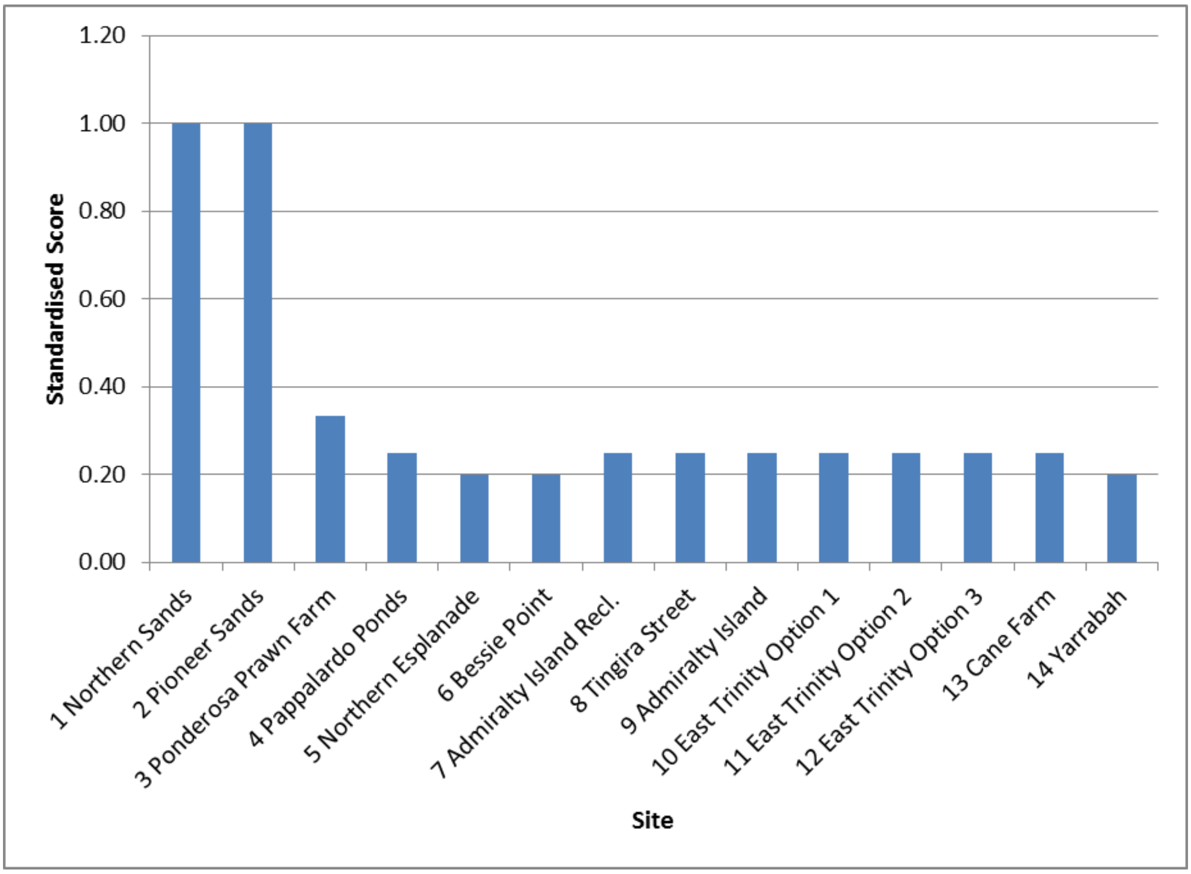


Chart 6-7 E6 – Coastal hazards.

This shows that:

- The two Barron delta voids (Sites 1 and 2) perform best for this attribute as they are outside the area covered by costal hazards. See **Section 8.2.1** for a discussion on the likely effect of Barron River flooding on voids.
- The two Cairns Bay reclamation sites (Sites 5 and 6) and Site 14 score worst due to their exposure.
- The remaining sites score equally quite poorly as they are all quite exposed or have a low elevation. Even a remote site such as Site 13 is exposed as it is located on land with an average elevation of between about 0.5 m AHD and 2.0 m AHD.

6.6.8 P1 – Pumping Head

a) Detailed Explanation

Material dredged by the TSHD will need to be pumped from the TSHD via a pipeline to the nominated placement site. The further the distance and/or elevation of the placement site from the TSHD pump out location, the increased pumping head required, and hence need to introduce booster pumps into the system. Increased pumping head leads to increased cost and technical challenges, and increased duration of works required. In the SS process sites were screened on elevation (< 10m AHD) and distance (< 11 km) separately for simplicity – in reality these two attributes need to be considered together and not all combinations will be necessarily practical.

In addition, if the offshore/marine dredge connection point is located beyond the inboard dredge pump's capacity to deliver, then it will be necessary to install a booster pump over the water (on a barge or jackup) – increasing technical and challenges, cost and increased risk to environment in relation to overwater activities (e.g. refuelling, benthic habitat impact).

The following figure shows the assumed pipeline routes used in the scoring of this attribute.

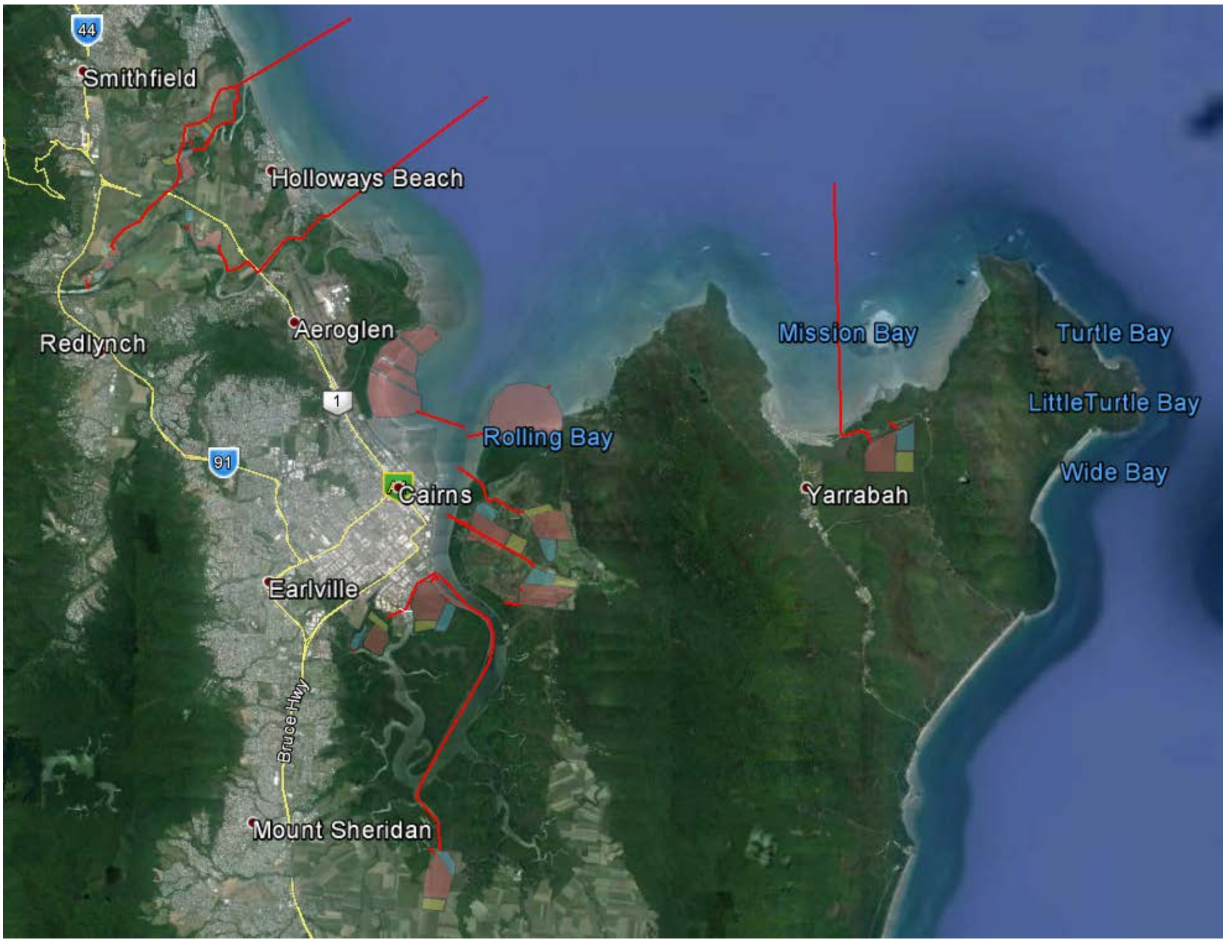


Figure 6-1 Assumed pipeline routes.

b) Scoring

Note that there are two main elements for this attribute. Scores were assigned based on the relevant mapping and calculations as follows:

- pumping head required, comprising:
  - distance from pump-out point (i.e. friction head)
  - elevation of placement site (i.e. gravity head) – for simplicity and based on experience, it was assumed that each metre of gravity head is equivalent to 1 km of pumping length.
- extra distance allowance for offshore pumping (i.e. score as extra friction head).

This is a 'cost' attribute as the most desirable outcome has the lowest raw score for each element. It applies to voids, reclamation, and terrestrial types.

Table 6-8 P1 – Pumping head

ELEMENT	DETAILS	NOTES	SCORE
Pumping head required	Pumping length (km) Gravity head = disposal site elevation above MSL (m)	Score = Pumping length (km) + gravity head (m). This assumes that each m of gravity head is equivalent to 1 km of pumping length.	See notes
Extra distance to offshore pumping connection point	Distance < 1.5 km Distance > 1.5 km	Interpolate score between 0 and 1 over distance 0 to 1.5 km. Score = 1.	See notes

c) Evaluation

The distance from the dredge location for pumping out to the placement site and elevation of the placement site was determined based on bathymetric and topographic information for each concept design and converted to a score as per the previous table.

As this table shows, there are two elements for pumping head:

- pumping head required, comprising:
  - distance from pump-out point (i.e. friction head)
  - elevation of placement site (i.e. gravity head).
- extra distance for offshore pumping (i.e. friction head).

The composite attribute score for each site was obtained by adding together the scores for each element.

The raw scores were standardised, with the results as shown on the following chart.

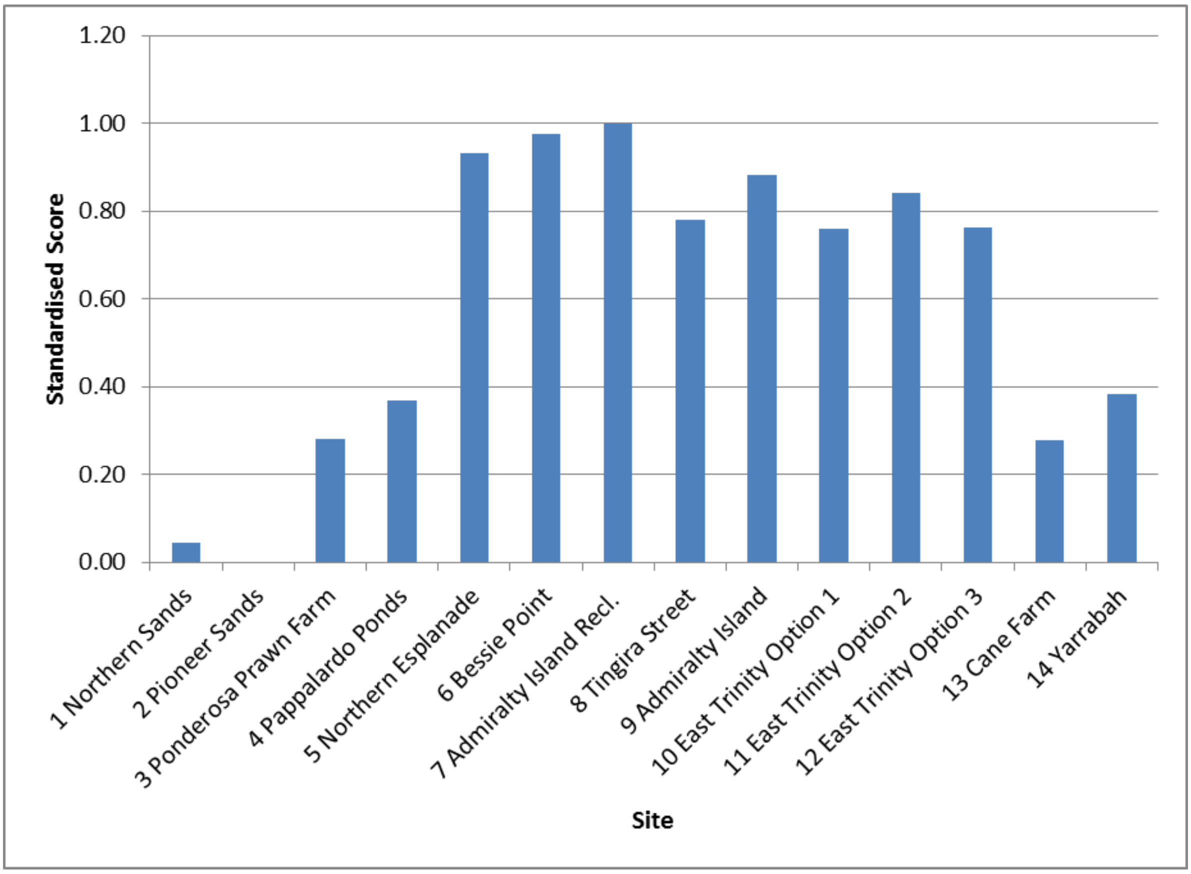


Chart 6-8 P1 – Pumping head.

This shows that:

- The three reclamation sites (Sites 5, 6 and 7) perform best for this attribute as they are all in close proximity to possible dredger pump-out points.
- The more remote sites (Sites 1, 2, 13, and 14) all score poorly as they are at the maximum feasible pumping distance.
- The remaining sites all score quite well as they are within feasible pumping distances.

6.6.9 P2 – Placement Capacity

a) Detailed Explanation

For a site to be suitable it needs to be able to store all (or as much as possible) of the material dredged for Scenario 1 and Scenario 2. However, some smaller sites may still be suitable if used in combination or if they are otherwise desirable. Such sites become attractive if only a portion of the spoil is placed in the first episode and some treated material exported prior to receiving additional spoil. In addition, it is likely that due to consolidation, the available placement capacity will increase over time. This has not been considered as it involves detailed consolidation analysis. However, it may be a matter to address in the EIS.

b) Scoring

Scores were assigned based on the actual volume achieved during the concept design process.

This is a 'benefit' attribute as the most desirable outcome has the highest raw score. It applies to voids, reclamation, and terrestrial types.

Table 6-9 P2 – Placement volume

ELEMENT	TYPE: Void	TYPE: Reclamation	TYPE: Terrestrial	DETAILS	NOTES	SCORE
Placement capacity	✓			The placement capacity of existing voids was estimated based on available storage volume (no allowance for consolidation).	This volume is pre-determined and was estimated based on plan area and assumed depth below groundwater.	% of target volume
		✓		The placement capacity of reclamation sites was estimated based on available storage volume (no allowance for consolidation).	Volume was calculated based on plan area and average depth below MSL using chart contours.	% of target volume
			✓	The placement capacity of existing bunded areas was estimated based on available storage volume (no allowance for consolidation).	This volume is pre-determined and was estimated based on plan area and known bund height.	% of target volume
			✓	The long term placement capacity of new bunded areas was estimated based on available storage volume (no allowance for consolidation).	Volume was calculated based on plan area and proposed bund height.	% of target volume

c) *Evaluation*

The raw scores were standardised, with the results as shown on the following chart.

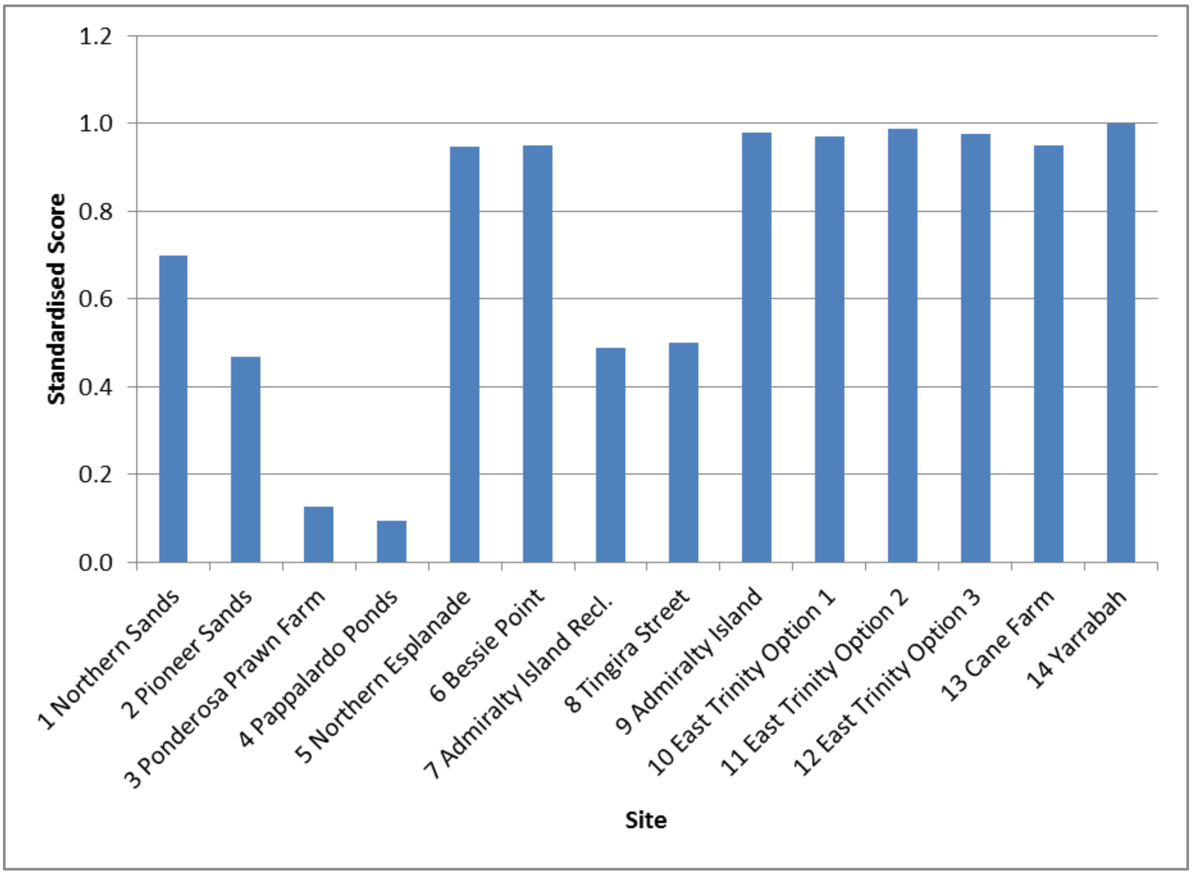


Chart 6-9 P2 – Placement capacity.

This shows that:

- Most new sites (Sites 5, 6, and 9 to 14) all perform best for this attribute as they could be designed for the target volume.
- Sites 1, 7, and 8 are limited by site conditions and are approximately 50% of target volume.
- The two existing bunded areas (Sites 3 and 4) score worst as they are extremely limited by existing dimensions.

Because Sites 3 and 4 have very small volumes they should be considered for rejection in the suitability assessment.

6.6.10 P3 – Tailwater Discharge

a) Detailed Explanation

An additional logistical issue around site suitability will be the ability to manage the tailwater on the placement site and to convey the supernatant dredge tailwater from the placement site back to the marine environment.

Key considerations as part of this criteria are the need for pump-assisted conveyance of the tailwater from the placement site back to the marine environment, the need for additional discharge channels and/or the need for hydraulic structures (such as a diffuser) to address any volumetric capacity constraints of the receiving environment.

b) Scoring

Scores were assigned based on inspection of mapping to determine whether or not pumping is required to return tailwater to the ocean.

This is a 'benefit' attribute as the most desirable outcome has the highest raw score. It applies to voids, reclamation, and terrestrial types.

Table 6-10 P3 – Tailwater discharge

ELEMENT	TYPE			DETAILS	NOTES	SCORE
	Void	Reclamation	Terrestrial			
Pumping Logistics of Tailwater	✓		✓	Discharge will require pump assistance to get tailwater back to marine environment. Discharge will require the need for additional discharge channels, diffusers or other ancillary works.	Mapping rule – >200 m would mean that pumps will need to be considered and/or significant discharge channels will need to be constructed and likely hydraulic controls on the discharge.	-2
				And/or The receiving waterbody has limited volumetric capacity (i.e. the discharge will likely change the hydrology/flood/scour the bed and banks of the receiving waters unless engineered and controlled).		-1
		✓		Default score for reclamation options. Discharge point is directly adjacent to waterbody, no discharge channels required and largely unconstrained in terms of volumetric capacity.	Mapping rule – disposal point is 0-20 m from the discharge waterbody.	0

c) Evaluation

The raw scores were standardised, with the results as shown on the following chart.

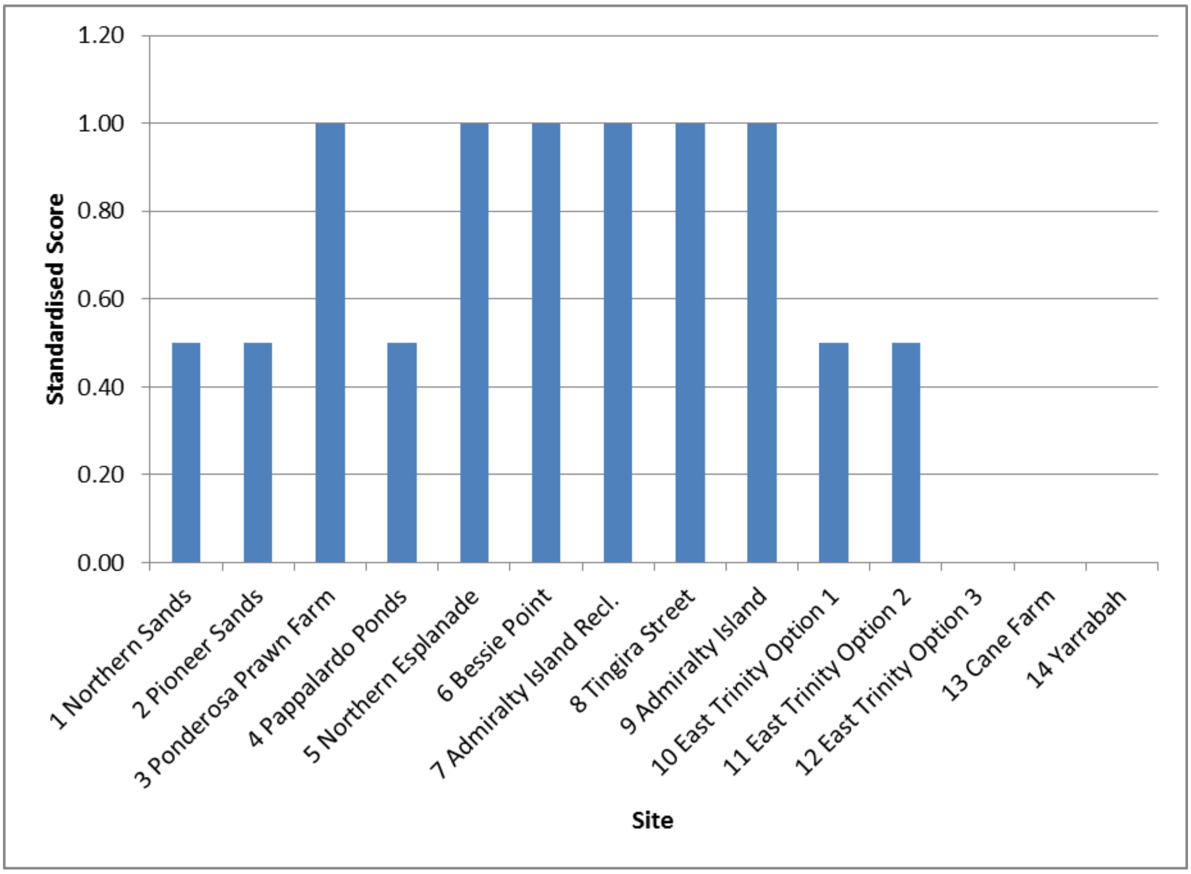


Chart 6-10 P3 – Tailwater discharge.

This shows that:

- Sites 3, 5, 6, 7, 8, and 9 all perform best for this attribute as no discharge channel or pumping is required to convey tailwater.
- Sites 12, 13, and 14 score worst as there will be a need to pump tailwater in order for it to reach a suitable natural discharge channel.
- The remaining sites score equally as they all require construction of a discharge channel (but without the need to pump).

6.6.11 P4 – Ground Conditions & Stability

a) Detailed Explanation

For sites requiring bunded areas for disposal of material and/or management of tailwater, stable foundation conditions are required. It is also preferable that the material to be excavated from voids or bunded areas can be reused for bund construction.

Geological maps were used to assess ground conditions at sites as well as to assess the potential for material reuse for export and/or bund construction and the potential for foundation issues. For example, where geologically 'younger' alluvial deposits are indicated there is a higher potential for the site to be underlain by soft soils with inherent foundation and reuse issues.

b) *Scoring*

Note that there are two elements for this attribute and these vary slightly between voids and terrestrial sites (this attribute is not relevant to reclamation). Scores were assigned based on inspection of geological mapping as follows:

- Voids:
  - Expected suitability of excavated materials for offsite reuse/sale
  - Potential issues with foundations and/or stability:
- Terrestrial:
  - Expected suitability of excavated materials for bund construction:
  - Potential issues with foundations and/or stability:

This is a 'benefit' attribute as the most desirable outcome has the highest raw score for each element. It applies to voids and terrestrial types only.

Table 6-11 P3 – Ground conditions & stability

ELEMENT	TYPE: Void	TYPE: Reclamation	TYPE: Terrestrial	DETAILS	NOTES	SCORE
Ground conditions	✓			Expected suitability of excavated materials for offsite reuse/sale:		
				• Holocene age deposits (Qc, Qhct, Qhcb)		-1
				• Holocene to Pleistocene age alluvial deposits (Qha)		2
				• Pleistocene age deposits (Qa, Qpa)		1
				• All other non-alluvial deposits		1
		✓		N/A	N/A	
			✓	Expected suitability of excavated materials for bund construction:	Ideally, bunds up to ~3 m high can be constructed from material won from the site.	
				• Holocene age deposits (Qc, Qhct, Qhcb)		-1
				• Holocene to Pleistocene age alluvial deposits (Qha)		0
				• Pleistocene age deposits (Qa, Qpa)		1
				• All other non-alluvial deposits		1

(Continued over)

ELEMENT	TYPE			DETAILS	NOTES	SCORE
	Void	Reclamation	Terrestrial			
Stability	✓			Potential issues with foundations and/or stability: • Holocene age deposits (Qc, Qhct, Qhcb) • Holocene to Pleistocene age alluvial deposits (Qha) • Pleistocene age deposits (Qa, Qpa) • All other non-alluvial deposits		 -1 -1 1 1
		✓		N/A	N/A	
			✓	Potential issues with foundations and/or stability: • Holocene age deposits (Qc, Qhct, Qhcb) • Holocene to Pleistocene age alluvial deposits (Qha) • Pleistocene age deposits (Qa, Qpa) • All other non-alluvial deposits	Sites need to be suitable for the construction of bunds and the storage of up to 3 m depth of dredged material.	 -1 0 1 1

As this table shows, there are two elements for this attribute:

- expected suitability of excavated materials for offsite reuse/sale (voids) or bund construction (terrestrial)
- potential issues with foundations and/or stability:

These were assessed for each concept design and converted to a score as per the previous table. Scores were added to create a composite score for the attribute.

c) Evaluation

Ground conditions were assessed for each concept design and converted to a score as per the previous table.

The raw scores were standardised, with the results as shown on the following chart.

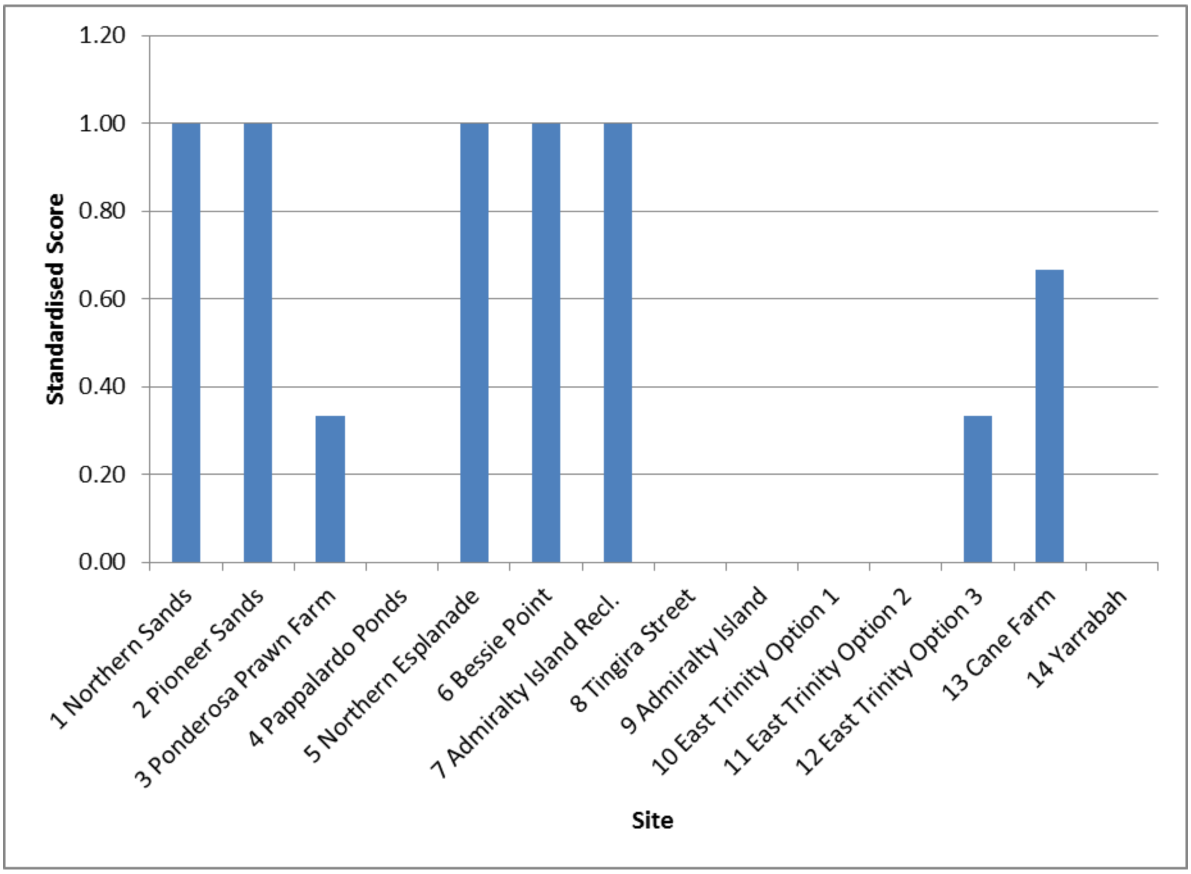


Chart 6-11 P4 – Ground conditions & stability.

This shows that:

- The two voids (Sites 1 and 2) perform best for this attribute as they already exist and are known to be stable.
- The reclamation sites (Sites 5, 6, and 7) all scored well as ground conditions and stability considerations are not a problem for reclamation.
- Sites 8, 9, 10, 11 and 14 perform very poorly due to poor scores on both elements.
- Sites 3, 12, and 13 have moderate scores for each element and hence overall.

6.6.12 S1 – Remoteness from Incompatible Land Use

Site Selection attribute S1 excluded land considered to be insufficiently remote from various land uses as a measure of a range of amenity issues such as air and noise emissions and visual impacts. These are all proximity-related.

It was decided to not proceed with this attribute in the SE process on the basis that once the nominated buffers were observed, there would be no further advantage in additional separation.

For more detailed assessments (i.e. in the EIS) it will be appropriate to consider the additional impacts on amenity of the pumping process (i.e. the pipeline(s) for transporting the dredge material to the placement site (P1) and, where needed, return of the tailwater to the receiving environment (P3)).

6.6.13 S2 – Important Agricultural Areas

a) Detailed Explanation

Important agricultural areas were identified by the Queensland Agricultural Land Audit 2013 (Audit). Agricultural Land Classification (ALC) refers to the Agricultural Land Classes identified and mapped in the Audit. The classes are largely based on the Queensland ALC approach.

According to the SPP guidelines (DSDIP 2014), four classes of agricultural land have been defined for Queensland. Under this system, ALC Class A and ALC Class B land is the most productive agricultural land in Queensland, with soil and land characteristics that allow successful crop and pasture production

The SPP Interactive Mapping System was used to delineate areas of designated ALC (Class A and B).

b) Scoring

The area of clearing of ALC Class A or B was measured for each concept design to determine the raw score. However, some sites (e.g. Sites 1, 2 and 3) are mapped as ALC but have other uses (e.g. operational sand extraction / aquaculture facility) whose development has involved the alienation of ALC. Mapping in these areas was discounted. This is a 'cost attribute as the most desirable outcome has the lowest raw score. It applies to terrestrial sites only.

c) Evaluation

The raw scores were standardised, with the results as shown on the following chart.

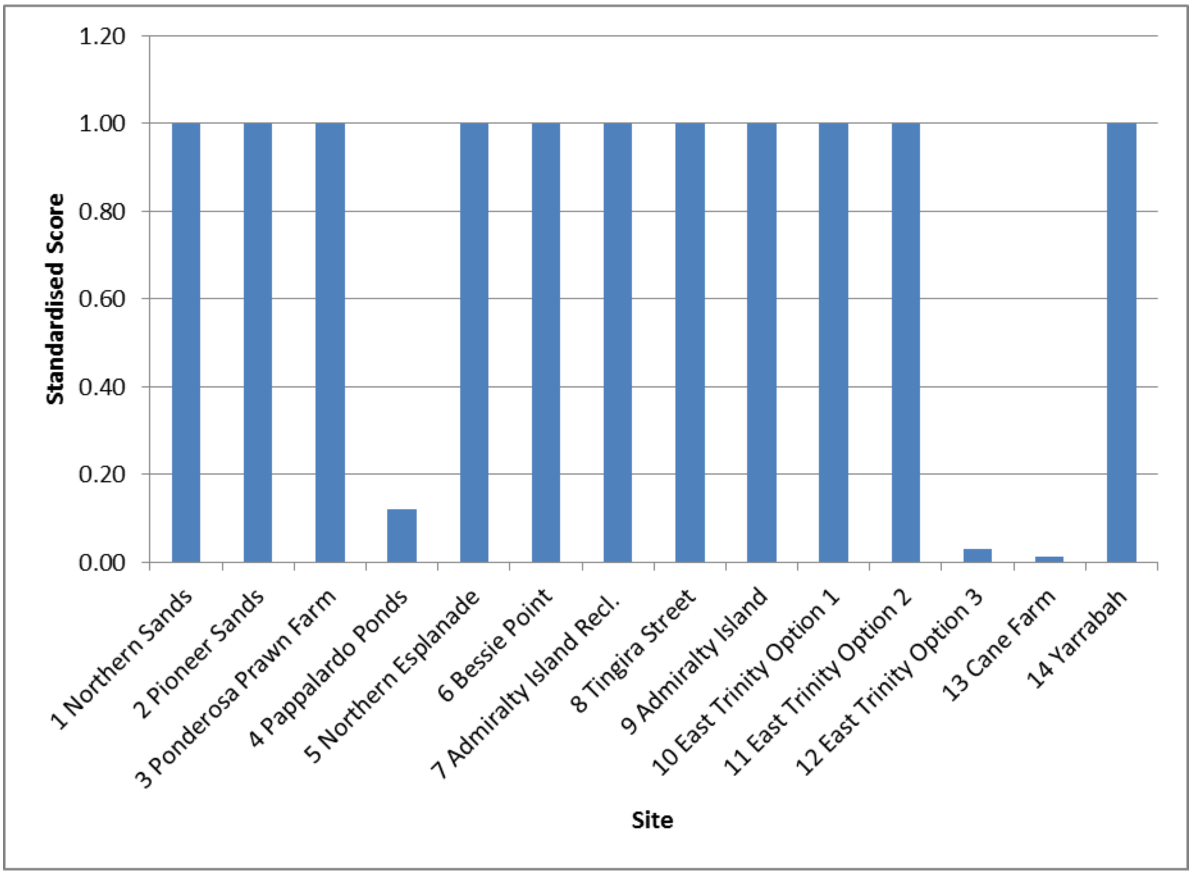


Chart 6-12 S2 – Important agricultural areas.

This shows that:

- Most sites perform well for this attribute as they either have no mapped agricultural land values or previous resource allocations decisions have alienated the land from agriculture.
- The existing cane farms (Sites 4, 12, 13, and 14) score poorly, with Site 13 being the worst.

6.6.14S3 – Traffic

a) Detailed Explanation

Although dredged material will be deliver to each site by pumping, treatment and general site activities will generate road traffic, with the main activities being delivery of bund material (if that on site is unsuitable), lime, and fuel, and carting of exported treated material (if appropriate).

This traffic has the potential to create impacts on the road network and the general community.

b) Scoring

Scores were assigned based on the haul distance between the assumed source of the material and the site, stratified by the relative sensitivity of the adjacent land use along the route. For consistency, the minimum buffers assigned for SS attribute S1 were used to weight the adjacent distances as per the following table. A 'barging' rule was also applied to Site 9 on the basis that transport of lime and bund material is assumed to be by barge and that this will impose some interference with Smiths Creek boat traffic.

For the purposes of this study:

- the source of lime was assumed to be the railway yards (i.e. lime would be railed to the yards)
- the source of construction material for bunds (when required) was assumed to involve 10 km transit through a residential area and 3 km through the industrial area

This is a 'cost' attribute as the most desirable outcome has the lowest raw score. It applies only to terrestrial sites where treatment is required.

Table 6-12 S3 – Traffic

DOMINANT LAND USES	SS ATTRIBUTE S1 MINIMUM BUFFER	WEIGHTING	SCORE
Residential & Tourism	200 m	4	Length x 4
Recreation	100 m	2	Length x 2
Commercial & Industrial (Light)	100 m	2	Length x 2
Industrial (Noxious)	50 m	1	Length x 1
Rural (residences)	200 m	4	Length x 4
Barging (Site 9 only)	N/A	6	Length x 6

c) Evaluation

The raw scores were standardised, with the results as shown on the following chart.

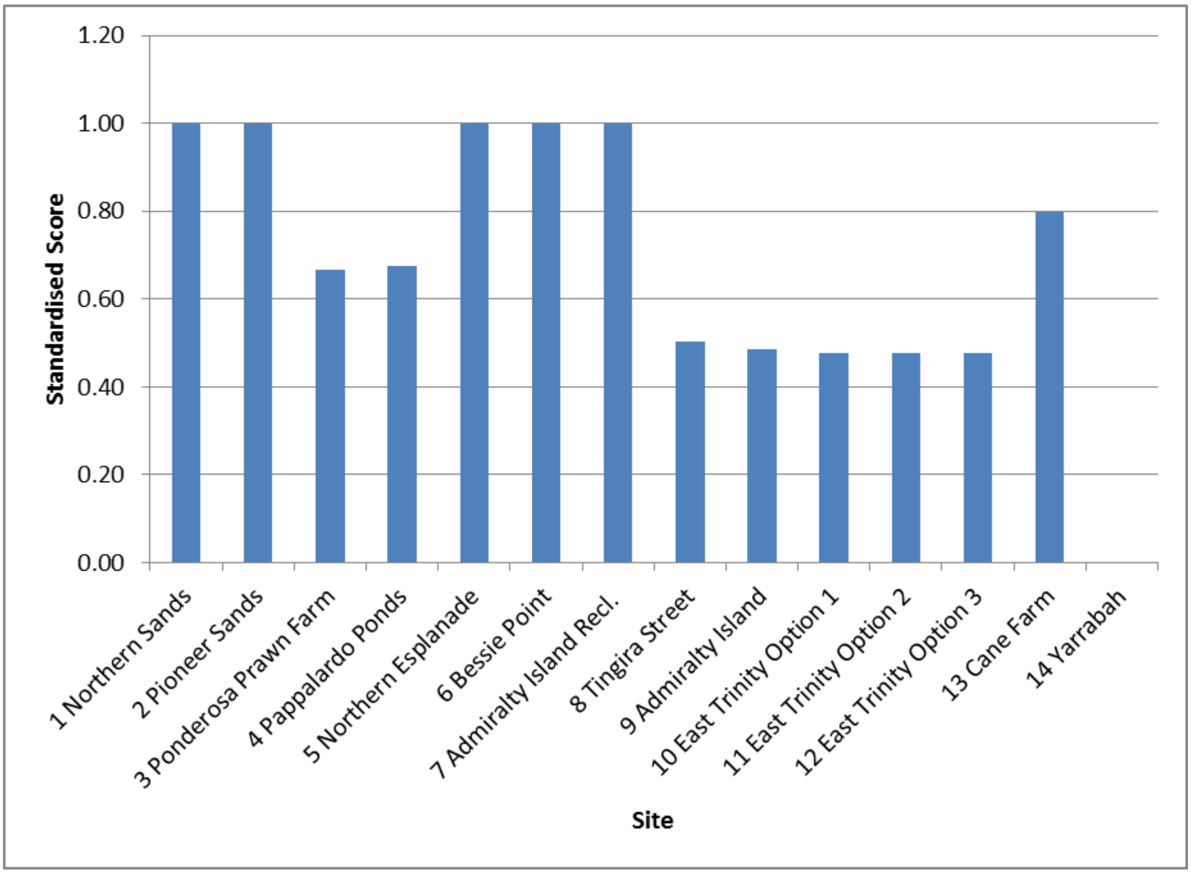


Chart 6-13 S3 – Traffic.

This shows that:

- Voids (Sites 1 and 2) and reclamation sites (Sites 5, 6, and 7) receive the best score for this attribute as they do not require treatment and hence no lime deliveries are required. In addition, no bund material is needed.
- Site 13 requires a substantial carting distance for lime which reduces its performance, even though no bund material is required
- The industrial area site (Site 8) performs quite well for this attribute as it has an extremely short haul distance for lime and this is through the low sensitivity industrial area. This is advantage is overturned due to the relatively large haul distance for fill material.
- The performance of Site 9 is reduced slightly due to the fact that barging of lime and bund material to Admiralty Island could interfere with Smiths Creek shipping.
- The remaining sites score poorly as they all involve large haul distances for lime.

6.6.15 S4 – Appropriate Tenure (Ownership)

a) Detailed Explanation

Most of the previous attributes deal with the suitability / desirability of sites based on the triple bottom line of people + planet + profit plus performance measures. A further consideration is the ease of acquiring the land identified as being suitable / desirable. For example, it is assumed that land in public ownership will be easier to acquire than private land, especially land with advanced planning for development.

The DCDB was used to map tenure in the SE area and this was stratified into following groups as per the following table, and an associated score based on assessed ease of acquisition. A sub-stratification was applied to account for whether or not native title has been extinguished. Although native title can be extinguished by the payment of compensation or accommodated via an Indigenous Land Use Agreement (ILUA), this can be a complex process that involves delays and potentially conflict.

Note that this attribute (acquisition and extinguishment of native title or production of an ILUA) is not a price consideration (allowed for in C1) but rather a measure of ease of securing the site for dredge spoil placement.

b) Scoring

This is a 'cost attribute as the most desirable outcome has the lowest raw score. It applies to voids, reclamation, and terrestrial types.

Table 6-13 S4 – Appropriate tenure

TENURE	NOTES	SCORE
State Land	As this land is owned by the state, it could be allocated to land placement if the government supports the CSD Project. No commercial negotiations will be required. Native title has been extinguished on this land. It is considered to be the most desirable tenure.	1
Water (Ocean)	As this 'land' is owned by the state, it could be allocated to land placement if the government supports the CSD Project. No commercial negotiations will be required. However, there are some complexities in securing appropriate tenure (i.e. development lease etc.) that make this land less desirable than state land. In addition, native title has not been extinguished on this land.	1.5
Water (within Inlet)	As for Water (ocean).	1.5
Freehold	Commercial negotiations will be required or compulsory acquisition required. Native title has been extinguished on this land. The need acquisition makes this tenure less desirable than state land but better than tenures where native title may exist.	2
Freehold and Reserve	As for Reserve.	3
Reserve	As this land is owned by the state, it could be allocated to land placement if the government supports the CSD Project. No commercial negotiations will be required. However, native title has not been extinguished on this land and this makes it less desirable than state land.	3

c) Evaluation

The raw scores were standardised, with the results as shown on the following chart.

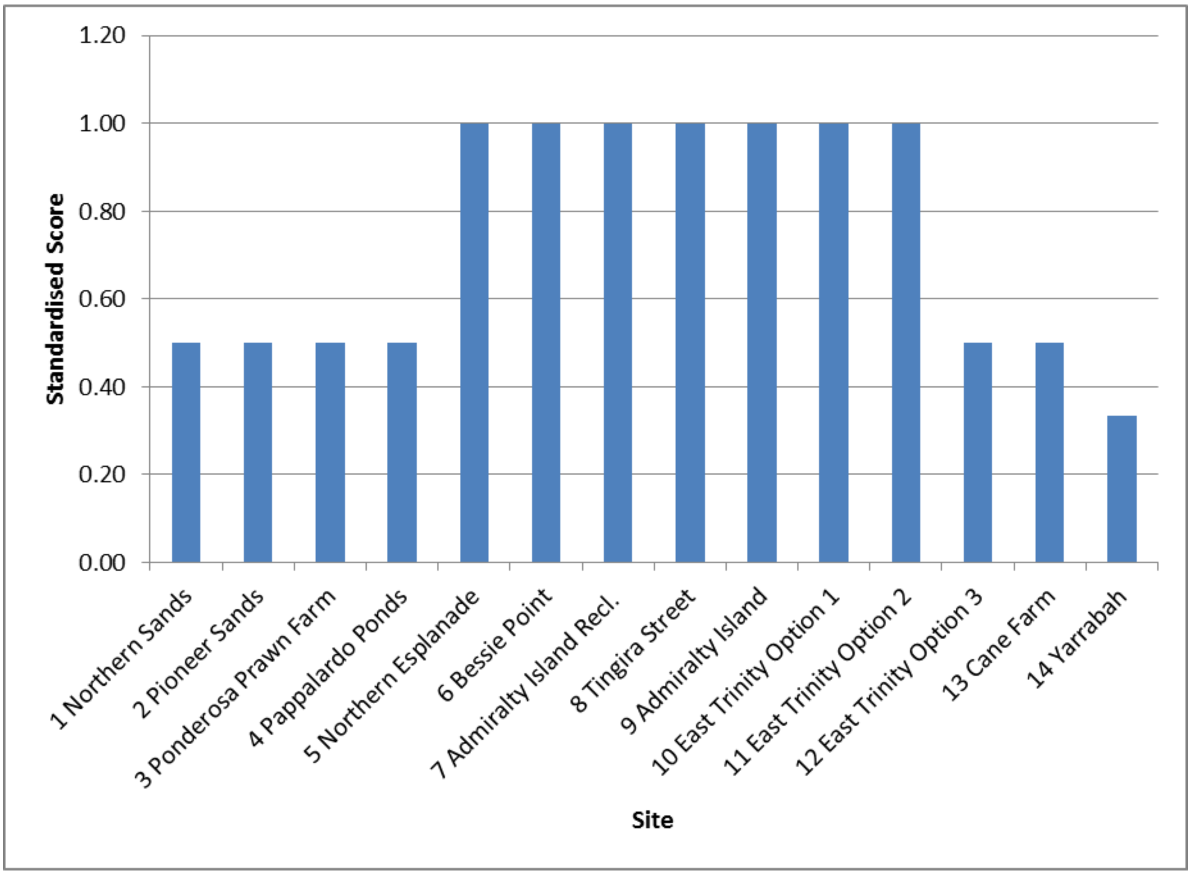


Chart 6-14 S4 – Appropriate tenure.

This shows that:

- Sites 5 to 11 perform best for this attribute as they are on state land which is judged to be easiest to secure.
- The freehold sites (Sites 1, 2, 3, 4, 12, and 13) score next best.
- The remaining site (Site 14) scores worst due to the need to secure a lease over Aboriginal freehold land.

6.7 RESULTS – NON-COST CRITERIA ONLY

6.7.1 Methodology

In the following discussion *Cost* has been removed as it includes many matters that are captured by other attributes (as discussed in **Section 6.6.1**). It is dealt with separately in **Section 6.8.2**.

The performance of the site options at the individual attribute level has been discussed in the previous chapter and broad conclusions drawn. These results (standardised scores) are summarised in **Table 6-14**. This is based on a master spreadsheet that was used to collect together all criterion scores and perform the following analyses as described below, namely:

- attributes collected to the overall level (unweighted)
- attributes collected to the criterion level (unweighted).

This spreadsheet also allowed for the application of various weighting schemes described in the following chapter. Results can be expressed as either standardised scores or rankings and can be filtered for type of site (i.e. void, reclamation, and terrestrial).

Table 6-14 Site evaluation findings – standardised scores (non-cost attributes)

ID	TYPE	SITE	E1 – Surface Water	E2 – Groundwater	E3 – Biodiversity Values	E4 – Acid Sulfate Soil	E5 – Birdstrike	E6 – Coastal Hazards	P1 – Pumping Head	P2 – Placement Capacity	P3 – Tailwater Discharge	P4 – Ground Conditions & Stability	S2 – Important Agricultural Areas	S3 – Traffic	S4 - Appropriate Tenure (Ownership)
1	BV1	1 Northern Sands	0.67	0.83	1.00	0.67	0.67	1.00	0.05	0.70	0.50	1.00	1.00	1.00	0.50
2	BV2	2 Pioneer Sands	0.33	0.33	1.00	0.67	0.67	1.00	0.00	0.47	0.50	1.00	1.00	1.00	0.50
3	BB2	3 Ponderosa Prawn Farm	0.67	0.83	1.00	0.67	0.67	0.33	0.28	0.13	1.00	0.33	1.00	0.67	0.50
4	BB1	4 Pappalardo Ponds	0.67	1.00	0.97	0.67	0.67	0.25	0.37	0.09	0.50	0.00	0.12	0.67	0.50
5	CR1	5 Northern Esplanade	0.00	1.00	0.16	1.00	0.00	0.20	0.93	0.95	1.00	1.00	1.00	1.00	1.00
6	CR2	6 Bessie Point	0.00	1.00	0.00	1.00	0.67	0.20	0.97	0.95	1.00	1.00	1.00	1.00	1.00
7	WR1	7 Admiralty Island Recl.	0.67	1.00	0.99	1.00	0.67	0.25	1.00	0.49	1.00	1.00	1.00	1.00	1.00
8	WT2	8 Tingira Street	0.67	0.67	0.74	0.33	0.67	0.25	0.78	0.50	1.00	0.00	1.00	0.50	1.00
9	WT1	9 Admiralty Island	1.00	0.67	0.53	0.33	0.67	0.25	0.88	0.98	1.00	0.00	1.00	0.48	1.00
10	ET1	10 East Trinity Option 1	0.67	0.50	1.00	0.00	0.67	0.25	0.76	0.97	0.50	0.00	1.00	0.48	1.00
11	ET2	11 East Trinity Option 2	0.67	0.67	0.99	0.00	0.67	0.25	0.84	0.99	0.50	0.00	1.00	0.48	1.00
12	ET3	12 East Trinity Option 3	0.67	0.50	0.99	0.33	0.67	0.25	0.76	0.97	0.00	0.33	0.03	0.48	0.50
13	ST1	13 Cane Farm	0.67	0.50	1.00	1.00	1.00	0.25	0.28	0.95	0.00	0.67	0.01	0.80	0.50
14	YT1	14 Yarrabah	0.33	0.50	0.16	0.33	1.00	0.20	0.38	1.00	0.00	0.00	1.00	0.00	0.33

Notes: 1: Best-scores (standardised score of 1.0) highlighted.

6.7.2 Non-cost Attributes Collated Overall

The various non-cost attributes were collated by summing the standardised scores (unweighted) and then re-standardising the sum (after removing the excluded sites). These results are shown graphically below.

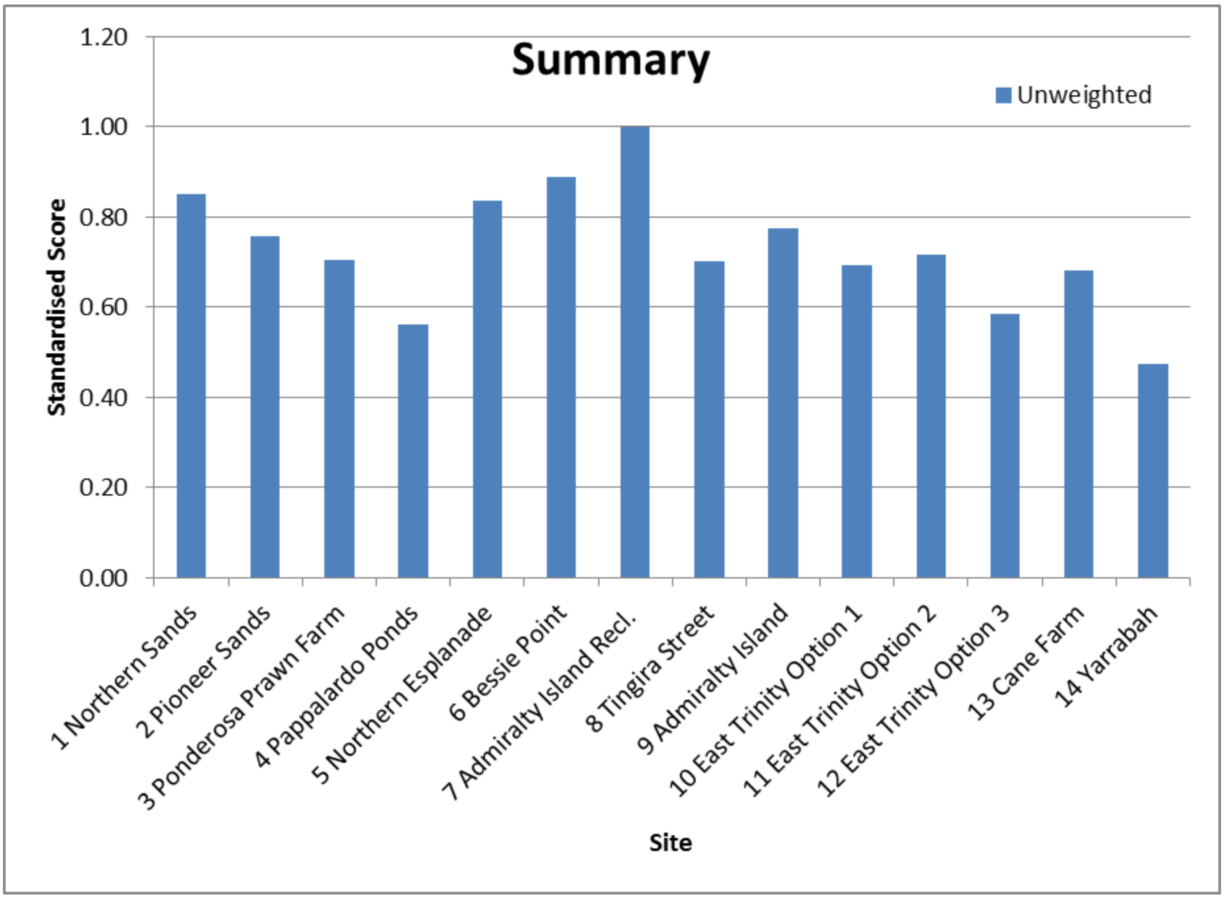


Chart 6-15 Attributes overall (less cost).

6.8 RESULTS – ATTRIBUTES COLLATED TO CRITERION LEVEL

6.8.1 Methodology

The various attributes were collated by summing the standardised scores (unweighted) for each of the four criteria and then re-standardising the sum. These results are shown graphically below.

6.8.2 Cost

Section 6.6.1 shows the results of the application of attribute C1 – *Cost* for all sites, based on unit rates. This is repeated below.

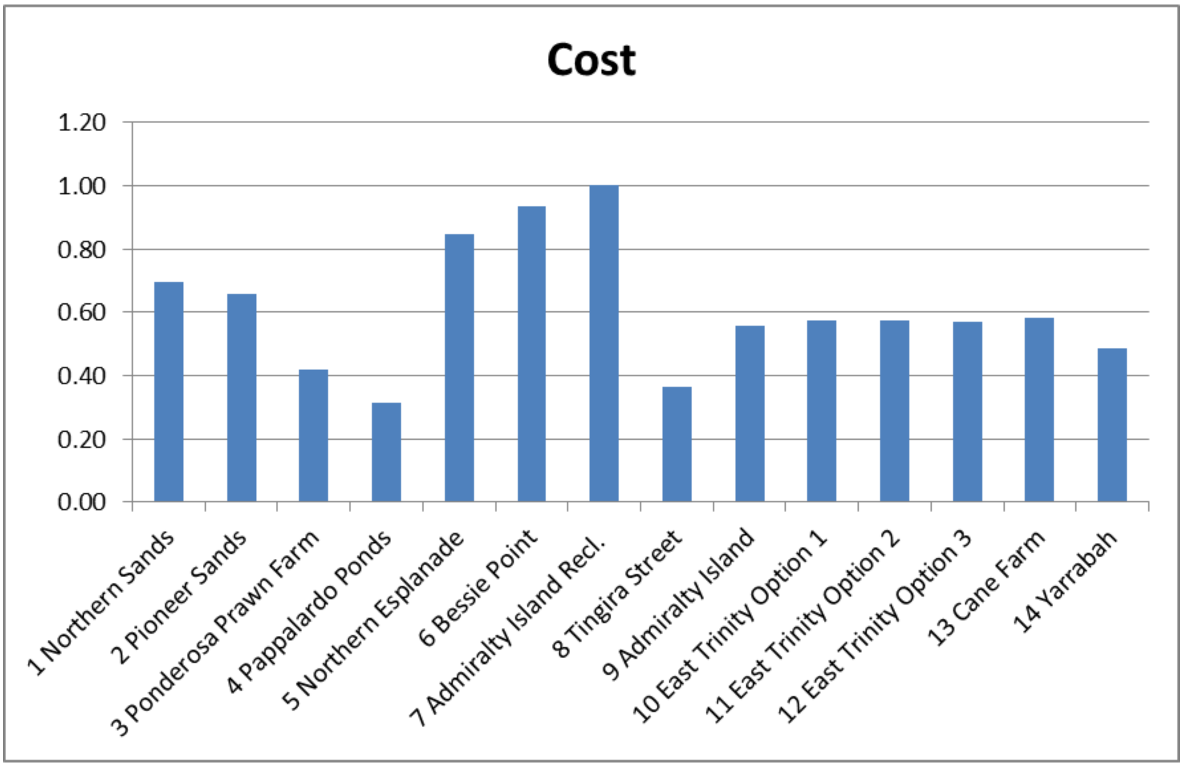


Chart 6-16 *Cost* attribute only.

6.8.3 Environment

Results of all *Environment* attributes (un-weighted) are shown graphically below.

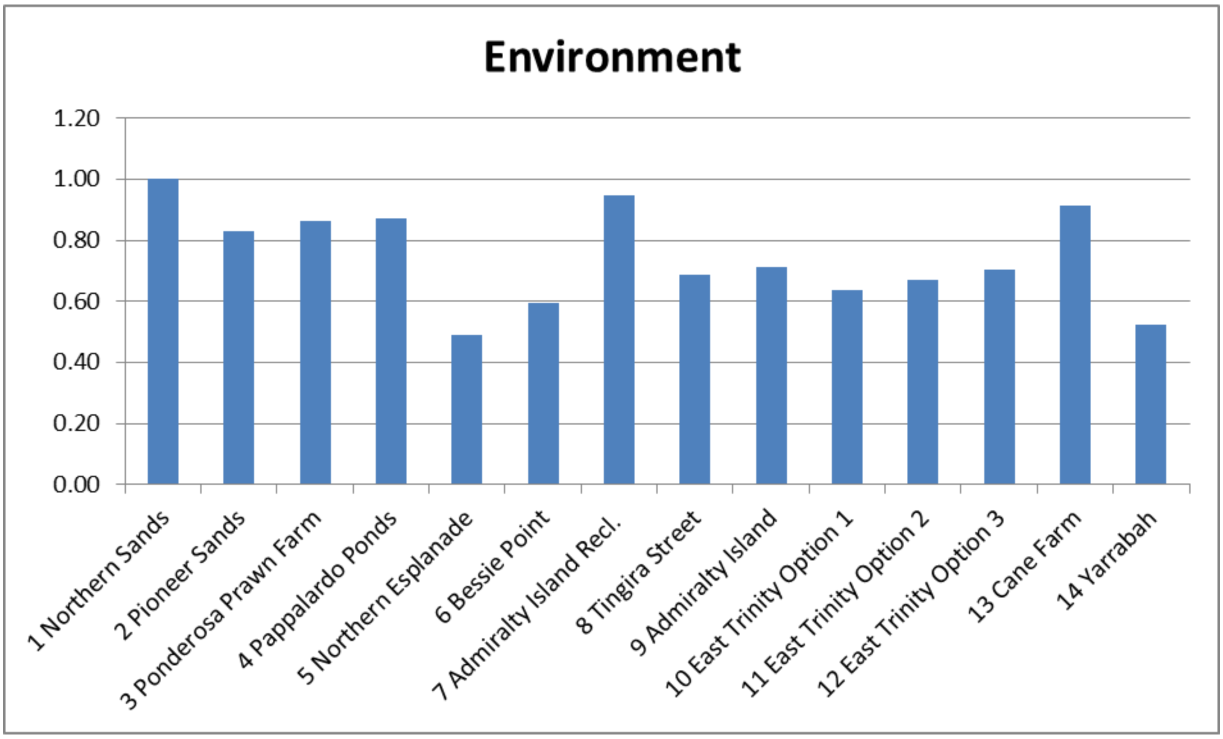


Chart 6-17 *Environment* attributes only.

This analysis shows that:

- Sites 1 to 4, 7 and 13 perform best as they are all existing features and are remote from coastal hazards and have moderate acid sulfate soil and groundwater issues and little in the way of biodiversity values.
- While scoring poorly on biodiversity and coastal hazards, Site 7 (2nd overall for *Environment* attributes) scores moderately on other environmental attributes due to favourable surface water, groundwater, and acid sulfate soil conditions.
- The worst performing sites are Sites 5, 6, and 14 which all score poorly due to impacts on biodiversity and/or acid sulfate soil issues.

6.8.4 Performance

Results of all *Performance* attributes (un-weighted) are shown graphically below.

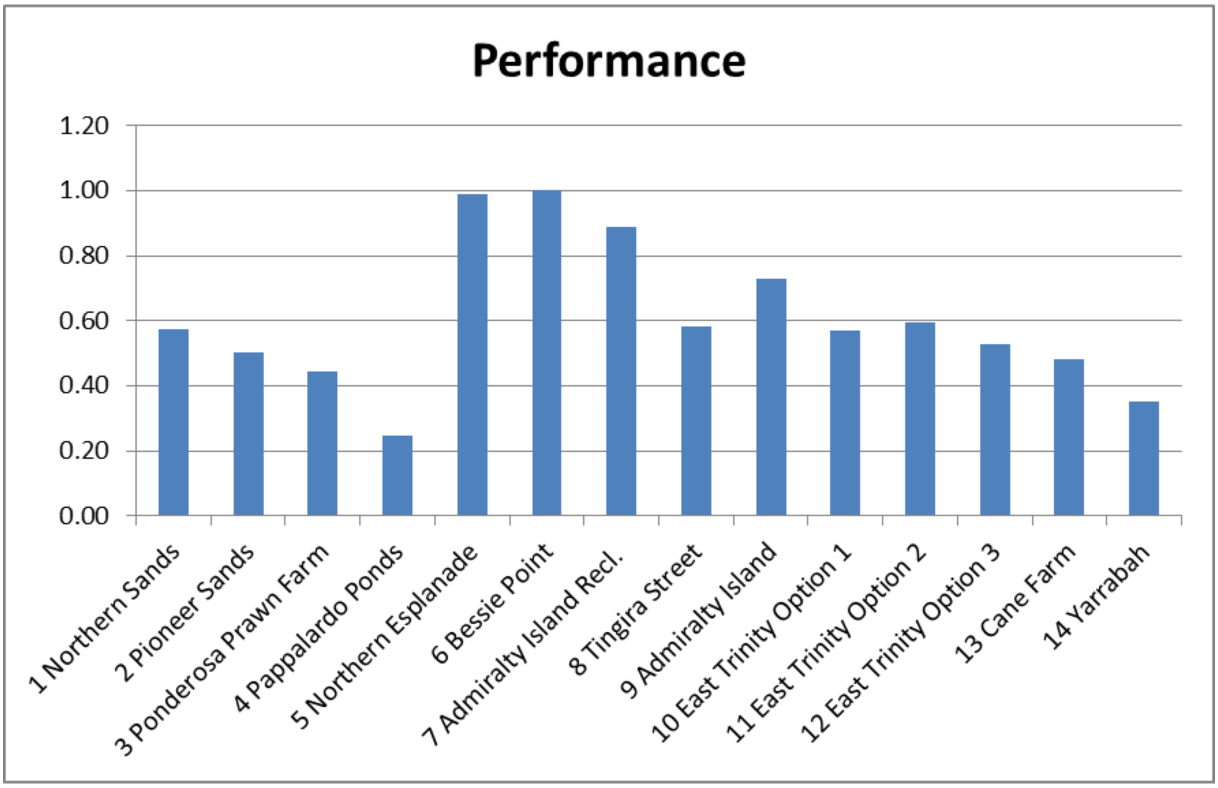


Chart 6-18 *Performance* attributes only.

This analysis shows that:

- Sites 5, 6, and 7 score well, largely due to low pumping head and favourable ground conditions.
- Site 9 scores moderately well, with a major negative being ground conditions / stability.
- The attractiveness of Sites 1 and 2 is reduced by high pumping head and limited volume.
- The worst site is Site 4 which suffers from a very low capacity.

6.8.5 Social

Results of all *Social* attributes (un-weighted) are shown graphically below.

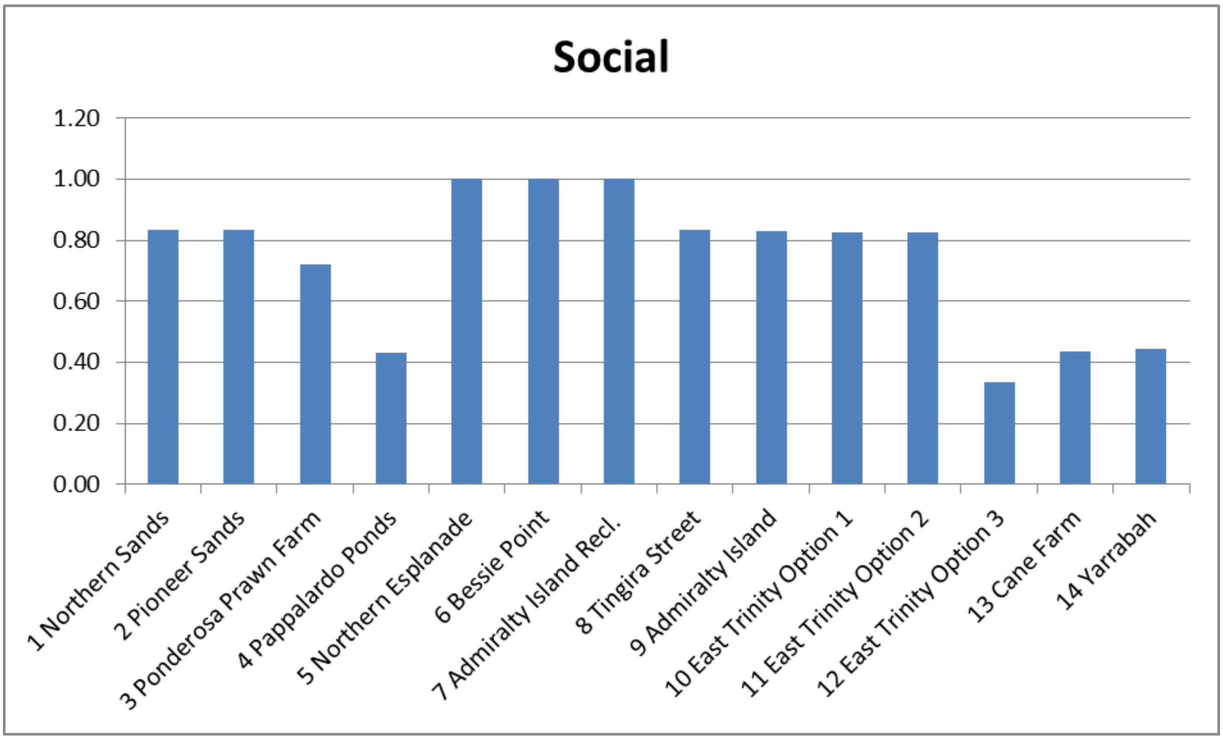


Chart 6-19 *Social* attributes only.

This analysis shows that:

- Sites 5, 6, and 7all score well due to absence of agricultural land values and relatively low traffic problems. Sites 1 and 2 and 8 to 11 are in public ownership which is considered to be desirable.
- The worst sites are 4, and 12 to 14 which all suffer from remoteness (traffic) and in the case of Sites 12 and 13, agricultural land values.

7 WEIGHTING AND SENSITIVITY ANALYSIS

7.1 INTRODUCTION

It is important to recognise that MCA is not a simple arithmetic exercise and requires sound judgement in addressing a number of issues. These are:

- What weight should be given to each attribute in arriving at a criterion score? Are all attributes equally important in arriving at an overall score? Are particular attributes important to the project but do not help in distinguishing between options (either because they are not measurable or if they are, may not yield any significant differences)? What if an attribute shows a clear distinction between options but this difference is easily removed or reduced by simple mitigation or design change?
- What weight should be given to the various criteria? Is, for example, Environment more or less important than *Cost*? And to whom?

The adopted process addressed these questions by a two distinct processes, namely:

- a technical assessment to weight attributes in arriving at a whole-of-criterion score
- a values-based (sensitivity) process to investigate the effect of different values systems on the final whole-of-project score.

These quite distinct processes and their outcomes are described below.

7.2 ATTRIBUTE WEIGHTING – A TECHNICAL PROCESS

7.2.1 Introduction

In arriving at a whole-of-criterion score, the standardised scores for each option for each attribute were weighted based on an assessment of how important the attribute is. The adopted weighting and its rationale was formulated based on a detailed analysis by senior members of the study team and considered:

- the attributes themselves
- how they were measured and scored
- the significance of the difference between scores
- the importance of the matter in question
- the extent to which the distinctiveness of the options could be removed by minor design changes or refinement.

For this purpose the following scale was derived: to here

- Disregard — 0 (to be applied only if the post-scoring learnings revealed that the attribute has little relevance to the assessment).
- Of some importance — 0.5 – 0.75.
- Of moderate importance — 1.0 – 1.25.
- Of great importance — 1.5.

Using this process, the individual standardised attribute scores were multiplied by the selected weighting and the outcome re-standardised.

7.2.2 Attribute Weighting

The following table sets out the attribute weightings determined by the study team and the reasoning behind these.

Table 7-1 Attribute weighting

ATTRIBUTE	WEIGHT	NOTES
C1 – Cost	N/A	Not considered in technical assessment (dealt with separately).
E1 – Surface Water	1.0	While discharge locations can be modified to some extent as part of the engineering design, the environmental values are fixed (location of seagrass, salinity of receiving waters) and the ability to minimise impacts through mitigation is limited. For example, there is no feasible way to discharge tailwater without causing some impact due to TSS or altering the salinity of the discharge.
E2 – Groundwater	1.5	Saline intrusion into freshwater aquifer is not acceptable, so salinity of receiving groundwater is of great importance (even when the opportunity for mitigation with a cut off barrier is considered).
E3 – Biodiversity Values	1.5	High biodiversity values will be an important constraint to be considered in the EIS. Many of these are subject to legislative controls which will be expected to be given considerable weight by management agencies.
E4 – Acid Sulfate Soil	1.25	Presence of Actual Acid Sulfate Soils has the potential to cause environmental harm (if not managed appropriately) and will require active management/remedial measures (additional cost and effort). All sites can probably be managed for Potential Acid Sulfate Soils.
E5 – Birdstrike	0.0	This has been given zero weight in recognition of the fact that Site 5, which lies in the (unacceptable) Area 1, is certain to be unsuitable. For the balance of the sites, all that is required is relatively straightforward management / monitoring.
E6 – Coastal Hazards	1.5	Immunity from coastal hazards is an important differentiator. Although it is possible to protect terrestrial sites (with a cost premium), reclamation areas are seriously susceptible to coastal processes.
P1 – Pumping Head	0.75	Pumping head is essentially a technical challenge that can be overcome via engineering solutions, such as the mobilisation and use of booster pumps and installation of additional pipeline to reach the disposal area. It is also heavily represented in Cost.
P2 – Placement Capacity	1.0	This has been given average weight, although there are remedies for most sites with less than optimum volumes.
P3 – Tailwater Discharge	1.5	There are some opportunities for engineering a solution and this was taken into account in the scoring system, based on distance from the dredge pond/reclamation to the receiving waters and/or the likely need for additional engineering design measures to minimise impacts (scour controls, etc.). However, if the receiving waters are of substantially lower salinity than tailwater, no form of treatment is feasible.
P4 – Ground Conditions & Stability	0.5	Even on sites with poorer ground conditions engineering solutions are available for construction of the works that would be required (i.e. low height bund walls, etc.).
S1 – Remoteness	0.0	Deleted

ATTRIBUTE	WEIGHT	NOTES
S2 – Important Agricultural Land	0.0	The alienation of important agricultural areas is a resource allocation decision for which there is an established process. Mitigation in the form of payment is available and this has been considered as a cost item.
S3 – Traffic	0.50	The impact of traffic (for delivering lime etc. to sites where acid sulfate soil treatment is required) will be more on other road users than on adjacent land uses. This is because most of the transport routes assumed are main roads. So, while traffic is a differentiator, it Is not of great importance and impacts and mitigation can be assesse4d in the EIS.
S4 – Appropriate Tenure (Ownership)	1.5	This is an important differentiator as some tenures will require considerable negotiations and complexities.

Source: Study team compilation.

7.2.3 Results

The above weightings were applied at the overall level to produce the following results. This involved multiplying each standardised score for each attribute by the appropriate weighting and re-standardising. For clarity, the results are presented for both the unweighted (**Section 6.7.2**) and weighted analyses.

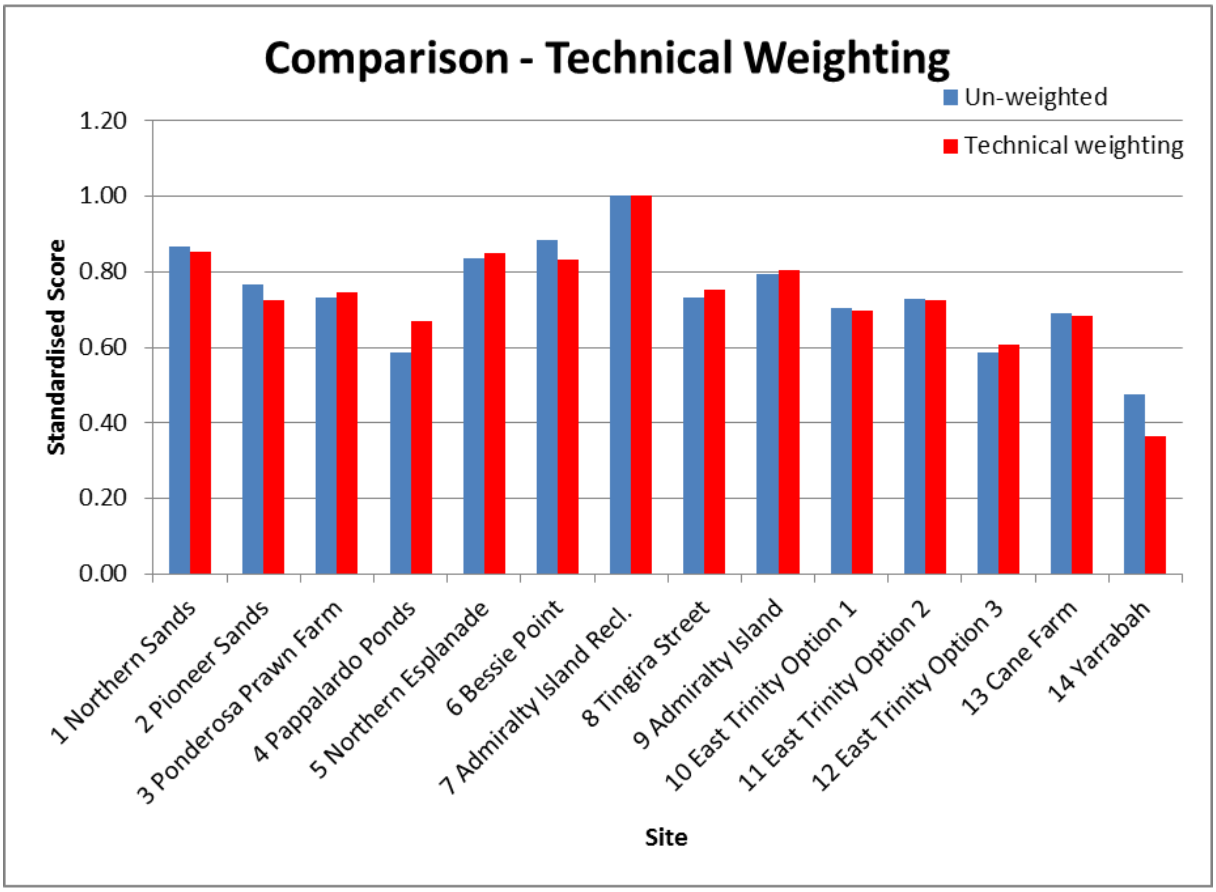


Chart 7-1 Technical weighting.

This analysis shows that with the applied weighting:

- Some sites benefit from technical weighting although in most cases the effects are subtle while for others the converse is true. In all cases the ranking does not change.
- Site 7 remains the preferred option.

7.3 CRITERION WEIGHTING – A 'VALUES-BASED' PROCESS

7.3.1 Introduction

In seeking to arrive at a whole-of-project score, it is necessary to weight the average attribute-weighted scores (or un-weighted if this task has not been undertaken) for each criterion in accordance with a weighting system that considers the relative importance of criteria. As noted above, this is a values-based (as opposed to technical) process that attempts to capture proponent objectives, community values, and government policy.

In order to test the sensitivity of the outcome to various value systems, various 'sensitivity profiles' can be derived that give different criterion weights as follows.

7.3.2 Draft EIS Approach

The draft EIS used 'category weightings' in the sensitivity analysis. This is as shown in the following table (adapted from Table A2.9.17a).

Table 7-2 Draft EIS category weighting profiles

CATEGORY EMPHASIS	CATEGORY AND WEIGHTING
Even	Env (25%); Social (25%); Planning (25%); Econ (25%)
Environment	Env (55%); Social (15%); Planning (15%); Econ (15%)
Social	Env (15%); Social (55%); Planning (15%); Econ (15%)
Planning	Env (15%); Social (15%); Planning (55%); Econ (15%)
Economics	Env (15%); Social (15%); Planning (15%); Econ (55%)

Source: Ports North (2014) adapted from Table A2.9.17a.

This is not directly applicable to this Dredge Material Placement Options Study for the reasons already explained, that is:

- there is no 'Planning' category (criterion) in the Dredge Material Placement Options Study MCA approach
- the draft MCA 'Economics' category was spilt into *Cost* and *Performance* for the Dredge Material Placement Options Study site evaluation.

However, the draft EIS philosophy can be adapted such that each category (criterion) to be emphasised is weighted by 55% and the remaining three by 15%.

7.3.3 Adopted Profiles

The following table details the adopted sensitivity profiles. These are based on the draft EIS amended as described above.

Table 7-3 Sensitivity profiles

PROFILE	DETAILS
Unweighted	No weighting (i.e. all attributes considered equally)
Cost	0.55 weighing to *Cost*, 0.15 to each of the balance
Environmental	0.55 weighing to *Environmental*, 0.15 to each of the balance
Performance	0.55 weighing to *Performance*, 0.15 to each of the balance
Social	0.55 weighing to *Social*, 0.15 to each of the balance

The following results were obtained by multiplying the criterion level standardised scores (see **Section 6.8**) by the appropriate weightings and re-standardising.

7.4 RESULTS

7.4.1 Details

a) Unweighted

This is the unweighted analysis described in **Section 6.7**. It is used for comparison in all of the following profiles.

b) Cost

Giving weight to *Cost* (based on unit rates) resulted in the following chart. For ease of analysis the weighted results (Yellow) are shown beside the unweighted figures (Black) from **Section 6.8**.

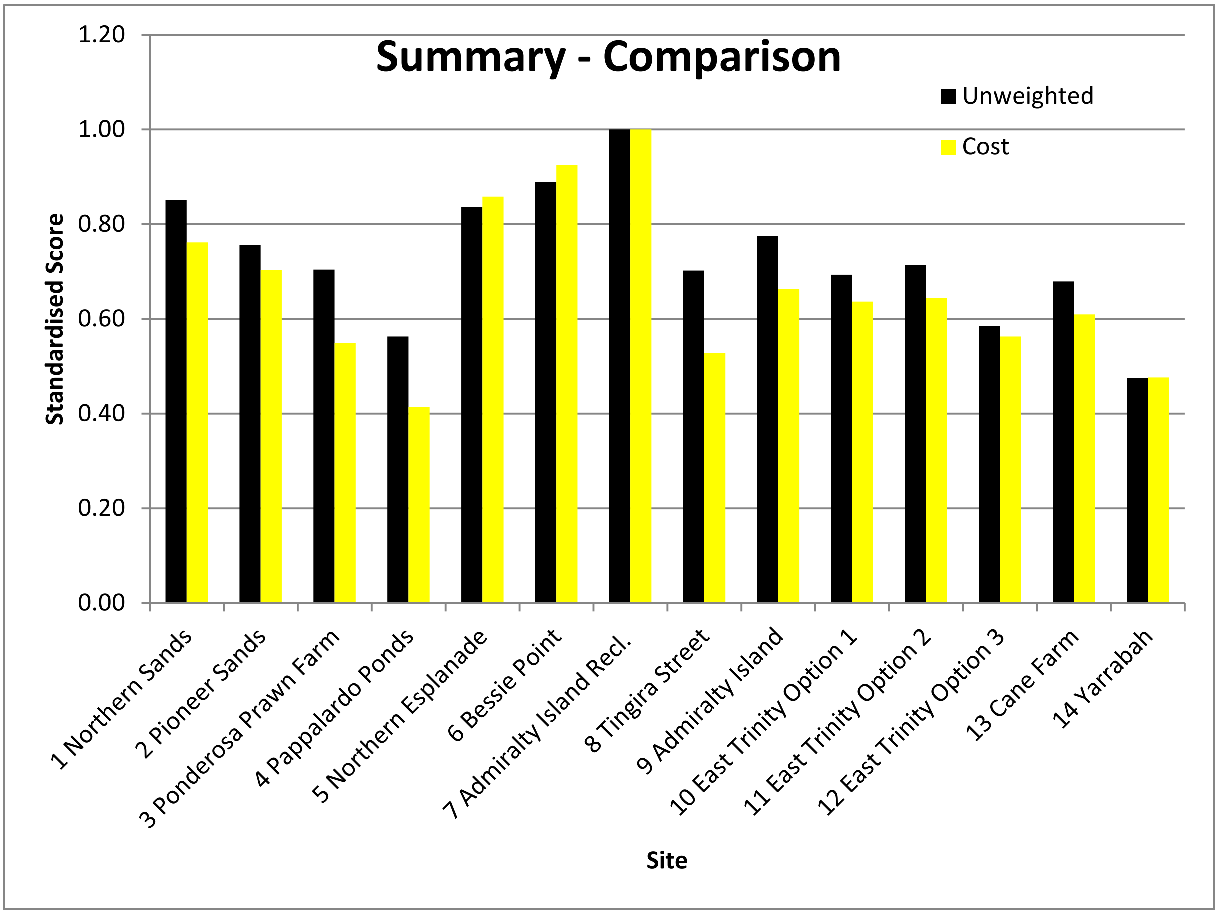


Chart 7-2 Cost profile.

This analysis shows that with the applied weighting and compared with the un-weighted analysis:

- Site 7 remains the highest ranking site.
- Site 4 becomes the lowest ranking site.
- The ranking of the smaller sites (i.e. those with higher unit costs) deteriorates by up to 3 positions.

c) Environment

Giving weight to *Environment* attributes resulted in the following chart. For ease of analysis the weighted results (Green) are shown beside the unweighted figures (Black) from **Section 6.8**.

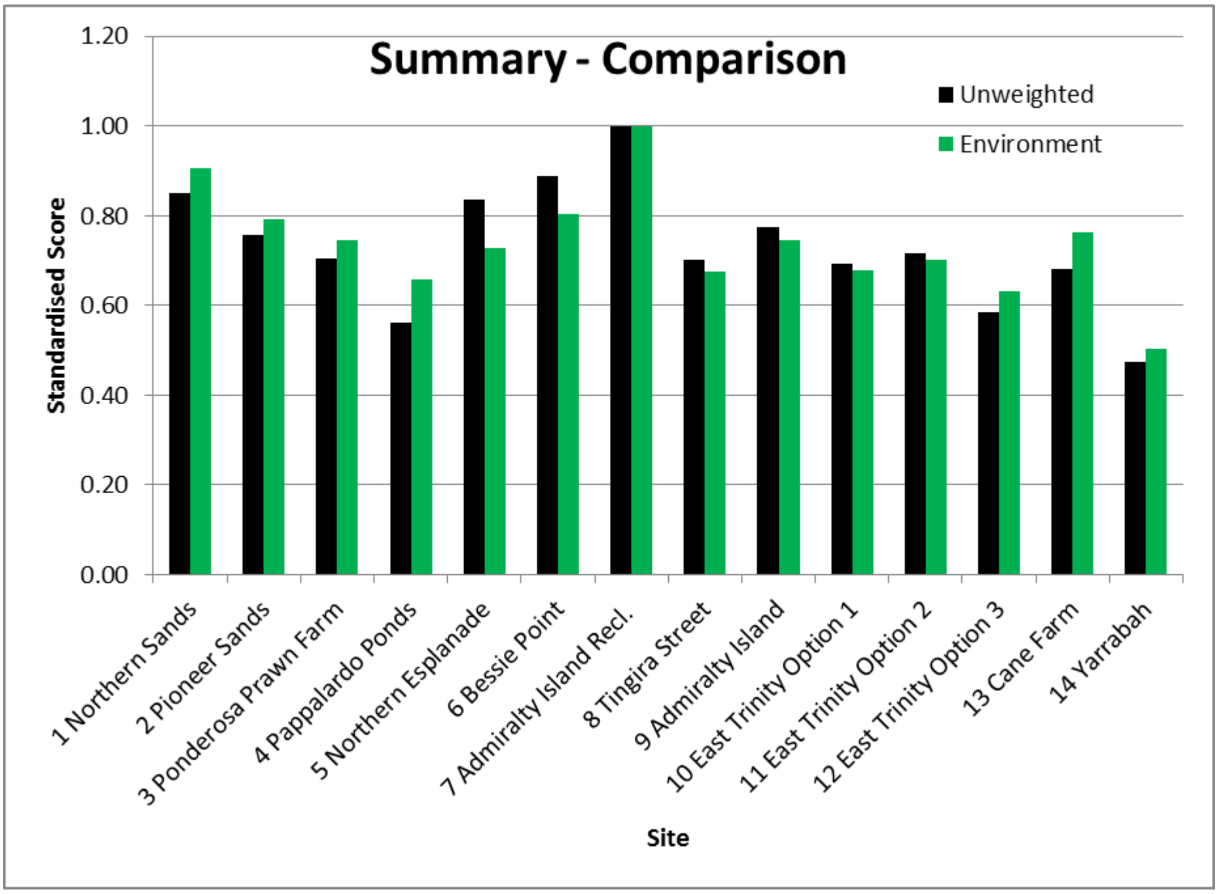


Chart 7-3 Environment profile.

This analysis shows that with the applied weighting and compared with the un-weighted analysis:

- Site 7 remains the highest ranking site.
- Site 14 remains the lowest ranking site.
- The Cairns Bay reclamation sites, Admiralty Island, and East Trinity Sites 10 and 11 drop in performance due to the effect on seagrass and mangroves.
- The two voids and existing bunded areas rise in ranking due to the absence of environmental values.

d) *Performance*

Giving weight to *Performance* attributes resulted in the following chart. For ease of analysis the weighted results (Blue) are shown beside the unweighted figures (Black) from **Section 6.8**.

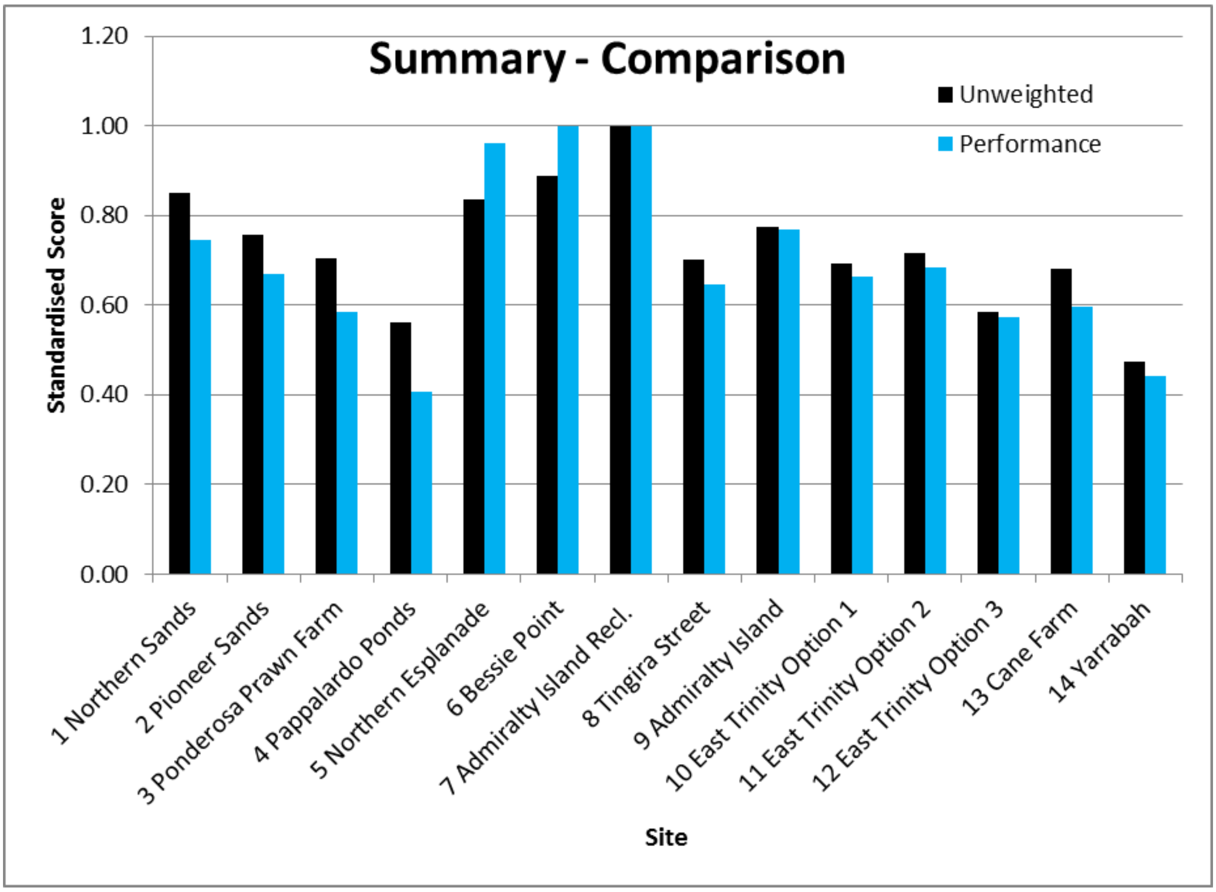


Chart 7-4 Performance profile.

This analysis shows that with the applied weighting and compared with the un-weighted analysis:

- Sites 6 and 7 become the highest ranked sites, only just ahead of Site 5.
- Sites 5 and 6 are elevated due to their low pumping head.
- The attractiveness of Sites 1 to 4 is reduced by high pumping head and limited volume.
- All other sites score slightly worse when weighted due to issues with ground conditions / stability.

e)* *Social

Giving weight to *Social* attributes resulted in the following chart. For ease of analysis the weighted results (Orange) are shown beside the unweighted figures (Black) from **Section 6.8**.

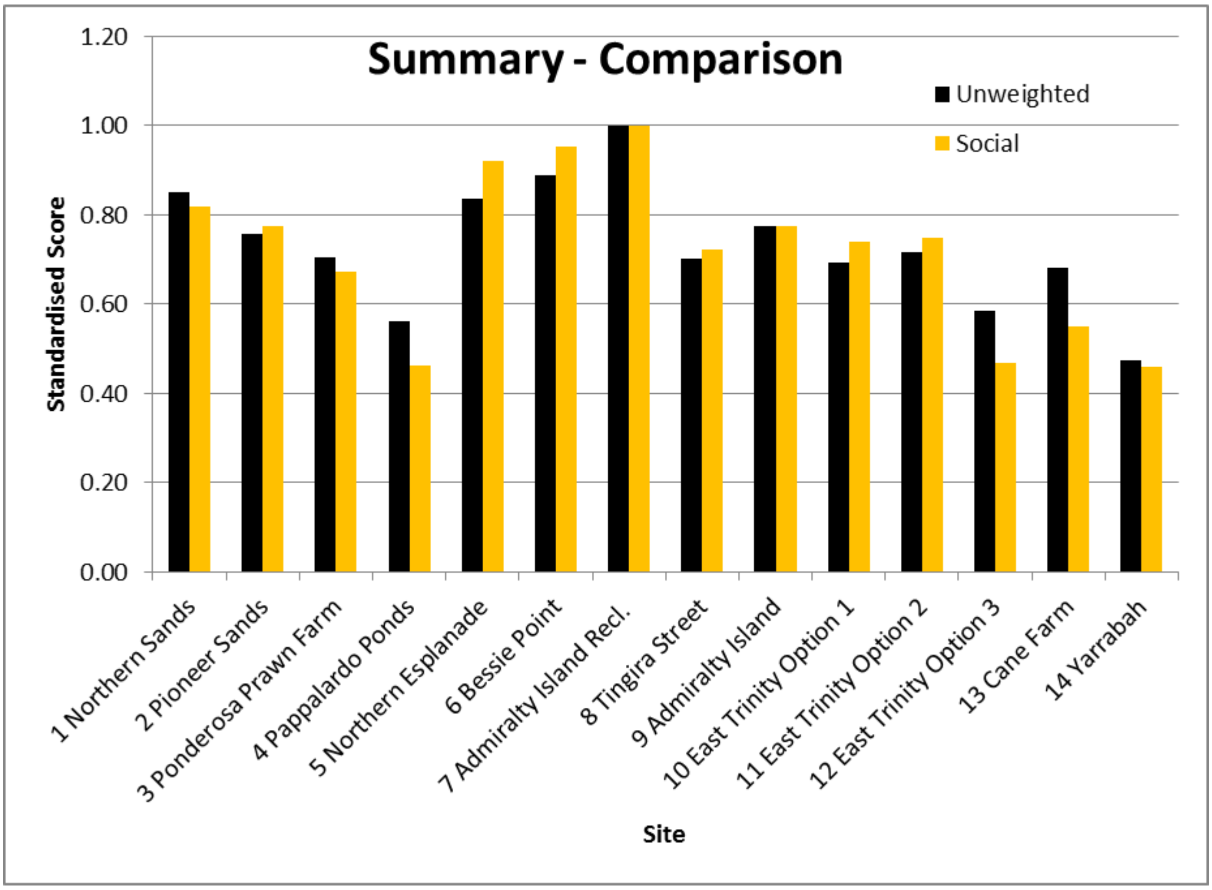


Chart 7-5 Social profile.

This analysis shows that with the applied weighting and compared with the un-weighted analysis:

- The attractiveness of Sites 2 and 5 to 11 and 14 is increased due to absence of agricultural land values and low traffic problems.
- All other sites score slightly worse when weighted due to issues with traffic and / or agricultural land values

7.4.2 Overall Comparison

The following chart shows the unweighted results together with each of the above profiles for all sites.

As this chart is difficult to interpret, an analysis of ranking was undertaken as shown below the chart using two methods:

- rank of each site by profile (**Table 7-4**)
- rank of each site for all profiles (including Technical) (**Table 7-5**).

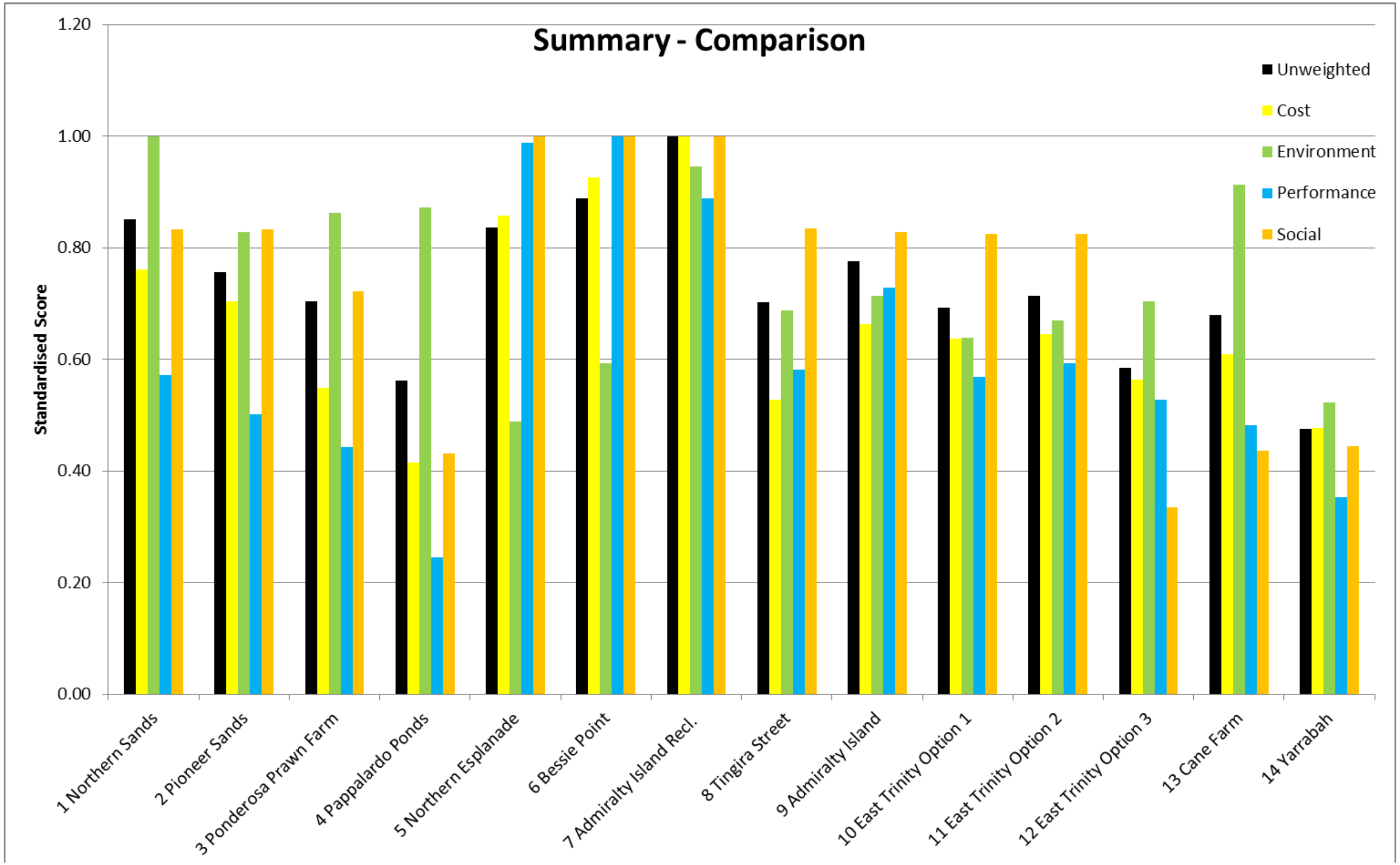


Chart 7-6 Comparison of all profiles.

Table 7-4 Results based on ranking

Rank	Unweighted (incl. Cost)	Cost	Environment	Performance	Social	Technical
1	7 Admiralty Island Recl.	7 Admiralty Island Recl.	7 Admiralty Island Recl.	7 Admiralty Island Recl.	7 Admiralty Island Recl.	7 Admiralty Island Recl.
2	6 Bessie Point	6 Bessie Point	1 Northern Sands	6 Bessie Point	6 Bessie Point	1 Northern Sands
3	1 Northern Sands	5 Northern Esplanade	6 Bessie Point	5 Northern Esplanade	5 Northern Esplanade	5 Northern Esplanade
4	5 Northern Esplanade	1 Northern Sands	2 Pioneer Sands	9 Admiralty Island	1 Northern Sands	6 Bessie Point
5	9 Admiralty Island	2 Pioneer Sands	13 Cane Farm	1 Northern Sands	2 Pioneer Sands	9 Admiralty Island
6	2 Pioneer Sands	9 Admiralty Island	3 Ponderosa Prawn Farm	11 East Trinity Option 2	9 Admiralty Island	8 Tingira Street
7	11 East Trinity Option 2	11 East Trinity Option 2	9 Admiralty Island	2 Pioneer Sands	11 East Trinity Option 2	3 Ponderosa Prawn Farm
8	3 Ponderosa Prawn Farm	10 East Trinity Option 1	5 Northern Esplanade	10 East Trinity Option 1	10 East Trinity Option 1	2 Pioneer Sands
9	8 Tingira Street	13 Cane Farm	11 East Trinity Option 2	8 Tingira Street	8 Tingira Street	11 East Trinity Option 2
10	10 East Trinity Option 1	12 East Trinity Option 3	10 East Trinity Option 1	13 Cane Farm	3 Ponderosa Prawn Farm	10 East Trinity Option 1
11	13 Cane Farm	3 Ponderosa Prawn Farm	8 Tingira Street	3 Ponderosa Prawn Farm	13 Cane Farm	13 Cane Farm
12	12 East Trinity Option 3	8 Tingira Street	4 Pappalardo Ponds	12 East Trinity Option 3	12 East Trinity Option 3	4 Pappalardo Ponds
13	4 Pappalardo Ponds	14 Yarrabah	12 East Trinity Option 3	14 Yarrabah	4 Pappalardo Ponds	12 East Trinity Option 3
14	14 Yarrabah	4 Pappalardo Ponds	14 Yarrabah	4 Pappalardo Ponds	14 Yarrabah	14 Yarrabah

Table 7-5 Summary of rank by profile

SITE / PROFILE	UNWEIGHTED	COST	ENVIRONMENT	PERFORMANCE	SOCIAL	TECHNICAL
1 Northern Sands	3	4	2	5	4	2
2 Pioneer Sands	6	5	4	7	5	8
3 Ponderosa Prawn Farm	8	11	6	11	10	7
4 Pappalardo Ponds	13	14	12	14	13	12
5 Northern Esplanade	4	3	8	3	3	3
6 Bessie Point	2	2	3	2	2	4
7 Admiralty Island Recl.	1	1	1	1	1	1
8 Tingira Street	9	12	11	9	9	6
9 Admiralty Island	5	6	7	4	6	5
10 East Trinity Option 1	10	8	10	8	8	10
11 East Trinity Option 2	7	7	9	6	7	9
12 East Trinity Option 3	12	10	13	12	12	13
13 Cane Farm	11	9	5	10	11	11
14 Yarrabah	14	13	14	13	14	14

7.5 DISCUSSION

The analysis of sensitivity demonstrates that the ranking of sites does not vary significantly whatever the weighting system used. For example, in most cases the ranking remains reasonably consistent and most sites vary in rank by only 1 or two numbers. The exceptions are:

- Site 3 which scores well for *Environment* and *Technical* weightings but poorly for *Cost*, *Performance* and *Social* weightings.
- Site 5 which scores well for *Cost*, *Performance*, *Social* and *Technical* but poorly for *Environment.*
- Site 8 drops six positions from the *Technical* profile to the *Cost* profile and five for *Environment.*
- Site 11 which scores well for *Cost*, *Performance,* and *Social* weightings but poorly for *Environment* and *Technical.*

Overall, the sensitivity testing demonstrates that the SE process is relatively robust. While there is no utility in further analysing the results, there are many learnings that can be applied to the final site selection based on overall suitability at the Placement Precinct level. This is described in the following chapter.

8 SUITABILITY ASSESSMENT

8.1 METHODOLOGY

The previous assessment describes the SS, CD, and SE process by which a set of possible sites has been created and evaluated. While the SE process has provided a semi-quantitative and demonstrably robust evaluation and has produced much information about the likely performance of the sites for a range of attributes based on triple bottom line criteria, it is necessary to assess the *suitability* of the Placement Precincts overall and by introducing external issues not previously addressed.

So, while the previous analysis deals with the performance of all sites on an attribute-by-attribute basis and under various weighting profiles, the following assessment collects together key findings for each Placement Precincts basis and provides additional comments in terms of:

- summary of performance for each attribute (un-weighted) – see also **Table 8-1**
- assumed beneficial reuse and comments regarding feasibility and suitability
- serious deficiencies identified in the SE process or in other work
- other considerations where relevant.

8.2 BARRON DELTA PLACEMENT PRECINCT

8.2.1 Precinct Overview

The Barron Delta Placement Precinct is highly constrained by Barron River flooding and sites evaluated consist of existing voids (Sites 1 and 2) and existing bunded areas already compliant with the flood code (Sites 3 and 4). Other voids could possibly be developed, subject to further feasibility and environmental assessments.

8.2.2 Summary of Performance

The performance of the four sites in this Placement Precinct is shown on the following charts.

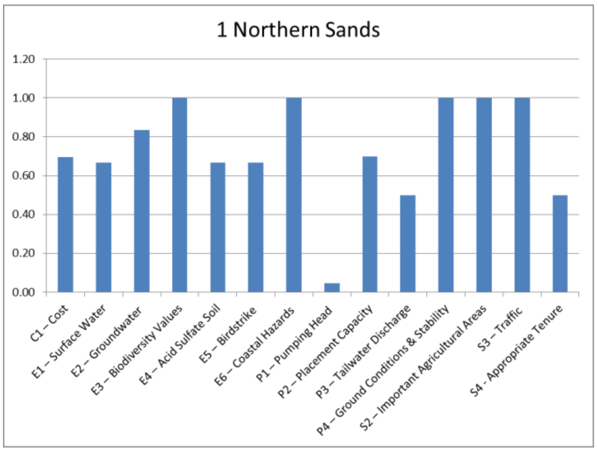


Chart 8-1 Northern Sands.

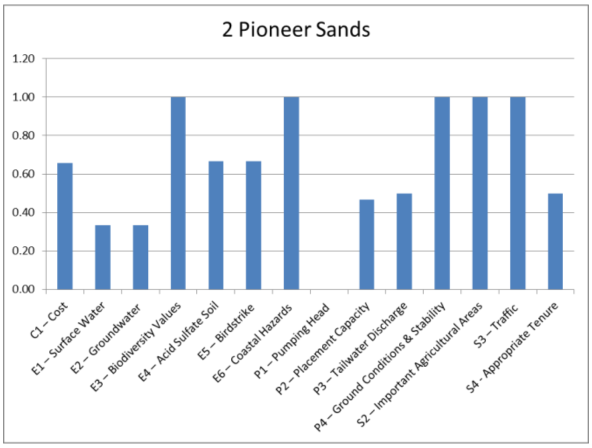


Chart 8-2 Pioneer Sands.

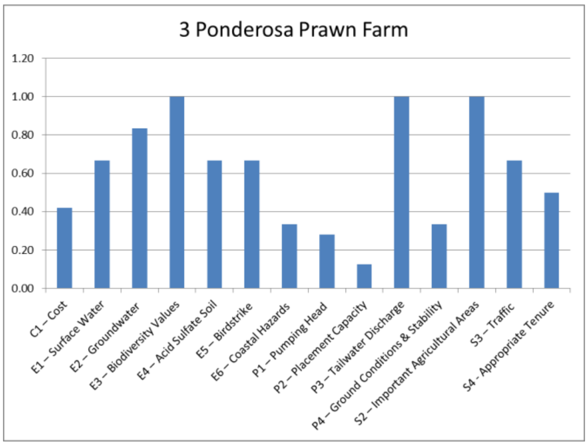


Chart 8-3 Ponderosa Prawn Farm.

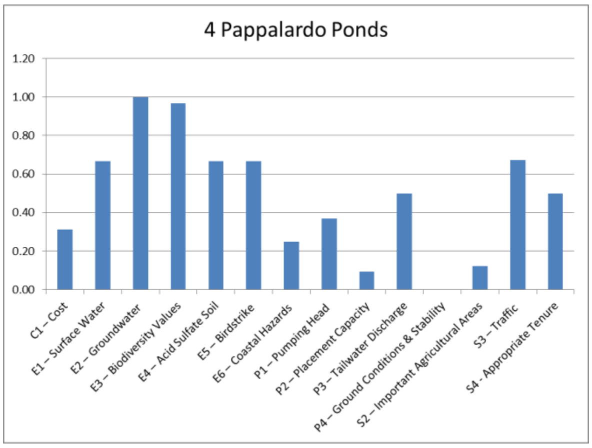


Chart 8-4 Pappalardo Ponds.

In summary:

- Site 1. As a Barron delta void, the site scores well to very well for most attributes except for pumping head, as it is remote from the channel. As it lies a substantial distance upstream from the coast, tailwater management will require attention (probably by timing releases to coincide with higher salinity in the receiving waters or when higher dilution is available). It ranks between 1 and 5 for all profiles.
- Site 2. As the smaller of the two Barron delta voids, the site scores well for most attributes except for pumping head, as it is remote from the channel (more so than Site 1). It lies further upstream from the coast than Site 1 and tailwater management will require attention. It ranks between 3 and 8 for all profiles.
- Site 3. As an existing prawn farm located adjacent to saline water quite close to the coast, the site scores well in terms of biodiversity values, tailwater discharge, and has low agricultural values (although the analysis was based on mapped cane land and ignored the primary production capacity of the aquaculture facility which is actually quite high). It ranks between 7 and 12 for all profiles.
- Site 4. Site 4 consists of a number of abandoned aquaculture ponds with an uncertain history. As an existing bunded area located adjacent to saline water quite close to the coast, the site scores well in terms of biodiversity values and tailwater discharge. However, the necessary treatment areas would alienate cane land and on-site material has been assessed as being poor for future bund construction. It ranks between 12 and 14 for all profiles.

8.2.3 Beneficial Reuse

a) Site 1

No beneficial reuse is contemplated. Once the available void has been filled, the site will be left as-is. All placed material will be below the water table and no treatment is required. For all intents and purposes, the site will continue to be a freshwater lake, albeit somewhat shallower than at present. This will have some biodiversity values for birds in particular. It is of note that this site is currently mapped as a lacustrine wetland under Queensland Government mapping. The site could have the potential to be used for open space or outdoor recreational pursuits when placement is complete.

b) Site 2

As for Site 1, the site will continue to be a freshwater lake, albeit somewhat shallower than at present. This will have some biodiversity values for birds in particular. Like Site 1, this site is currently mapped as a lacustrine wetland under Queensland Government mapping.

Reuse opportunities are as for Site 1.

c) Site 3

Nil. As the placement would be above the water table, treatment and capping will be required. The Ponderosa bunds are above the 100 year ARI Barron River flood and have been subjected to analysis with Council's flood model. Accordingly, development on top of the capped spoil may be possible, subject to geotechnical considerations.

d) Site 4

Nil. This is similar to Site 3. As the placement would be above the water table, treatment and capping will be required. The Pappalardo bunds are above the 100 year ARI Barron River flood and are existing features included in the Council's flood model. Accordingly, development on top of the capped spoil may be possible, subject to geotechnical considerations. Treatment ponds could conceivably be located downstream as per the concept design as they would be shielded from flooding effects by the existing structures.

8.2.4 Serious Deficiencies

a) Site 1

Nil.

b) Site 2

The discharge waters (Barron River) are well above the tidal limit – waters will be fresh to brackish and a high level of tailwater management will be required.

c) Site 3

With only 13% of the target placement volume, this site is severely limited in terms of capacity. There is little prospect to increase this as expansion of the bunded area is likely to result in adverse flooding impacts in contravention of Cairns Regional Council's flood policy.

d) Site 4

With only 10% of the target placement volume, this site is severely limited in terms of capacity. There is little prospect to increase this as expansion of the bunded area is likely to result in adverse flooding impacts in contravention of Cairns Regional Council's flood policy.

It is known from the Aquis EIS (FCG 2015) that the ponds are mapped as lacustrine waterbodies and that the Aquis ecological surveys describe these ponds as having considerable biodiversity values. It is only because of the relatively small area of these that the site scores as well as it does in terms of biodiversity. In addition, the Coordinator-General's approval conditions for the Aquis Resort (Condition 9) requires that the ponds not be filled as originally proposed by Aquis and that they remain in order to protect their biodiversity values. Although this condition is not directly relevant to a Ports North proposal to fill the ponds, it does signal the attitude of the Coordinator-General who would be responsible for reviewing any future Ports North EIS that deals with land placement of dredge spoil.

8.2.5 Other Considerations

a) Site 1

Based on assumed dimensions, the volume of Site 1 is about 75% of the target. It is possible that this has been underestimated and a survey early in the EIS would confirm the actual placement capacity and perhaps remove this deficiency. Further, the assumed bulking factor of 2.2 may also be conservative and it is assumed that placement will take place in one episode. Once the tailwater is discharged and some settlement takes place, the void will develop 'additional capacity' for future placement.

Alternatively, it may be practical to use Sites 1 and 2 in conjunction as together they have the necessary volume. Although the assumed spoil inflow pipelines follow different routes (see **Figure 6-1**), if necessary the sites could share a common route to Site 1 and this could be extended to Site 2. More detailed consideration of this option would be required.

In addition, the capacity of Site 1 could possibly be expanded (and a revenue stream created) if suitable sand exists in adjacent areas and a market can be found for the excavated material. This is a project opportunity.

b) Site 2

As for Site 1 – although the volume at 50% is below target, the two sites could possibly be used in conjunction to provide the necessary capacity or Site 2 could be expanded (i.e. a project opportunity).

c) Site 3

The transformation of a functioning aquaculture facility worth several million dollars to a site with limited reuse opportunities is not a desirable outcome.

d) Site 4

The land lies within the site of the proposed Aquis development. Although the project has not been approved, this presents complications for acquisition.

8.2.6 Recommendations

a) Site 1

Retain this site for further consideration, and investigate:

- actual placement volume
- opportunities to expand the existing void
- effects of reduced bulking factor and placement regime
- possibility of using in conjunction with Site 2.

b) Site 2

Retain this site for further consideration, and investigate:

- actual placement volume
- opportunities to expand the existing void
- effects of reduced bulking factor and placement regime
- possibility of using in conjunction with Site 1.

c) Site 3

Discard this site from further consideration due to unacceptably low placement capacity.

d) Site 4

Discard this site from further consideration due to unacceptably low placement capacity and the presence of wetlands of known state significance. The Aquis proposal for this land presents complications for acquisition.

8.2.7 Precinct Summary

a) Overall Findings

The analysis concludes that, although pumping head will be considerable and some tailwater / groundwater issues may require management, the Placement Precinct has desirable features.

- The two existing voids (Sites 1 and 2) should be retained for further consideration and further work be undertaken to investigate:
  - actual placement volume
  - opportunities to expand the existing void(s)
  - effects of reduced bulking factor and placement regime
  - possibility of using the two sites in conjunction.
- The two existing bunded sites (Sites 3 and 4) should be rejected for the reasons stated (especially low volume with poor prospects for expansion, and agricultural / biodiversity values).
- Opportunities exist for new voids, subject to feasibility investigations. See below.

b) Opportunities Associated with Voids

The SE process reveals that the two existing voids have many beneficial attributes (Site 1 ranks between 1 and 5 for all profiles and is the highest ranking for the *Technical* profile). The assessment of cost shows that the existing voids score well due to their relatively low infrastructure costs (they require simply delivering and placing material in existing holes). They are also attractive in that they:

- are not subject to Barron River flooding
- are remote from storm surge and tsunami effects
- do not have existing land uses that would be deleteriously affected by placement (the 'lakes' would remain and just be shallower).

One issue with the existing voids is their relatively low placement volume (75% and 50% for Sites 1 and 2 respectively, subject to confirmation by survey) and this is reflected in their unit costs. It may be worthwhile investigating ways by which the volume could be increased by expansion of existing voids or creation of new voids. Due to pumping considerations these would most likely need to be in the Barron Delta Placement Precinct.

At this this stage, the following is based on general concepts only and detailed evaluation would be required to investigate feasibility. It is recommended that these concepts be developed early in the EIS.

<u>Expansion of Existing Voids</u>

As discussed above, it is possible that the two Barron delta voids could be expanded to increase their placement capacity. While it is most likely that this would be technically feasible, studies would need to be undertaken into a number of matters with cost implications. These are:

- Investigations into underlying geology / soils on the assumption that an economic use needs to be found for the material to be extracted. This is most likely to be limited to sand or gravel.
- Market research to identify potential buyers of this material. From time to time large volumes of sand have a commercial value, either as fill for developing low-lying areas of for surcharging areas with settlement-prone soils. An example is the Cairns Airport where fill for surcharge may be needed for expansion works. Other examples may be found by market research. If excavation does not yield sought-after material, then the economics of expanding voids would suffer, perhaps fatally.

- Concept design and impact assessment. Any proposal to expand Sites 1 and 2 would require detailed studies into a number of matters, especially flooding, creek stability, and water quality. ASS issues would also need consideration as the inundated sediments would become exposed by extraction.

Creation of New Voids

The attractiveness of existing voids extends to new voids although a site selection exercise would be required to locate potential sites. These are likely to be in the Barron River delta but this is not essential. The studies required for expansion of existing voids listed above would also apply to new voids.

8.3 CAIRNS BAY PLACEMENT PRECINCT

8.3.1 Precinct Overview

The Cairns Bay Placement Precinct covers the protected waters adjacent to the Cairns Esplanade between the Ellie Point in the north and Bessie Point in the south. It extends seaward to approximately low water. This area contains sites for sub-tidal reclamation (Sites 5 and 6).

8.3.2 Summary of Performance

The performance of the two sites in this Placement Precinct is shown on the following charts.

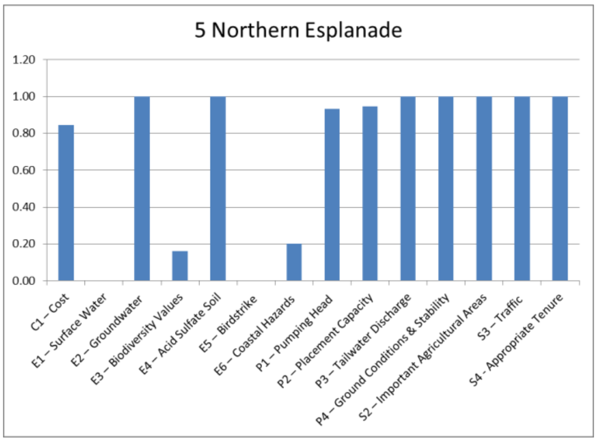


Chart 8-5 Northern Esplanade.

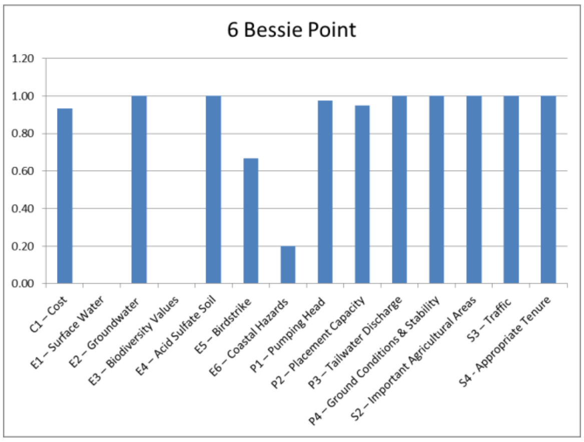


Chart 8-6 Bessie Point.

In summary:

- Site 5. As an intertidal reclamation project, this site scores well in many areas because the limitations of various terrestrial attributes are not relevant to this type of placement. It ranks between 5 and 8 for all profiles and is in the top five for all profiles except *Environment* as its scores poorly for surface water, birdstrike, and coastal hazards.
- Site 6. Similar to Site 5, this site scores well in many areas due to the inherent benefits of subtidal reclamation. It ranks between 2 and 4 for all profiles.

8.3.3 Beneficial Reuse

a) Site 5

As described in **Section 4.2.6**, the *Sustainable Ports Development Act 2015* (Qld) section 36(2) requires that any subtidal placement options or reclamation of land options within the GBRWHA will need to meet the 'beneficial reuse' test that includes (these are examples only):

- land reclamation
- beach nourishment
- environmental restoration purposes, such as creating or restoring wetlands or nesting islands.

This applies to Site 5. The proposed end-use of this site (which would be filled to MSL) is new habitat for birds (i.e. nesting islands). The habitat to be created would be simular in texture and elevation to much of the Esplanade mudflats and could be expected to function similarly as wading bird habitat.

However, the creation of wading bird habitat would be at the expense of existing seagrass habitat so no net gain would be involved.

b) Site 6

As for Site 5, the proposed end-use of Site 6 (which would be filled to MSL) is new habitat for birds (i.e. nesting islands). Although the habitat to be created would be simular in texture and elevation to much of the Esplanade mudflats and could be expected to function similarly as wading bird habitat, the creation of wading bird habitat would be at the expense of existing seagrass habitat so no net gain would be involved.

8.3.4 Serious Deficiencies

a) Site 5

In terms of permissible reuse, the creation of wading bird habitat would be at the expense of existing seagrass habitat so no net gain would be involved. The trade-off involved would need to be addressed in more detail in the EIS should this site be further considered.

As explained in **Section 6.6.6b)**, the site has a serious birdstrike risk (attribute E5). It lies within Area 1 (0 to 3 km radius from the Cairns Airport) under the CairnsPlan Wildlife Hazard Zone. This is deemed by CairnsPlan to be 'incompatible' for the proposed land use (the closest applicable land use definition is 'Conservation Estate (e.g. wetland)').

This is considered to be a fatal impediment.

b) Site 6

The Bessie Point reclamation scores very highly in the site evaluation analysis and is in the top four sites. Its worst area of performance is for *Environment* as it scores very poorly for attribute E3 (Biodiversity) due to the presence of seagrass. In creating inter-tidal terrestrial habitat for waders, this sub-tidal marine habitat (206 ha) would be lost. The trade-off involved would need to be addressed in more detail in the EIS should this site be further considered.

8.3.5 Other Considerations

a) Site 5

The presence of a large reclamation project in close proximity to the Cairns Esplanade is likely to involve a range of unacceptable impacts in terms of visual and other amenity issues.

b) Site 6

As for Site 5, the presence of a large reclamation project in reasonably proximity to the Cairns Esplanade (although not as close as Site 5) is likely to involve a range of undesirable impacts in terms of visual and other amenity issues.

8.3.6 Recommendations

a) Site 5

Discard this site from further consideration due to unacceptable birdstrike risk and undesirable end use. Visual amenity impacts are likely to be significant.

b) Site 6

Discard this site from further consideration due to undesirable end use and undesirable amenity issues.

8.3.7 Precinct Summary

The analysis concludes that, while the Placement Precinct is desirable in terms of location (especially low pumping head, saline water for tailwater discharge) the sites investigated have unacceptable limitations.

- The two existing reclamation sites (Sites 5 and 6) should be rejected for the reasons stated (especially unacceptable birdstrike risk (Site 5), no net gain of biodiversity (especially no beneficial reuse), and undesirable amenity impacts).
- Although there may be other reclamation sites in this Placement Precinct, they would all be expected to suffer from the same limitations.

8.4 TRINITY INLET WEST PLACEMENT PRECINCT

8.4.1 Precinct Overview

The Trinity Inlet West Placement Precinct includes Admiralty Island and land adjacent to Smiths Creek south of the Portsmith industrial area. This provides opportunities for both terrestrial (Sites 8 and 9) and reclamation options (Site 7).

8.4.2 Summary of Performance

The performance of the three sites in this Placement Precinct is shown on the following charts.

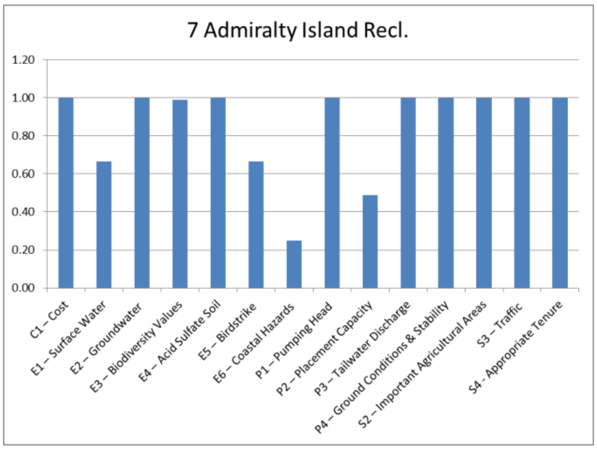


Chart 8-7 Admiralty Island Reclamation.

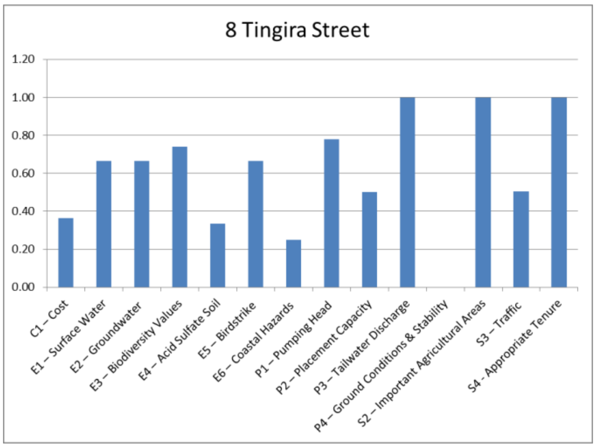


Chart 8-8 Tingira Street.

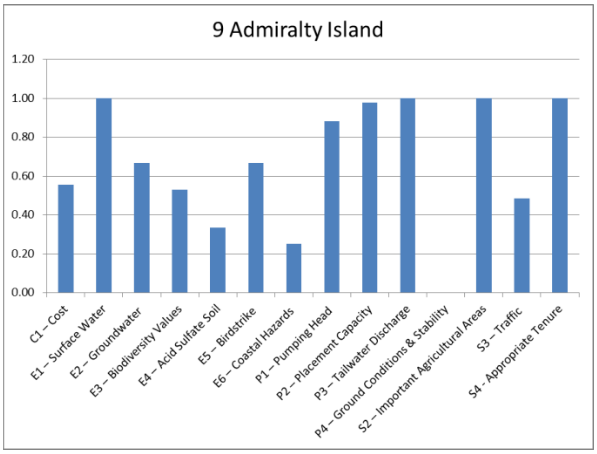


Chart 8-9 Admiralty Island.

In summary:

- Site 7. Similar to Sites 5 and 6, this site scores well in many areas due to the inherent benefits of subtidal reclamation. It ranks between 1 and 2 for all profiles.
- Site 8 is well-sited in terms of existing port and land transport infrastructure. It ranks between 6 and 12 for all profiles, with the worst result being for the *Cost* profile.
- Site 9. Admiralty Island was once used for port purposes (i.e. the WWII Catalina Base) and in the early 1990s was of interest for port expansion. However, this is no longer the case. It ranks between 4 and 7 for all profiles.

8.4.3 Beneficial Reuse

a) Site 7

Although this site is distant from the ocean within Trinity Inlet, it is nonetheless below LAT and therefore within the GBRWHA. Accordingly, the 'beneficial reuse' test applies. The proposed end-use of this site has not been considered in detail but could be either sub-tidal bird habitat (if the reclamation terminates at MSL) or provide the foundation for future reclamation for port infrastructure.

However, recent planning work undertaken by Ports North shows no short to medium term requirement for Admiralty Island (this includes adjacent reclamation).

b) Site 8

It is possible that this site could ultimately be used for port infrastructure due to its strategic location relative to other port facilities. It scores very poorly for attribute E3 (Biodiversity) due to the loss of mangroves that would be involved in its use for placement. Any structure on this reclaimed land would need to be piled or the site surcharged.

Whether or not this resource allocation decision is justified would be a matter for the EIS to determine should this site be further considered. As the placed material will have very low strength of over 30 years (see **Section 8.5.3**), any structure on this reclaimed land would need to be piled or the site surcharged.

c) Site 9

It is possible that this site may be ultimately (i.e. in the long to very long term) considered for port infrastructure due to its strategic location relative to other port facilities. However, it scores very poorly for attribute E3 (Biodiversity) due to the loss of mangroves that would be involved in its use for placement. In addition, the island has other biodiversity values not assessed.

As for Site 8, any structure on this reclaimed land would need to be piled or the site surcharged.

As described above, recent planning work undertaken by Ports North shows no short to medium term requirement for Admiralty Island for port infrastructure.

8.4.4 Serious Deficiencies

a) Site 7

Reclamation of this site will involve reducing the width of the navigable channel of Trinity Inlet east of Admiralty Island and this could affect the complex hydrodynamics of the Inlet. Advice on this issue provided by WBM (G Fisk pers. comm. 30 May 2016) based on the draft EIS findings is that tidal currents adjacent to Admiralty Island are asymmetric, with ebb tides typically having higher current speeds than flood tides. Ebb currents reach around 0.8 m/s during spring tidal ranges while flood currents reach around 0.4 m/s.

Impacts of reclaiming intertidal land along the northeast shoreline of Admiralty Island would arise from:

- loss of intertidal storage / change to tidal prism – may impact tidal flushing of the inlet more broadly
- loss of conveyance / constriction of channel leading to potential adjacent bank/channel scour impacts
- blockage and redirection of flow exchange with Admiralty Island mangrove areas
- associated berth and approach channel dredging impacts (if relevant).

The waters adjacent to Admiralty Island at Site 7 are within the GBRWHA and the GBRMP Estuarine Conservation Zone, and is a Fish Habitat Area. Accordingly, Site 7 has demonstrated biodiversity, recreation, and fisheries values.

It is considered that the high risk of adverse impacts on the Trinity Inlet ecosystem arising from hydrodynamic changes and in the absence of a compelling need to allocate these resources to port infrastructure in the short to medium term at least, Site 7 is unsuitable for reclamation.

b) Site 8

Use of this site results in a relatively high cost of disposal and treatment due to high clearing costs, environmental offsets, and the requirement for imported fill to form the bunds.

c) Site 9

Development of this land would result in the destruction of 102 ha of mangroves and the loss of associated ecological productivity. Admiralty Island is mapped within the PCTI Nationally Important Wetland, is within the GBRWHA, is part of the GBRMP Estuarine Conservation Zone, and is part of the Trinity Inlet Fish Habitat Area.

Accordingly, the island has demonstrated biodiversity, recreation, and fisheries values. In the absence of a compelling need to allocate these resources to port infrastructure in the short to medium term at least, Site 9 is considered to be unsuitable for land placement.

8.4.5 Other Considerations

a) Site 7

Mapped seagrass is nearby but would not be directly affected.

b) Site 8

Development of this land would result in the destruction of 56 ha of mangroves and the loss of associated ecological productivity.

While the placement volume based on the concept design is only 53% of the target, it may be possible to extend this by making use of the adjacent vacant Port land for temporary works such as ASS/PASS treatment and tailwater management.

c) Site 9

Development could also impact on cultural heritage values. For example, the draft EIS notes that:

- Admiralty Island is associated with a number of women's stories and is a sacred and significant place.
- Aboriginal cultural heritage (shell middens and scattered artefacts) have been recorded and are registered in the Aboriginal Cultural Heritage Register for Admiralty Island.
- The database is not likely to reflect a complete picture of the Aboriginal cultural heritage values of … [the] site however, and further consultation with indigenous parties would be required to confirm potential impacts to cultural heritage. These finds do provide an indication that further cultural heritage values may be present at … [this site].
- Based on native title and Aboriginal cultural heritage considerations only, [the] Admiralty Island Site is a poor option. There is no immediate basis to conclude native title may be extinguished within the single lot that comprises this site. Subject to confirming the correct lot on plan number, there is a single registered native title claim over the area and a single Aboriginal Party for cultural heritage purposes, and there is no registered Aboriginal cultural heritage within the area.
- However, it is considered that the nature of this site is such that it is very likely to include intangible and resource areas of cultural heritage significance, and any use of this site for the Project is likely to draw active interest from a number of traditional owner groups.

8.4.6 Recommendations

a) Site 7

Discard this site from further consideration due to likely serious hydrodynamic issues and no short to medium need for port land (i.e. no case for beneficial reuse).

b) Site 8

Discard this site from further consideration due to no short to medium need for port land (i.e. no case for beneficial reuse), high unit cost, and low volume.

c) Site 9

Discard this site from further consideration due to no short to medium need for port land (i.e. no case for beneficial reuse) and high biodiversity, recreational, fisheries, and cultural heritage values.

8.4.7 Precinct Summary

The analysis concludes that, while the precinct is desirable in terms of location (low pumping head, saline water for tailwater discharge), the sites investigated have unacceptable limitations.

- Site 7:
  - is likely to have unacceptable hydrodynamic impacts
  - no net beneficial reuse (subtidal habitat replaced by intertidal habitat with no identified future use for port infrastructure)
  - limited volume.
- Site 8:
  - unacceptable environmental impacts.
  - no net beneficial reuse (mangrove habitat to be lost with no identified future use for port infrastructure)
  - limited volume.
- Site 9:
  - unacceptable environmental impacts
  - no net beneficial reuse (mangrove habitat to be lost with no identified future use for port infrastructure).
- There are no other potentially suitable sites in this Placement Precinct.

8.5 TRINITY INLET EAST PLACEMENT PRECINCT

8.5.1 Precinct Overview

The Trinity Inlet East Placement Precinct contains land east of Trinity Inlet and bounded by Pine Creek Road. This area is locally known as East Trinity and provides opportunities for a number of possible terrestrial placement options on different types of land. In developing the concept designs for these three nominal sites (Sites 10, 11, and 12) it was recognised that the overall Trinity East Placement Precinct is very large and a multitude of different designs could be produced.

8.5.2 Summary of Performance

The performance of each of the three East Trinity sites for all SE attributes is shown on the following charts.

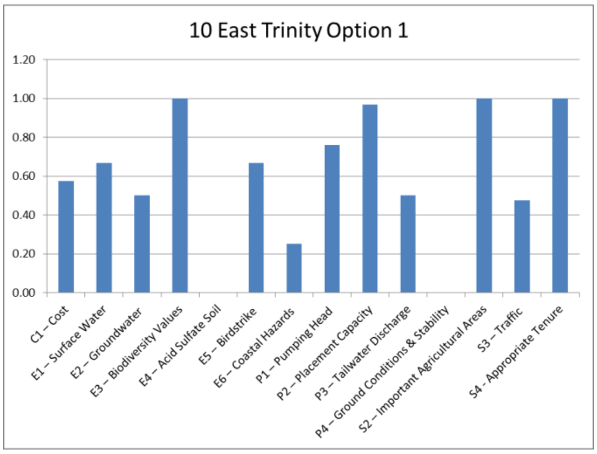


Chart 8-10 East Trinity Option 1.

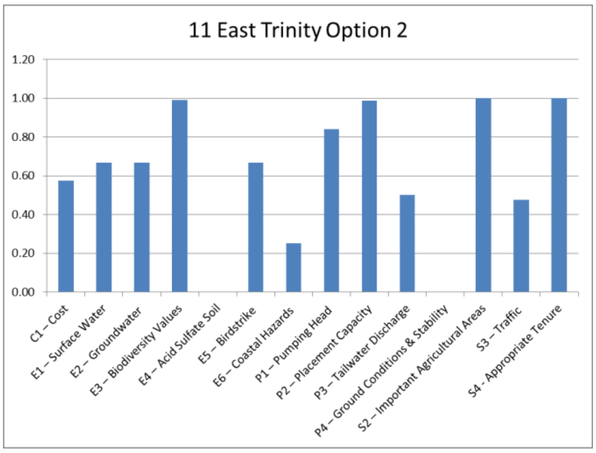


Chart 8-11 East Trinity Option 2.

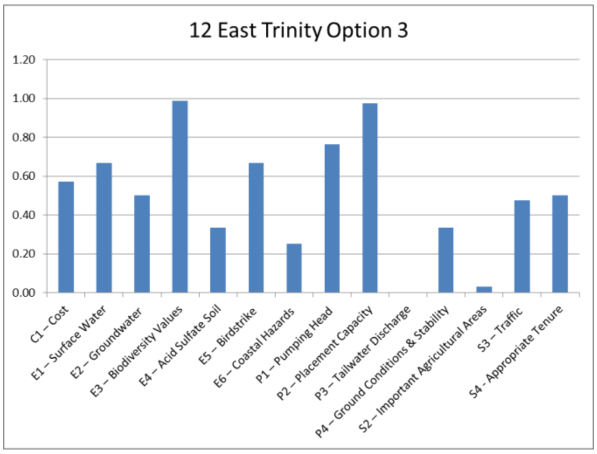


Chart 8-12 East Trinity Option 3.

Overall, the three East Trinity sites rank between 6 and 14 as there are both strengths and weaknesses at each selected site.

Each of the three East Trinity options has different characteristics and as expected, the SE process has identified strengths and weaknesses for each (see **Table 8-1**). Accordingly the overall performance of the precinct as a whole is discussed below.

8.5.3 Beneficial Reuse

After placement and treatment, each site will contain a bunded area of approximately 60 ha with an assumed depth of 3 m. As noted in **Section 4.2.4**, the initial geotechnical assessment for this project by Golder Associates (2015) reveals that under these circumstances:

- without surcharging with imported fill, this material would not increase in strength enough to allow development even after 30 years
- with surcharging, development may be feasible with appropriate engineering to accommodate settlements after a period of about 2 years
- use of wick drains to quicken consolidation is not technically viable for the relatively shallow thickness of dredged material envisaged.

Unless surcharging with imported fill is employed or piled foundations adopted for structures, beneficial reuse (for, for example residential development) is unlikely to be technically possible for over 30 years. Any value derived from the sale for such land in 30 years has a present value that is only a small fraction and therefore the financial benefits derived would be exceedingly small. For example, at a discount rate of 4% the present value (PV) of $1000 in 30 years' time is only $308.32. For higher discount rates the effect is more dramatic (e.g. for 7% the PV is $131.37).

The beneficial reuse of land at Trinity East or Trinity South for urban purposes needs to be considered on the relative economics of these sites compared to densification or other greenfield options to cater for the future growth of Cairns. This is a significant Regional Land Use Planning exercise.

Proponents of development at Trinity East presuppose that urban development at East Trinity is in fact a desired outcome for the future expansion of Cairns. It is suggested that many members of the Cairns community would argue that it is not. The issue of catering for the future development of Cairns is a broader regional development discussion that must be had by the Cairns and the Far North Community before possible development options are pre-emptively adopted on the basis of a quantity of fill (of limited volume and questionable quality) being available.

A valid argument could be put that future population growth should be catered for by densification and consolidation of development within the existing urban footprint (where services and transport networks already exist) rather than green field expansion into Trinity East or Trinity South. It could be argued that new green field development should be delayed until adequate densification and more efficient use of the existing urban footprint (and existing infrastructure) is achieved. Even if as a result of such planning Trinity East or Trinity South are determined to be a future growth corridor for Cairns it is expected that it will be many decades away.

This is even more likely in the event that major tourism projects are developed north of the city as the employment centroid of Cairns will be relocated further north. It is considered illogical to plan for low density urban growth to the south when the major employment centres will be to the north of the city. In addition, the residential yield of 60 ha is considered to be too small to support the infrastructure that would be required such remote development.

In summary proposals for urban expansion are premature and of insufficient scope to adequately address the broader Regional and City wide issues of planning for growth. Having a convenient source of fill which has a collateral benefit of allowing for expanded Port operations is not a sufficient basis for committing to a new development front with significant access and infrastructure constraints. This is a much bigger regional growth issue of which Port capacity is a relatively small part.

What this means is that the merits of East Trinity need to be considered for land placement of dredge material only as reliance cannot be placed on some future end use and associated income stream that is far from certain.

8.5.4 Serious Deficiencies

The interplay of beneficial and adverse features and other issues is too complex a matter for this Options Report. Accordingly, it is recommended that during the early stages of the EIS a planning exercise be undertaken to create the 'best' East Trinity site, based on impact avoidance and minimisation and a detailed understanding of opportunities and constraints of the precinct.

8.5.5 Other Considerations

From the draft EIS and detailed planning work undertaken over many years it is known that East Trinity has significant cultural heritage values. These will need to be addressed in the early stages of the EIS as above.

It is also the site of extensive Government-sponsored rehabilitation work and it will be necessary to carefully evaluate the effect of any placement in the vicinity of such works.

8.5.6 Recommendations

The Trinity East Placement Precinct has obvious advantages for land placement and was the preferred land placement option in the draft EIS (although this was for the much larger 4.4 M m^3 dredging project). It is recommended that during the early stages of the EIS a planning exercise be undertaken to create the 'best' East Trinity site, based on impact avoidance and minimisation and on a detailed understanding of opportunities and constraints.

8.5.7 Precinct Summary

The analysis concludes that the precinct is desirable in terms of location (low pumping head, saline water for tailwater discharge in some cases). The three sites exhibit a mix of desirable and undesirable features as follow:

- All East Trinity sites have some beneficial features, such as:
  - low biodiversity values (ignoring for the present the values of the on-going restoration project)
  - low pumping head

- Equally, they all have some features that are not beneficial, such as:
  - high ASS / PASS issues
  - high coastal hazards
  - poor ground stability
  - poor traffic performance.
- They also have some distinctives, such as:
  - At Sites 10 and 12, tailwater will discharge to brackish receiving waters and require either a discharge channel (Site 10) or pumping (Site 12). At Site 11 tailwater will discharge to saline receiving waters.
  - The tailwater discharge of Sites 10 and 12 will be greater than 1 km from seagrass whereas for Site 11, discharge will occur near the mouth of Hills Creek is within 500 m of a recovering seagrass site in very poor condition.
  - Sites 10 and 11 are in public ownership while Site 12 is privately owned.
  - Site 12 high agricultural values whereas sites 10 and 11 do not.
- It is recommended that during the early stages of the EIS a planning exercise be undertaken to create the 'best' East Trinity site, based on impact avoidance and minimisation and a detailed understanding of opportunities and constraints.

8.6 TRINITY INLET SOUTH PLACEMENT PRECINCT

8.6.1 Precinct Overview

The Trinity Inlet South Placement Precinct includes a suite of possible sites on cane land south of Trinity Inlet at the extreme limit of feasible pumping distance. Site 13 is typical of a number of similar possible sites.

8.6.2 Summary of Performance

The performance of this site for all SE attributes is shown on the following chart.

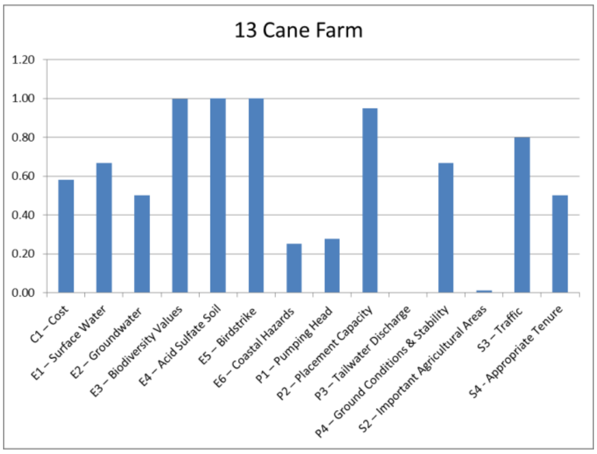


Chart 8-13 Cane Farm.

As for the East Trinity sites, Site 13 is one of a number of sites that could conceivably be developed in in the Trinity Inlet South Placement Precinct. As currently conceived, it ranks generally between 9 and 11 for most profiles, while ranking at 5 for *Environment* due to lack of biodiversity values.

8.6.3 Beneficial Reuse

As for Site 10.

8.6.4 Serious Deficiencies

Site 13 routinely ranks poorly when compared with other sites across most attributes. The site's most serious deficiencies are its high pumping head and tailwater return issues, coupled with agricultural land values (the loss of land mapped as an important agriculture area is not considered fatal but is undesirable given the adjacent rural land use).

8.6.5 Other Considerations

The small residential yield from 60 ha is considered to be too small to support the infrastructure that would be required such out-of-sequence development.

8.6.6 Recommendations

Discard this site from further consideration due to overall poor performance.

8.6.7 Precinct Summary

The analysis concludes that the precinct is not particularly desirable in terms of location (high pumping head, poor tailwater discharge performance) and high agricultural values.

- Site 13 ranks poorly for all profiles and no remedies are feasible to improve performance.
- Although there may be other possible terrestrial sites in this Placement Precinct, they would all be expected to suffer from the same limitations.

8.7 YARRABAH PLACEMENT PRECINCT

8.7.1 Precinct Overview

The Yarrabah Placement Precinct includes a single possible site (Site 14) on unoccupied land east of Yarrabah.

8.7.2 Summary of Performance

The performance of this site for all SE attributes is shown on the following chart.

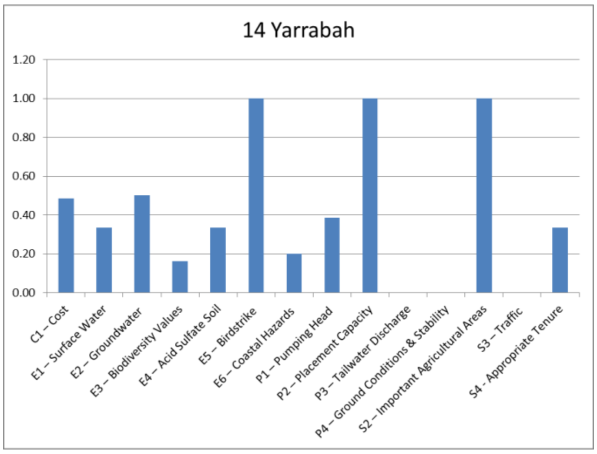


Chart 8-14 Yarrabah.

Site 14 is the only feasible site within the Yarrabah Placement Precinct due to topographic and land use constraints. It ranks between 12 and 14 for all profiles.

8.7.3 Beneficial Reuse

Possibly as for Site 10. However, there is unlikely to be a demand for land at this location.

8.7.4 Serious Deficiencies

Site 14 routinely ranks poorly (usually worst) when compared with other sites across most attributes. The site's most serious deficiencies are its high pumping head and tailwater return issues. In addition, this site is even more remote from development than the East Trinity sites and contains mapped biodiversity values (Class F – wetland / groundwater dependent ecosystems). Development of this land would result in the destruction of 119 ha of a groundwater dependent ecosystem and the loss of associated ecological productivity.

8.7.5 Other Considerations

The small residential yield from 60 ha is considered to be too small to support the infrastructure that would be required such out-of-sequence development.

8.7.6 Recommendations

Discard this site from further consideration due to overall poor performance.

8.7.7 Precinct Summary

The analysis concludes that the precinct is not particularly desirable in terms of location (high pumping head, poor tailwater discharge performance) and high biodiversity values.

- Site 14 ranks poorly for all profiles and no remedies are feasible to improve performance.
- There are no other possible terrestrial sites in this Placement Precinct.

8.8 SUMMARY

The following table provides a summary of each site in terms of:

- rank (based on the 'Balanced' profile)
- key strengths
- key weaknesses
- when the site is recommended for rejection based on the suitability assessment
- reason for rejection and where appropriate, additional comments.

The overall suitability of the Placement Precinct is also assessed.

Based on the suitability assessment, it is recommended that the following sites be further investigated in the EIS:

- **Barron Delta Placement Precinct:** Site 1, possibly expanded and / or in conjunction with Site 2 or a new void.
- **Trinity East Placement Precinct:** a new site drawing together the strengths of Sites 10, 11, and 12.

Table 8-1 Summary of Placement Precinct suitability

SITE	RANK	KEY STRENGTHS	KEY WEAKNESSES	EIS?	REASON / COMMENT
Barron Delta Placement Precinct					
1 Northern Sands	3	• Moderate unit cost • Low biodiversity values • Low coastal hazards • Low ASS / PASS issues • Good ground conditions • Low agricultural values • Low traffic issues	• High pumping head • Limited volume (75%) • Moderate tailwater issues • Private ownership	Yes	Voids have many attractive features that are worthy of further consideration. Consider whole Barron Delta Placement Precinct for developing an optimum void site or sites: • confirm volume (survey) • confirm placement capacity (i.e. bulking factor) • consider combining both sites • consider expanding one or other existing sites • consider creating new void(s).
2 Pioneer Sands	6	• Moderate unit cost • Low groundwater constraints • Low biodiversity values • Low coastal hazards • Low ASS / PASS issues • Good ground conditions • Low agricultural values • Low traffic issues	• High pumping head • Limited volume (50%) • Moderate tailwater issues • Private ownership	Yes	
3 Ponderosa Prawn Farm	9	• Low groundwater constraints • Low biodiversity values • Low tailwater constraints • Low agricultural values (but, see comments)	• High unit cost • Moderate to high coastal hazards • High pumping head • Severely limited volume (13%) • Poor ground conditions • Private ownership	No	Inadequate volume with little prospect to remedy. Site is a functioning aquaculture facility with moderate primary production values.
4 Pappalardo Ponds	13	• Low groundwater constraints • Low biodiversity values (but, see comments)	• High unit cost • Moderate to high coastal hazards • High pumping head • Severely limited volume (13%) • Moderate tailwater constraints • Poor ground conditions • High agricultural values • Private ownership	No	Inadequate volume with little prospect to remedy. Although little clearing of natural areas is required, ponds are wetland values are recognised by the Queensland Government.
Overall				Yes	Voids have many attractive features that are worthy of further consideration in the EIS.

(Continued over)

SITE	RANK	KEY STRENGTHS	KEY WEAKNESSES	EIS?	REASON / COMMENT
Cairns Bay Placement Precinct					
5 Northern Esplanade	5	• Low unit cost • Low pumping head • Freedom from all terrestrial constraints (groundwater, ASS / PASS, tailwater, ground stability, agricultural values, traffic) • Public ownership	• Very poor surface water performance • High biodiversity values • Unacceptable birdstrike risk • High coastal hazards	No	Unacceptable birdstrike risk (note, for all other sites risk can be managed). No net beneficial reuse. High visual and amenity impacts.
6 Bessie Point	2	• Low unit cost • Low pumping head • Freedom from all terrestrial constraints (groundwater, ASS / PASS, tailwater, ground stability, agricultural values, traffic) • Public ownership	• Very poor surface water performance • High biodiversity values • High coastal hazards	No	No net beneficial reuse (subtidal habitat replaced by intertidal habitat).
Overall				No	Cairns Bay intertidal reclamations are unsuitable largely due to no net beneficial reuse opportunities and high visual and amenity impacts.
Trinity Inlet West Placement Precinct					
7 Admiralty Island Recl.	1	• Low unit cost • Low pumping head • Freedom from all terrestrial constraints (groundwater, ASS / PASS, tailwater, ground stability, agricultural values, traffic) • Public ownership	• Very poor surface water performance • High biodiversity values • High coastal hazards • Limited volume (52%)	No	Unacceptable hydrodynamic impacts. No net beneficial reuse (subtidal habitat replaced by intertidal habitat with no identified future use for port infrastructure). Limited volume.
8 Tingira Street	7	• Low pumping head • Freedom from some terrestrial constraints (groundwater, tailwater, ground stability, agricultural values, traffic) • Public ownership	• High unit cost • Moderate ASS / PASS issues • High coastal hazards • Limited volume (53%) • Poor ground stability	No	Unacceptable environmental impacts. No net beneficial reuse (mangrove habitat to be lost with no identified future use for port infrastructure). Limited volume.
9 Admiralty Island	4	• Good surface water performance • Low pumping head • Freedom from most terrestrial constraints (tailwater, agricultural values, traffic) • Public ownership	• Moderate ASS / PASS issues • High biodiversity values • High coastal hazards • Poor ground stability	No	Unacceptable environmental impacts. No net beneficial reuse (mangrove habitat to be lost with no identified future use for port infrastructure).

SITE	RANK	KEY STRENGTHS	KEY WEAKNESSES	EIS?	REASON / COMMENT
Overall				No	The Trinity Inlet West Placement Precinct is unsuitable largely due to no net beneficial reuse opportunities of sites and high ecological impacts.
Trinity Inlet East Placement Precinct					
10 East Trinity Option 1	11	• Low surface water values • Low biodiversity values • Low pumping head • Low agricultural values • Public ownership	• High ASS / PASS issues • High coastal hazards • Tailwater will discharge to brackish receiving waters, discharge channel required • Poor ground stability • Poor traffic performance	Yes	Consider whole Trinity Inlet East Placement Precinct for siting an optimum placement site. For example, it may be possible to avoid high value agricultural land and reduce tailwater impacts by appropriate site design and placement.
11 East Trinity Option 2	8	• Low biodiversity values • Low pumping head • Tailwater will discharge to saline receiving waters • Low agricultural values • Public ownership	• High ASS / PASS issues • High coastal hazards • Discharge channel required • Poor ground stability • Poor traffic performance	Yes	
12 East Trinity Option 3	12	• Low biodiversity values • Low pumping head	• High ASS / PASS issues • High coastal hazards • Tailwater will discharge to brackish receiving waters, discharge pumping required • Poor ground stability • High agricultural values • Poor traffic performance • Private ownership	Yes	
Overall				Yes	The Trinity Inlet East Placement Precinct has many attractive features that are worthy of further consideration in the EIS.
Trinity Inlet South Placement Precinct					
13 Cane Farm	10	• Low biodiversity values • Low ASS / PASS issues • Low traffic issues	• High coastal hazards • High pumping head • Tailwater will discharge to brackish receiving waters, discharge pumping required • High agricultural values • Private ownership	No	Overall poor performance (ranks poorly for all profiles and no remedies are feasible to improve performance).

SITE	RANK	KEY STRENGTHS	KEY WEAKNESSES	EIS?	REASON / COMMENT
Overall				No	The Trinity Inlet South Placement Precinct is unsuitable due to a range of areas of poor performance.
Yarrabah Placement Precinct					
14 Yarrabah	14	• Tailwater will discharge to saline receiving waters • Low agricultural values	• Poor surface water / groundwater performance • High biodiversity values • High ASS / PASS issues • High coastal hazards • High pumping head • Discharge channel required • Poor traffic performance • Private ownership	No	Overall poor performance (ranks poorly for all profiles and no remedies are feasible to improve performance).
Overall				No	The Yarrabah Placement Precinct is unsuitable due to a range of areas of poor performance.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS

The following conclusions are made:

1. The site selection process identified six placement precincts with fourteen individual sites identified within these precincts.

2. The fourteen identified sites were evaluated using Multi-Criteria Analysis techniques. Ignoring cost, existing legislative and planning constraints and without weighting the evaluation determined that:

   - Voids – the void sites on Northern Sands (Site 1) and Pioneer Sands (Site 2) scored well on most attributes with the main weaknesses being pumping head and the fact that they are in private ownership. Northern Sands does not quite have enough capacity (75% of target) to score well in this regard and, similarly, Pioneer Sands has only 50% capacity. A new void would be constructed to deliver 100% of the capacity.
   - Reclamation – As reclamation sites in seawater, Northern Esplanade (Site 5), Bessie Point (Site 6), and Admiralty Island Reclamation (Site 7) scored well on tailwater and ground-related issues and, due to close proximity to the channel, have minimal pumping head. They score poorly on several environmental attributes and coastal hazards. It was assumed that Site 7 cannot achieve the target placement capacity (52%) due to waterway restrictions.
   - Terrestrial – The Admiralty Island (Site 9) scored well on most attributes but poorly on biodiversity, acid sulfate soil and ground conditions. It is well-located with respect to pumping head and traffic and is under state control. The best East Trinity site (Site 11) scored similarly to Site 9 but, whilst being able to provide the required capacity and having favourable biodiversity and pumping head scores, its attractiveness is diminished by acid sulfate soil, ground stability, traffic, and to a lesser degree, coastal hazards.

3. Separate analyses (sensitivity testing) were undertaken with the result that the top ranking sites remained the top level sites after the sensitivity testing although the order changes depending on weighting.

4. Weighting of attributes based on technical and non-technical sensitivity profiles changed the outcome slightly but not significantly. Overall, the sensitivity testing demonstrates that the SE process is relatively robust and reveals many learnings that can be applied to the final site selection based on overall suitability. The site with the most volatility in performance was Tingira Street (Site 8) which dropped six positions from the *Technical* profile to the *Cost* profile and five for *Environment.*

5. The overall suitability of the placement precincts was assessed by considering beneficial reuse, and site feasibility and suitability. This process considered the planning constraints, costs and other considerations including strengths, weaknesses, and any serious deficiencies.

6. The suitability assessment determined that:

   - Barron River delta voids score well due to their relatively low infrastructure costs (they require simply delivering and placing material in existing holes) and are attractive in that they are not subject to Barron River flooding, are remote from storm surge and tsunami effects, and do not have existing land uses that would be deleteriously affected by placement (the ‘lakes’ would remain and just be shallower). Management of groundwater and tailwater would be required.

   - The nominal reclamation options considered have excellent performance due to proximity to the channel (i.e. minimal pumping head) but suffer from surface water and biodiversity impacts and coastal hazards. Beneficial reuse is a challenge in the case of the Northern Esplanade and Bessie Point sites (Sites 5 and 6) where net gain in habitat value would be difficult to achieve. Site 7 (Admiralty Island Reclamation) suffers from capacity limitations and lack of a demonstrated need for the reclaimed land.

- The nominal terrestrial options offer opportunities in terms of placement volume but all require treatment of placed material and tailwater. Environmental performance varies depending on the site in question but in all cases land placement will replace existing values of some sort (biodiversity or agricultural) and possibly involve management of in-situ soils and groundwater.

7. The suitability assessment determined that the following precincts warranted further investigation:
   - **Barron Delta Placement Precinct**: Site 1 possibly expanded and or in conjunction with Site 2 or a new void.
   - **Trinity East Placement Precinct**: a site to be determined based on impact avoidance and minimisation and the opportunities and constraints considered in Sites 10, 11 and 12.
8. Beneficial reuse of terrestrial bunded sites is problematic in that it involves:
   - production of sites that could take 30 years to be able to be developed without surcharge or the use of piled structures
   - a land mass of perhaps 60 ha that would have little in the way of commercial yield to offset development cost
   - a revenue stream that is so far into the future as to be almost insignificant in terms of net present value
   - land that is not in a location supported by regional planning.
9. The separate analysis of cost reveals that:
   - Voids can be filled at a unit rate of around \$91-\$96 / m^3 (solid measure).
   - The corresponding figure for terrestrial sites varies widely between \$109 and nearly \$130 / m^3.
   - Based on a total volume of 860 000 m^3 to be dredged the total cost for dredging, placement and treatment is estimated to be
     - o Barron Delta Placement precinct: \$80 - \$86 Million
     - o Trinity Inlet East Placement Precinct: \$90 - \$100 Million
   - When the cost of landside infrastructure, other project costs including design and project management and an allowance for ongoing monitoring and offsets are added to the dredging costs, the overall project costs are estimated to be:
     - o Barron Delta Placement precinct \$100 - \$110 Million
     - o Trinity Inlet East Placement Precinct: \$110 - \$120 Million
10. The analysis revealed several opportunities associated with voids, including expansion of voids, construction of new voids, staging, and the export of treated material to ‘free-up’ terrestrial bunded sites for reuse may be feasible but this requires:
    - investigations into underlying geology / soils
    - market research to identify potential buyers of this material
    - concept design and impact assessment.
11. A terrestrial site could have spare capacity once tailwater has been discharged and consolidation is achieved. This may be able to be exploited such that the site could be used for future placement. However, any new placement would have tailwater that also needs treatment (unless material removed by backhoe is to be considered) but perhaps the opportunity exists for a small volume to be placed in a second or subsequent stage.
12. It is possible that, following treatment, the material within terrestrial bunded areas could have some use as a low grade fill. Even if the cost-recovery value is small, the fact is that the export of treated material will allow the bunded area to be reused for further placement should staging considerations allow. This may be cheaper than creating new sites.

9.2 RECOMMENDATIONS

Following consideration of the channel design and dredge material characteristics and volume required to achieve the desired channel profile and the conduct of a rigorous consideration of options for dredge material placement and feasible locations, the following recommendations are made:

1. Placement Precincts that should be further considered in the EIS are:
   - Barron Delta Placement Precinct based on utilising either Northern Sands (Site 1) (with further expansion or possibly in conjunction with Pioneer Sands (Site 2)) separately or possibly in conjunction with a new void in the Barron Delta Placement Precinct. The actual placement volume should be confirmed by survey.
   - Trinity Inlet East Placement Precinct using the best features of the East Trinity Sites 10, 11, and 12. This will require a planning exercise be undertaken during the early stages of the EIS to create the 'best' East Trinity site, based on a detailed understanding of opportunities and constraints of the precinct.
2. Early investigations be undertaken to confirm the appropriate bulking factor (assumed to be 2.2) as the size of sites is highly influenced by the bulking factor.
3. Research be undertaken of alternative excavation methods (e.g. barge-mounted excavator or grab-bucket) and placement techniques for solid material (clay) that is unsuitable for pumping.
4. Early investigations be undertaken into material properties including proportion of clay as the size of sites is also highly influenced by staging and consolidation properties of the material. If material can be placed in two stages (i.e. Scenario 1 and then Scenario 2 some years later), it is possible that significant additional volume may be available due to discharge of tailwater and consolidation of the initially placed material.
5. Early investigations be undertaken into the proportion of ASS / PASS material in the channel as this will affect the design of treatment areas for terrestrial placement and this is not known with any precision at present. In addition, the nature of the material and dredging process makes PASS and non-PASS inseparable and therefore an overall lime treatment rate will need to be determined, taking into account self-neutralisation potential and PASS variability with material depth.
6. Investigations be undertaken into the creation of new voids as the assessment has found that voids have many desirable features. New voids may be especially attractive if their creation yields material that has a commercial value. Further work is required to identify potential areas (i.e. as determined by the SS process), understand underlying geology / soils, market research to identify potential buyers of this material, and concept design and impact assessment. Expanding existing voids is also a possible future opportunity and would require the same methodology as that suggested for existing voids.
7. Investigations be undertaken of the potential of a terrestrial site to be at least partially reused for subsequent placement once tailwater has been discharged and consolidation is achieved and / or after removal of treated material if a use can be found for this.

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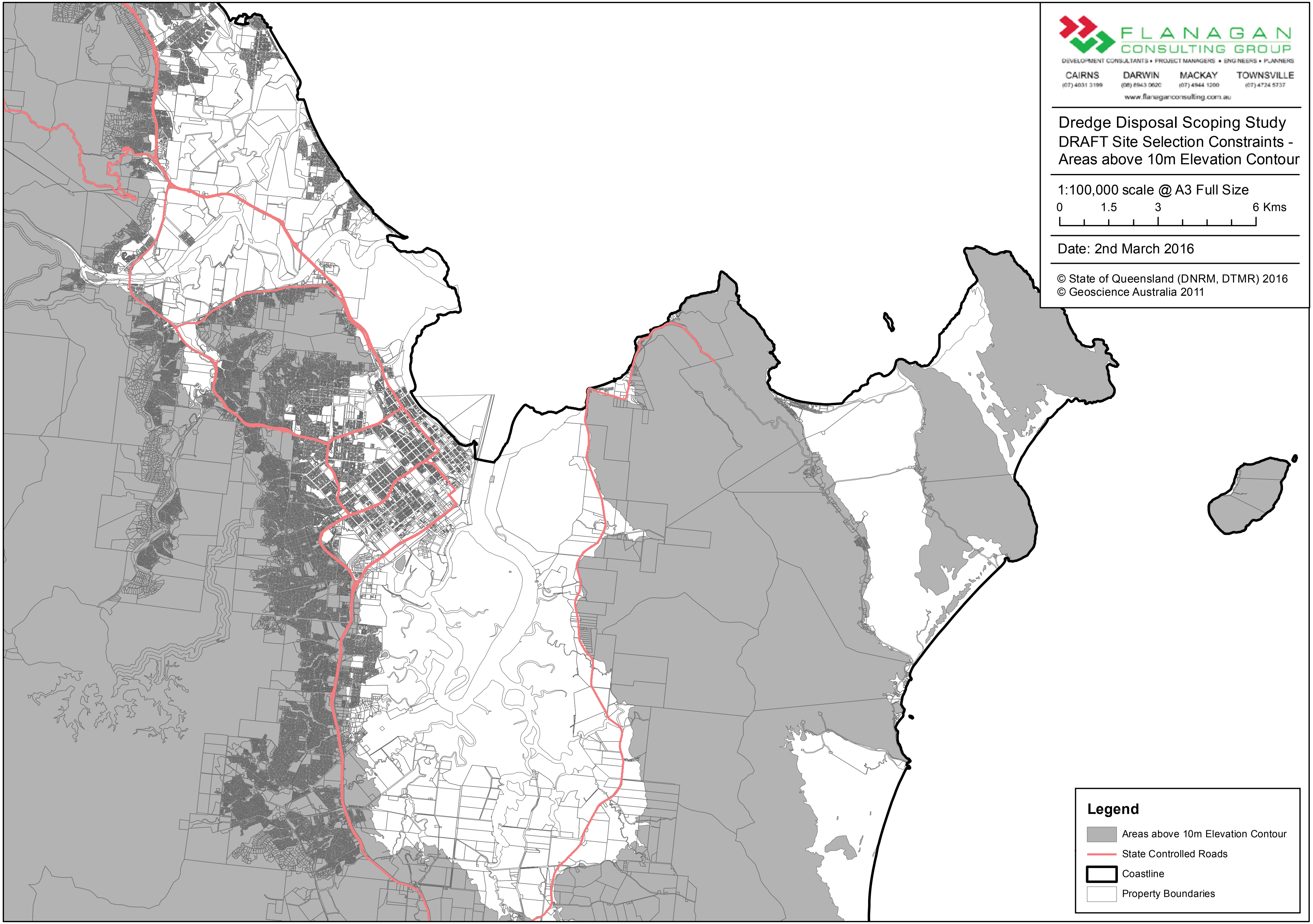
APPENDIX A
ATTRIBUTE MASTER LIST
(WORKSHOP 2 FEBRUARY)

CRITERION	ATTRIBUTE	ELEMENTS (IF APPLICABLE)	DESCRIPTION / NOTES	SUITABLE FOR SITE SELECTION?	Void	Reclamation	Terrestrial	SUITABLE FOR SITE EVALUATION?	Minor	Moderate	Major	OWNER	SE ID	EIS - SS	EIS - MCA
Cost / economic	Costs		Concept design undertaken for EIS.	No.	X	X	X	Yes. Also consider separately.			X	PF	C1		C4
Environmental	Surface water		Concept design undertaken for EIS.	No. Assume that impacts can be mitigated.	X	X	X	Yes. The extent to which the discharge waterbody is able to accept the water quantity and quality of the tailwater discharge – see T3 below.		X		GF	E1		E1A
Environmental	Topography	Slope	On relatively flat land.	No. Use 10 m contour as surrogate.			X	No. Unsuitable sites will have been excluded during SS.				DR		A1	
Environmental	Topography	Elevation	Below 10 m contour (terrestrial) Below MSL (reclamation).	Yes.		X	X	No. Unsuitable sites will have been excluded during SS.				DR			
Environmental	Groundwater		DNR Groundwater Bore Database Consider impact of saltwater seepage into freshwater environment. Depth to Groundwater	No. A solution can be engineered to be protective of groundwater.	X		X	Yes. Considers depth & salinity.			X	PS	E2		E1B
Environmental	Flooding afflux (bund solutions)		Outside Barron River Flood Code area. There is a zero afflux rule that bunded sites would most likely not be able to meet.	Yes (new bunded sites only) and only in Barron Delta.			X	No. Unsuitable sites will have been excluded during SS.				DR			
Environmental	Environmental values	Elements may be appropriate	Composite 'Environmental Values' attribute based on MNES, MSES and local values (e.g. CairnsPlan), stratified into *High*, *Moderate*, *Low*, *Nil* values.	No. Many values coverages are influenced by historic resource allocations that need to be revisited.	X	X	X	Yes. Impact on Environmental Values attribute to be scored based on broad assessment of value and area.			X	DR	E3		E2
Environmental	ASS		DSITIA mapping.	No. ASS mapping excludes all land below 20 m contour - too broad an approach.	X		X	Yes. Detailed DERM mapping used.		X		PS	E4		E3
Environmental	Air / Noise / Odour		Based on sensitive receptors.	No. Use proximity to other land uses (S1).				No. Use proximity to other land uses (S1).		X		DR			E4
Environmental	Pests (birds and bats)		Birdstrike / batstrike.	No.	X	X	X	Yes. Proximity to the airport or within key flight paths in terms of bird strike risk (CairnsPlan overlay).	X				E5		E5
Environmental	Coastal hazards		Distant from areas subject to coastal erosion or storm surge, or capable of being otherwise engineered to be resistant to such impacts.	No. Assume all exposed sites can be protected.	X	X	X	Yes. Sites distant / elevated from exposure will be more desirable.			X	DR	E6	A3	
legislative / Planning	Land use planning / tenure / approvals		Urban footprint GQAL CairnsPlan / complexity of approvals Port Land Use Plan *Fisheries Act* (marine plants, FHA) *Coastal Protection and Management Act* *EPBC Act (GBRWHA)*	No. Only GQAL (S?). Listed environmental acts part of E3				No. EIS (impact mitigation) issue.							L1
Performance	Pumping distance		Based on feasible pumping distance (location of pump, number of boosters) with assumed minimum static head (E1b)	Yes.	X	X	X	Yes. Affects economics of the site. Anything >1.5 km requires boosters. Scoring includes friction head and gravity head.		X		TG	P1	A4	C2

CRITERION	ATTRIBUTE	ELEMENTS (IF APPLICABLE)	DESCRIPTION / NOTES	SUITABLE FOR SITE SELECTION?	Void	Reclamation	Terrestrial	SUITABLE FOR SITE EVALUATION?	Minor	Moderate	Major	OWNER	SE ID	EIS - SS	EIS - MCA
Performance	Minimum storage volume		Available placement volume of site.	No. This is a site creation task.				Yes. Sites with low capacities are relatively undesirable.	X			TG/MC	P2	I1	C1
Performance	Tailwater discharge		Close to existing tidal drainage or creek lines to enable saline tailwater discharge (gravity or pump-assisted).	No. Assume if we can pump there we can pump tailwater back to the ocean.	X	X	X	Yes. The volumetric capacity and hydrology of the receiving waterbody – extent to which the discharge would change the hydrology of the waterbody and/or cause overtopping or scour – would need to be assessed and potentially modelled.	X		X	TG	P3	A2	
Performance	Ground Conditions & Stability		Review soils and geology maps. Type of materials present on site. Stability and bearing capacity of subsurface materials.	No.	X		X	Yes. Assess suitability of site materials for reuse (bund materials or void excavation) Assess for presence of soft/loose soils may impact on bund wall/excavation stability and design.	X			PS	P4		
Performance	Impact on length (duration) of dredge campaign.		Relative assessment, moderated by comparison with marine placement.	No.				No.			X	TG			C3
Social	Remoteness from established land uses	Various land uses	Various land uses. Res & Tourism Commercial & Industrial Rural	Yes. Suitable sites should be sufficiently remote from settled areas of various classes. Buffers to determined based on planning principles.	X	X	X	No. Buffers greater than the minimum are not considered especially advantageous.	X			GV		I2	
Social	Cultural heritage / native title	Non-indigenous cultural heritage	Queensland Heritage Register	No.	X	X	X	No.				DR			S1A
Social	Cultural heritage / native title	Indigenous cultural heritage	Database (noted to be not complete)	No.	X	X	X	No.				DR			S1B
Social	Cultural heritage / native title	Native title	Extinguished on freehold land. Formal advice relevant to EIS sites only.	No. Native title can be extinguished and compensation paid.		X	X	No.							S1C
Social	Important agricultural areas		Stratified by class.	No. Loss of ALC Class A and B is a resource allocation consideration.			X	Yes. Higher value land has higher priority for protection.	X			DR	S2		
Social	Traffic	Road traffic (truck transport assumed)	Concept 'design' undertaken to generate truck movements. Descriptive assessment, final score based on truck numbers.	No. impact assessment / mitigation issue.	X	X	X	Yes. Stratify segments of route by sensitivity.	X			DR	S3		S3
Social	Public safety		Secure dewatering areas need to be fenced and made secure as there are inherent public safety issues with the soft nature of the material while it is in the process of dewatering.	No. Design issue.				No. Design issue.				GF		A5	
Social	Community benefit		End use (placement VS development)	No.				No.				PF			S4
Social	Appropriate tenure (ownership)		State freehold State reserve Port land Private	No. Not relevant to initial screening.	X		X	Yes. Some tenures will make acquisition easier.			X	GV	S4		
Social	(Visual) amenity issues		End use (placement VS development) Allowance made for visibility	No. impact assessment / mitigation issue.				No. impact assessment / mitigation issue.				DR			S5

APPENDIX B

RESULTS OF SITE SECTION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Dredge Disposal Scoping Study
DRAFT Site Selection Constraints -
Areas above 10m Elevation Contour
1:100,000 scale @ A3 Full Size
0 1.5 3 6 Kms
Date: 2nd March 2016
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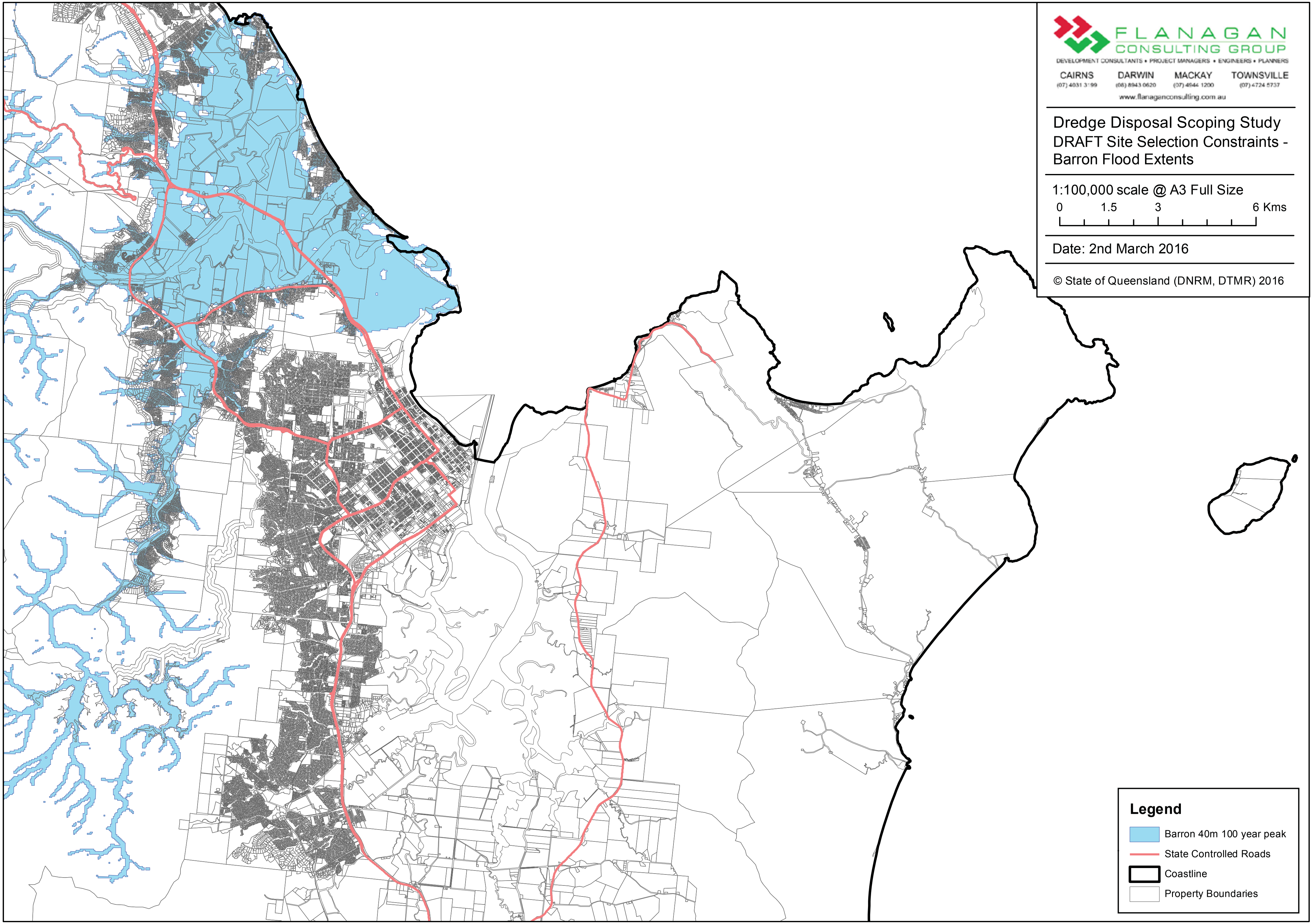
Legend
Areas above 10m Elevation Contour
State Controlled Roads
Coastline
Property Boundaries



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DRAFT Site Selection Constraints - Barron Flood Extents

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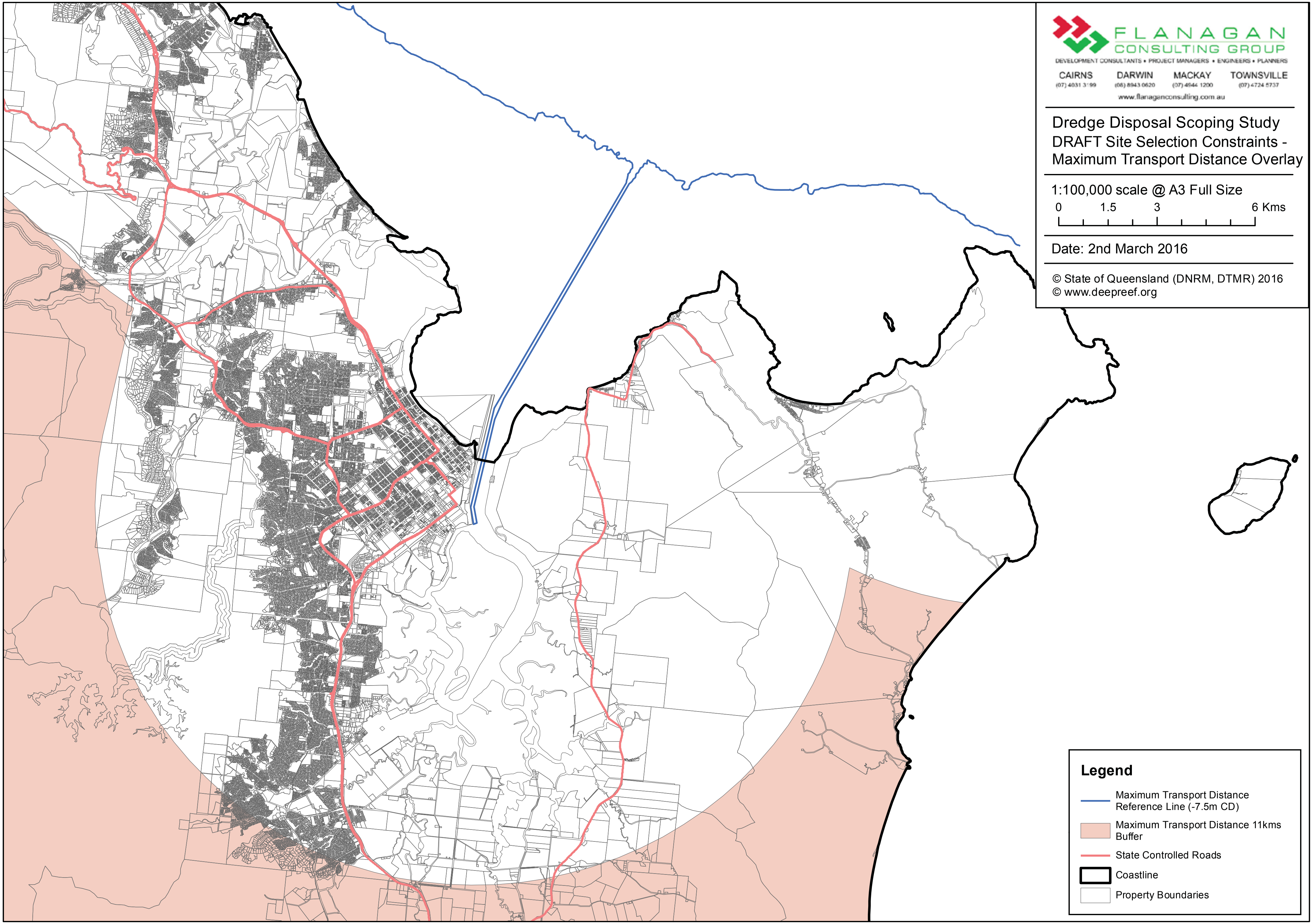
Date: 2nd March 2016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Dredge Disposal Scoping Study
DRAFT Site Selection Constraints - Maximum Transport Distance Overlay
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1.5
3
6 Kms
Date: 2nd March 2016
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Legend
Maximum Transport Distance Reference Line (-7.5m CD)
Maximum Transport Distance 11kms Buffer
State Controlled Roads
Coastline
Property Boundaries

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Dredge Disposal Scoping Study DRAFT Site Selection Constraints - Variable Buffer from Urban Land

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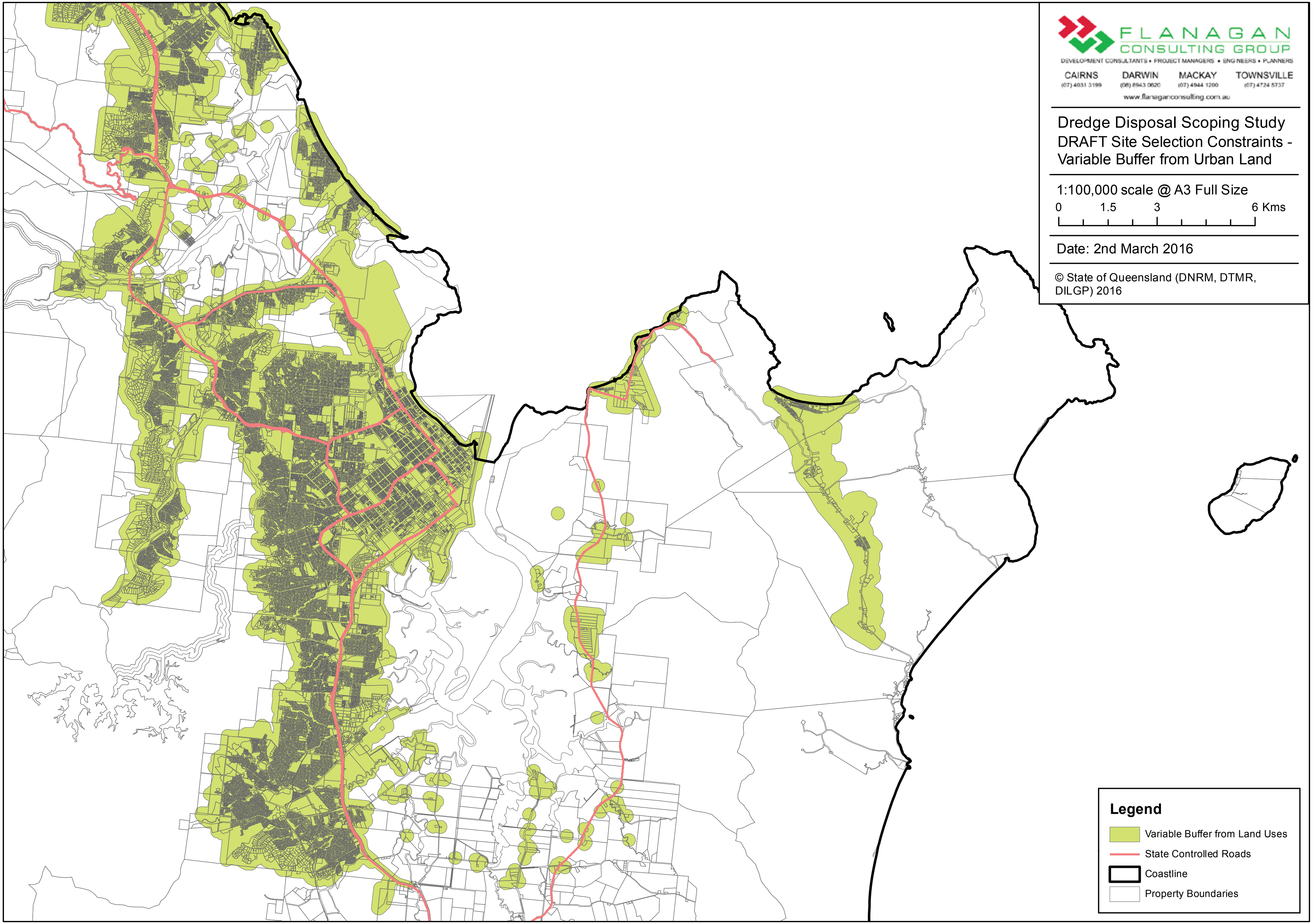
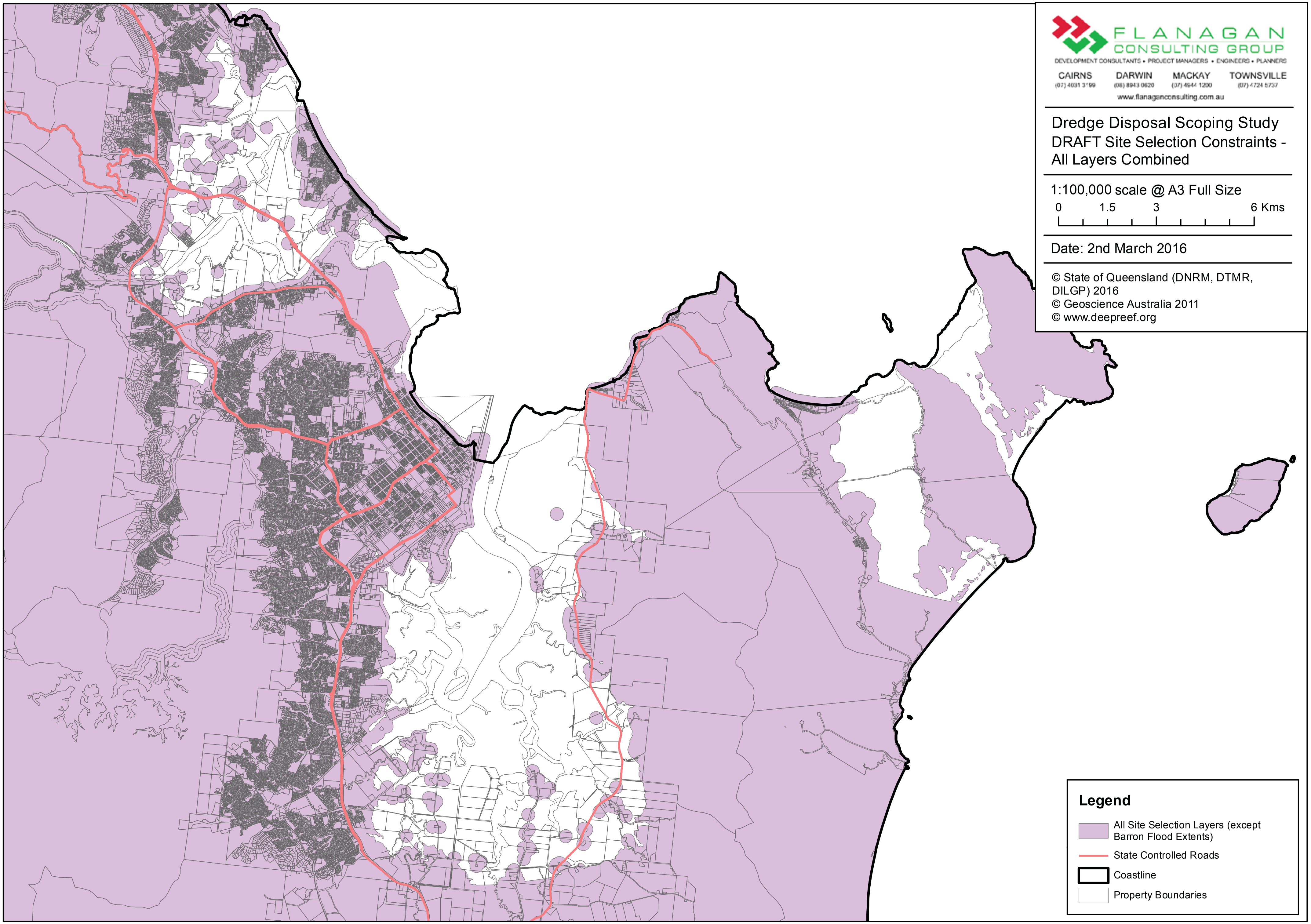
Date: 2nd March 2016

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DRAFT Site Selection Constraints -
All Layers Combined
1:100,000 scale @ A3 Full Size
0
1.5
3
6 Kms
Date: 2nd March 2016
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Legend
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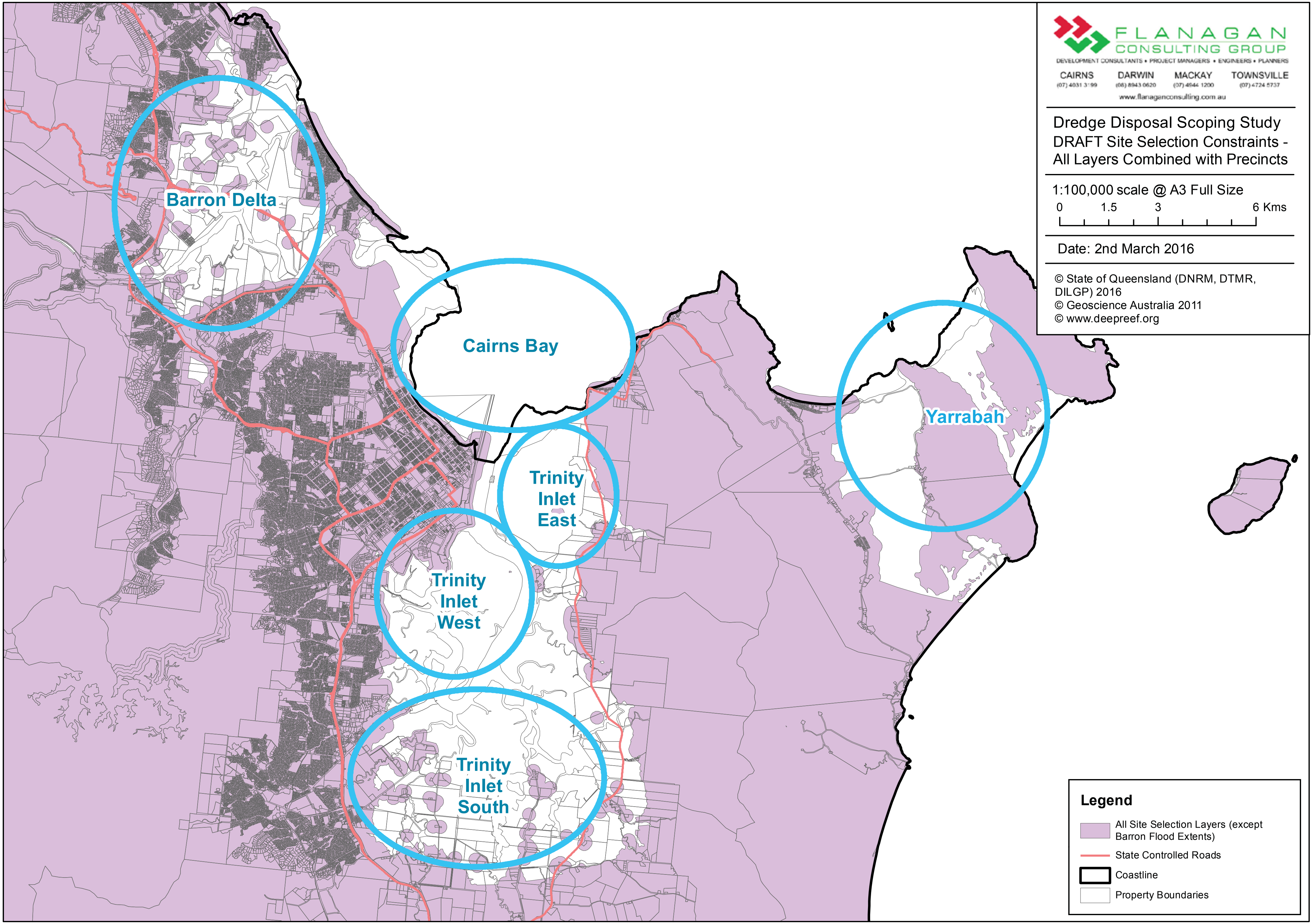
State Controlled Roads
Coastline
Property Boundaries



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Dredge Disposal Scoping Study
DRAFT Site Selection Constraints -
All Layers Combined with Precincts
1:100,000 scale @ A3 Full Size
0 1.5 3 6 Kms
Date: 2nd March 2016
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Barron Delta
Cairns Bay
Yarrabah
Trinity Inlet East
Trinity Inlet West
Trinity Inlet South
Legend
All Site Selection Layers (except Barron Flood Extents)
State Controlled Roads
Coastline
Property Boundaries

APPENDIX C

CONCEPT DESIGNS FOR SITE EVALUATION

Dredge Disposal Scoping Study
DRAFT Concept Plan Site 1 - Northern Sands

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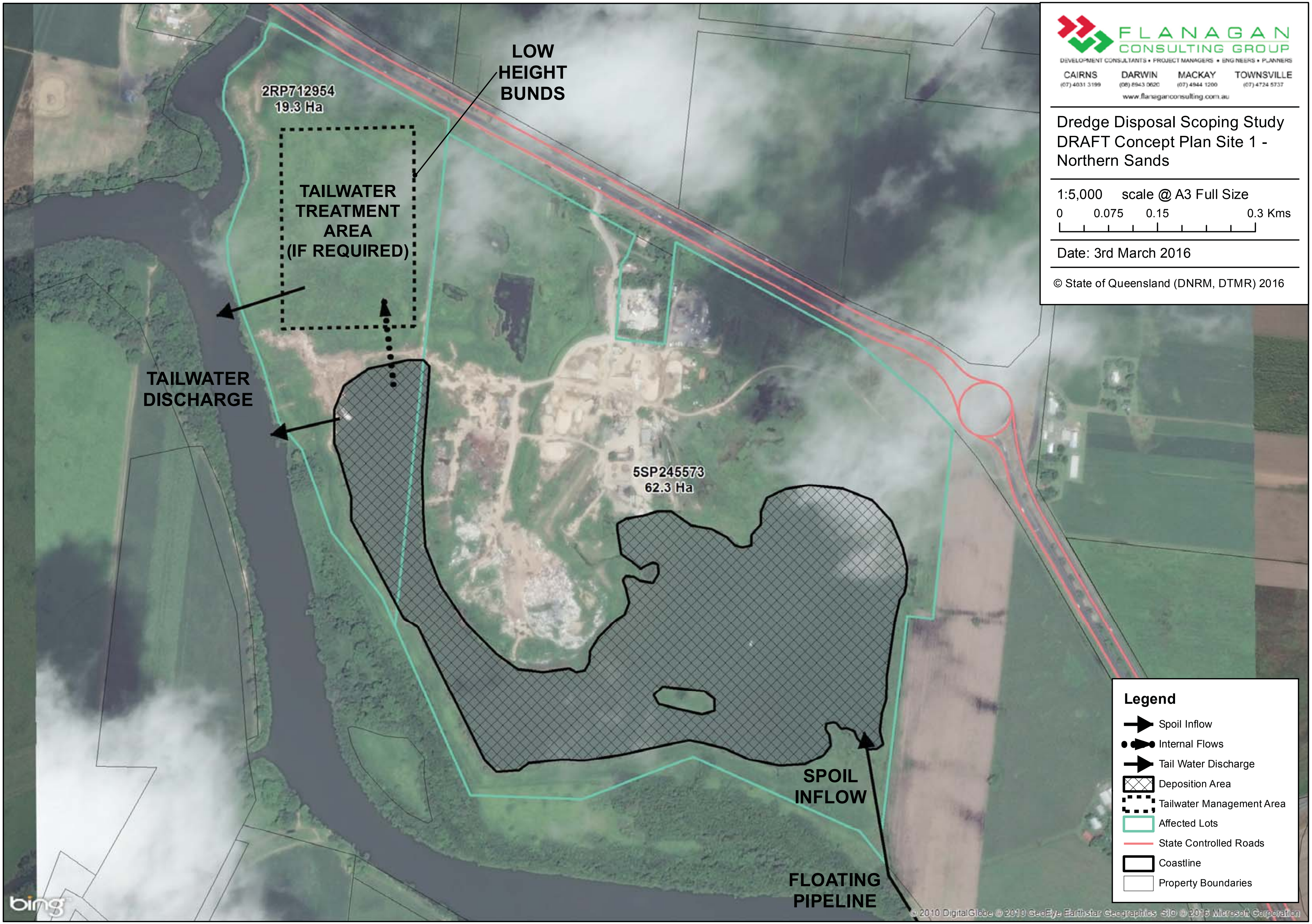
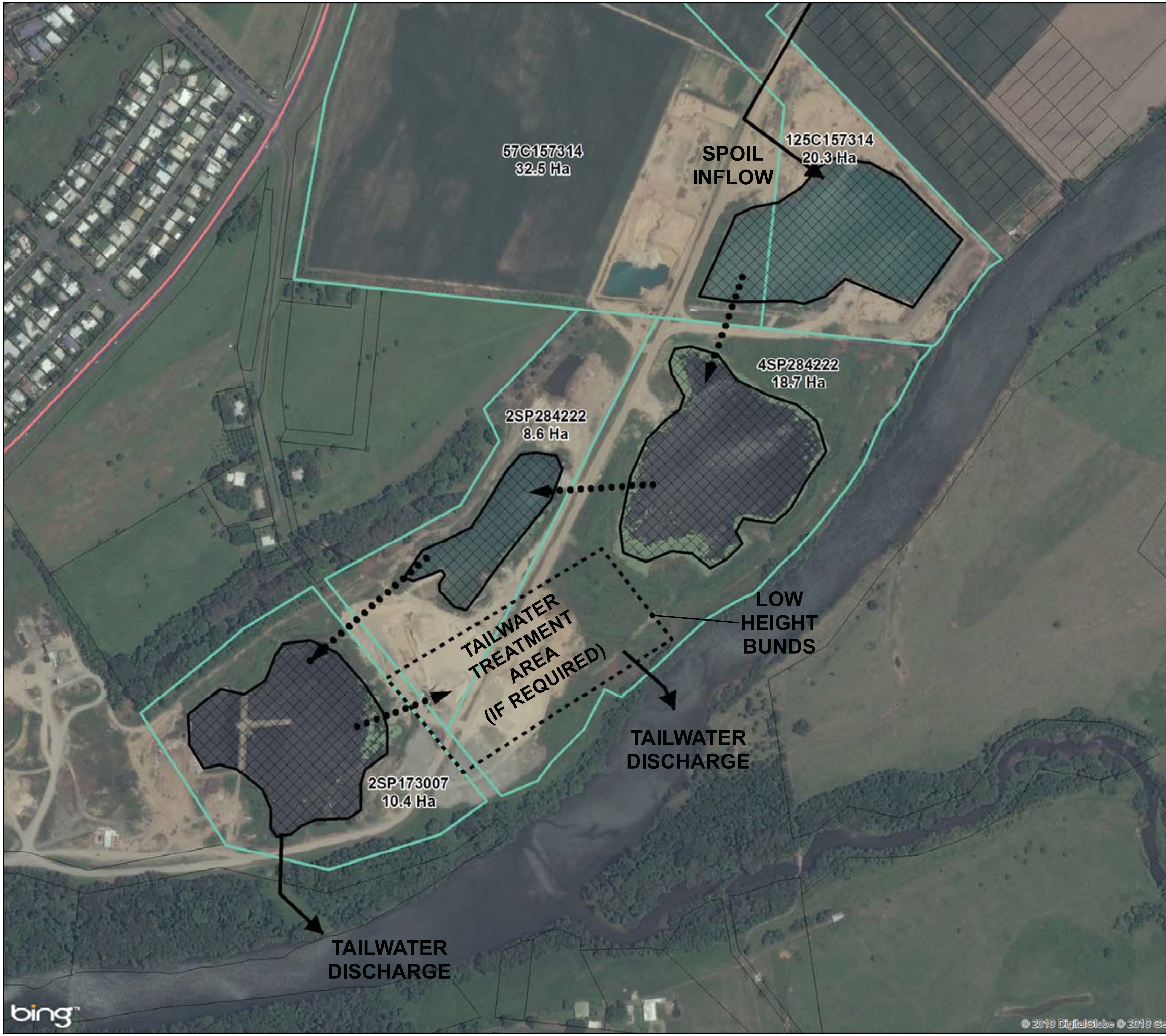
Date: 3rd March 2016





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Dredge Disposal Scoping Study
DRAFT Concept Plan Site 2 -
Pioneer Sands

1:5,000 scale @ A3 Full Size
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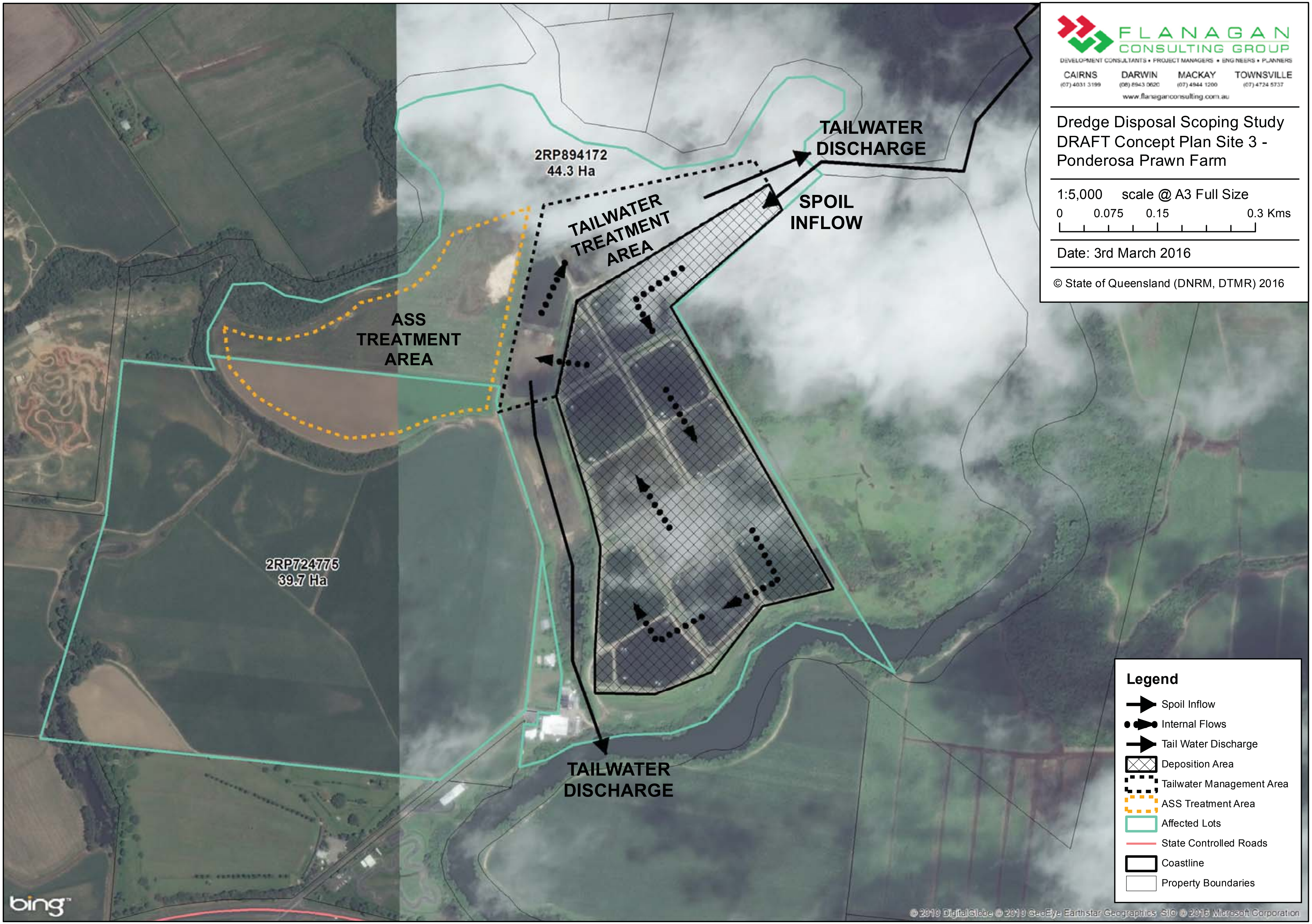
Date: 3rd March 2016



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Dredge Disposal Scoping Study
DRAFT Concept Plan Site 3 -
Ponderosa Prawn Farm
1:5,000 scale @ A3 Full Size
0 0.075 0.15 0.3 Kms
Date: 3rd March 2016
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TAILWATER DISCHARGE
SPOIL INFLOW
TAILWATER TREATMENT AREA
2RP894172
44.3 Ha
ASS TREATMENT AREA
2RP724775
39.7 Ha
TAILWATER DISCHARGE
Legend
Spoil Inflow
Internal Flows
Tail Water Discharge
Deposition Area
Tailwater Management Area
ASS Treatment Area
Affected Lots
State Controlled Roads
Coastline
Property Boundaries
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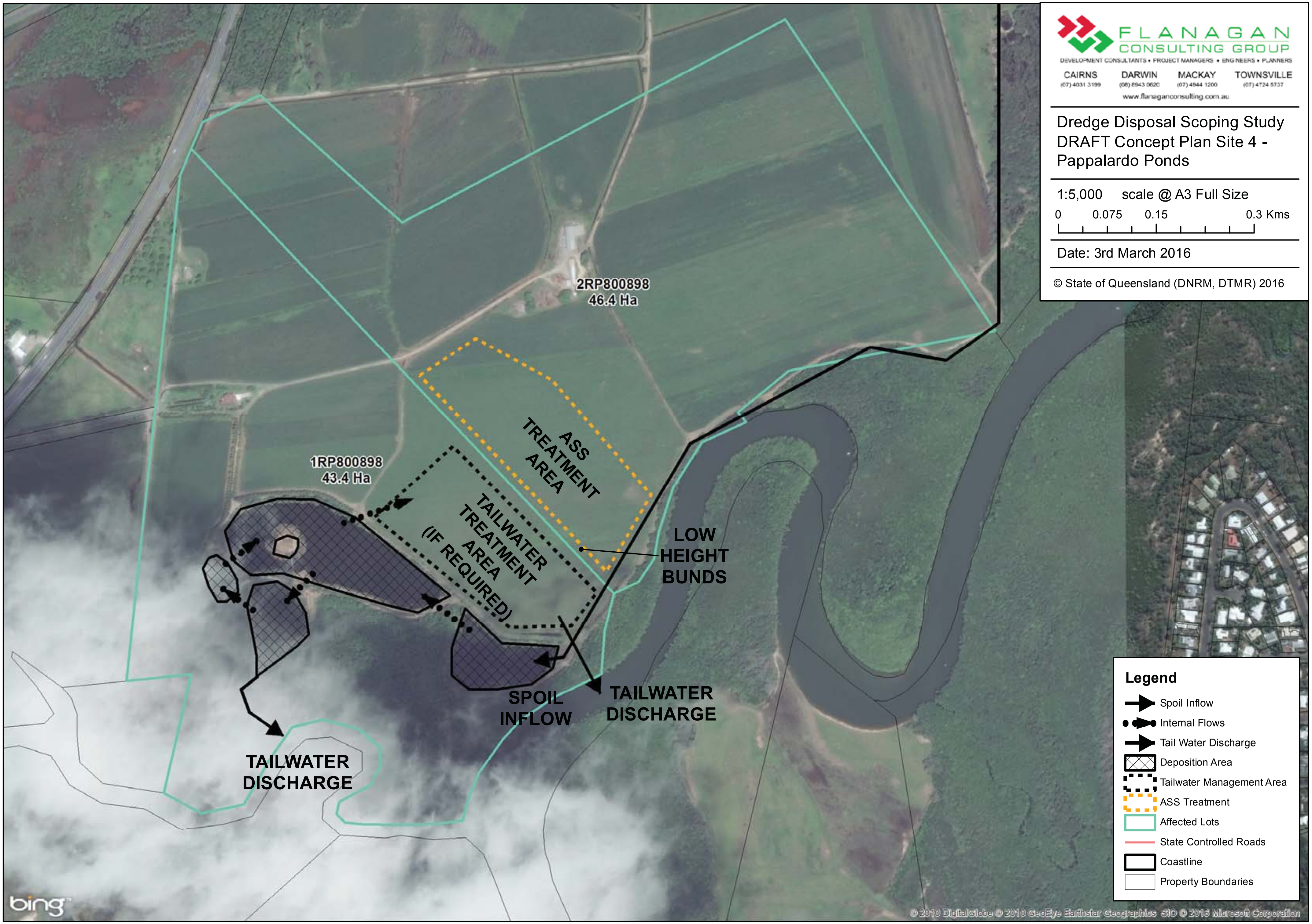

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Dredge Disposal Scoping Study DRAFT Concept Plan Site 4 - Pappalardo Ponds

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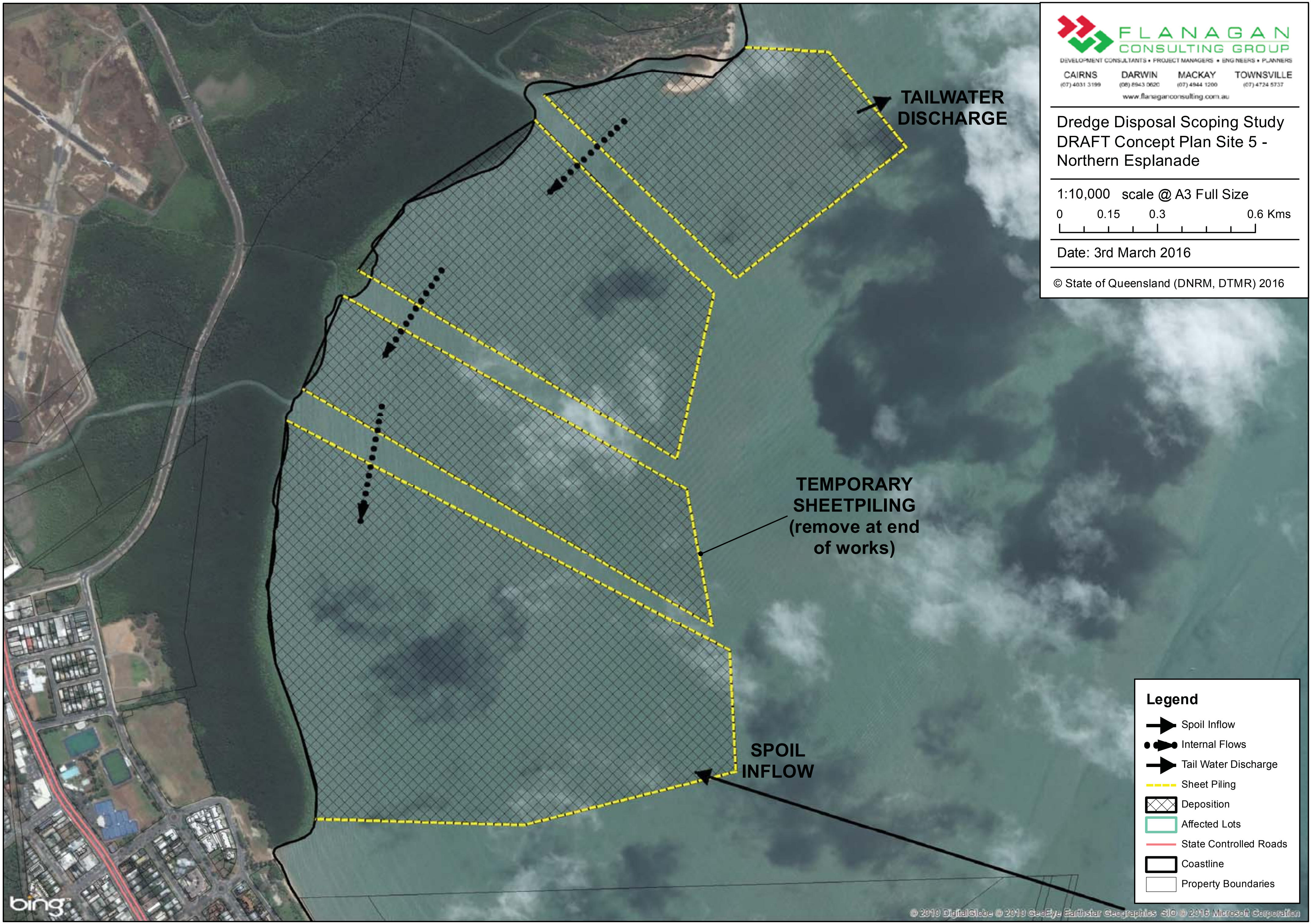
Date: 3rd March 2016



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Dredge Disposal Scoping Study DRAFT Concept Plan Site 5 - Northern Esplanade
1:10,000 scale @ A3 Full Size
0
0.15
0.3
0.6 Kms
Date: 3rd March 2016
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TAILWATER DISCHARGE
TEMPORARY SHEETPILING (remove at end of works)
SPOIL INFLOW
Legend
Spoil Inflow
Internal Flows
Tail Water Discharge
Sheet Piling
Deposition
Affected Lots
State Controlled Roads
Coastline
Property Boundaries
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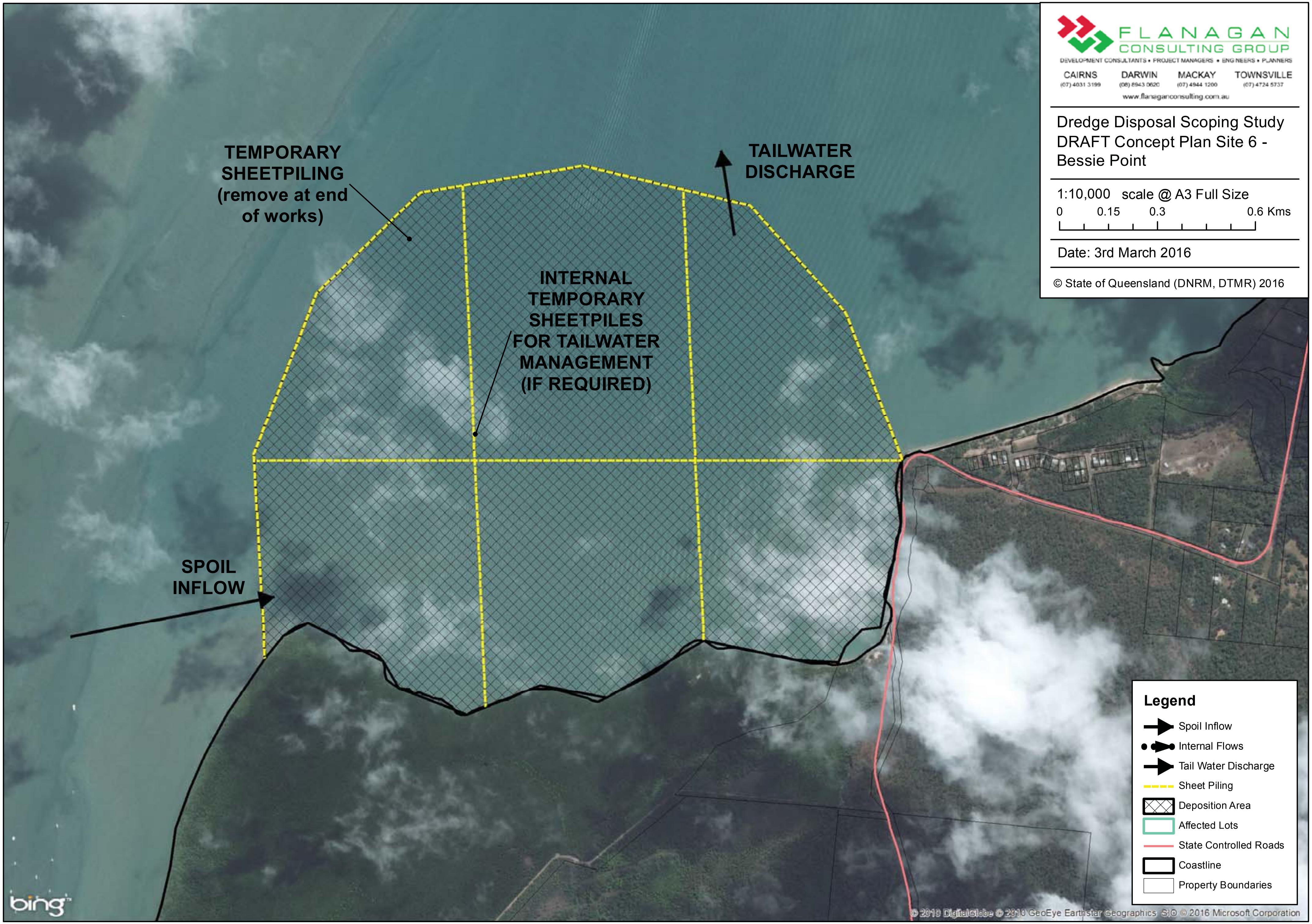
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Dredge Disposal Scoping Study
DRAFT Concept Plan Site 6 -
Bessie Point
1:10,000 scale @ A3 Full Size
0 0.15 0.3 0.6 Kms
Date: 3rd March 2016
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TEMPORARY SHEETPILING (remove at end of works)
TAILWATER DISCHARGE
INTERNAL TEMPORARY SHEETPILES FOR TAILWATER MANAGEMENT (IF REQUIRED)
SPOIL INFLOW
Legend
Spoil Inflow
Internal Flows
Tail Water Discharge
Sheet Piling
Deposition Area
Affected Lots
State Controlled Roads
Coastline
Property Boundaries
bing
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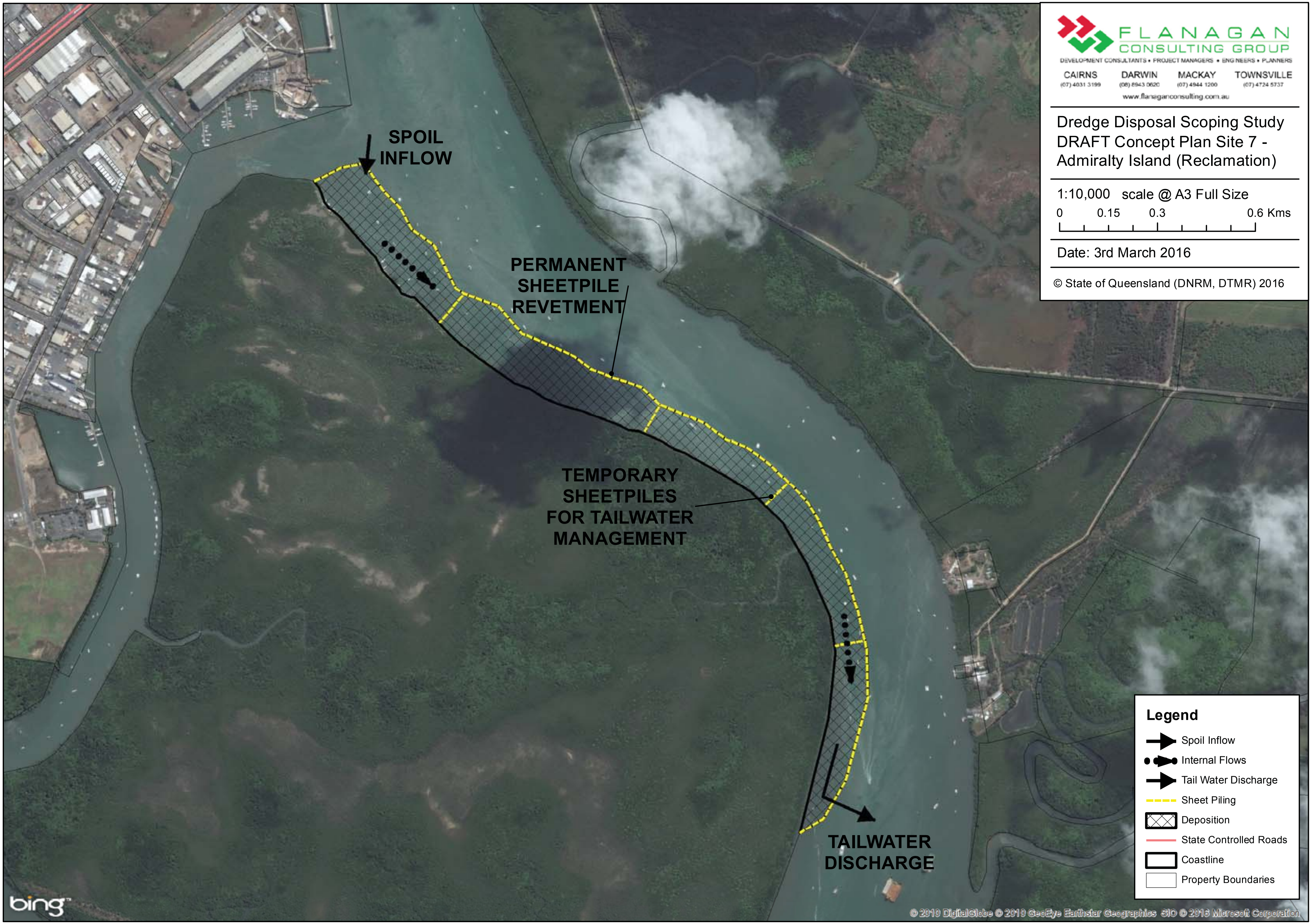
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DRAFT Concept Plan Site 7 -
Admiralty Island (Reclamation)
1:10,000 scale @ A3 Full Size
0 0.15 0.3 0.6 Kms
Date: 3rd March 2016
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SPOIL INFLOW
PERMANENT SHEETPILE REVETMENT
TEMPORARY SHEETPILES FOR TAILWATER MANAGEMENT
TAILWATER DISCHARGE
Legend
Spoil Inflow
Internal Flows
Tail Water Discharge
Sheet Piling
Deposition
State Controlled Roads
Coastline
Property Boundaries
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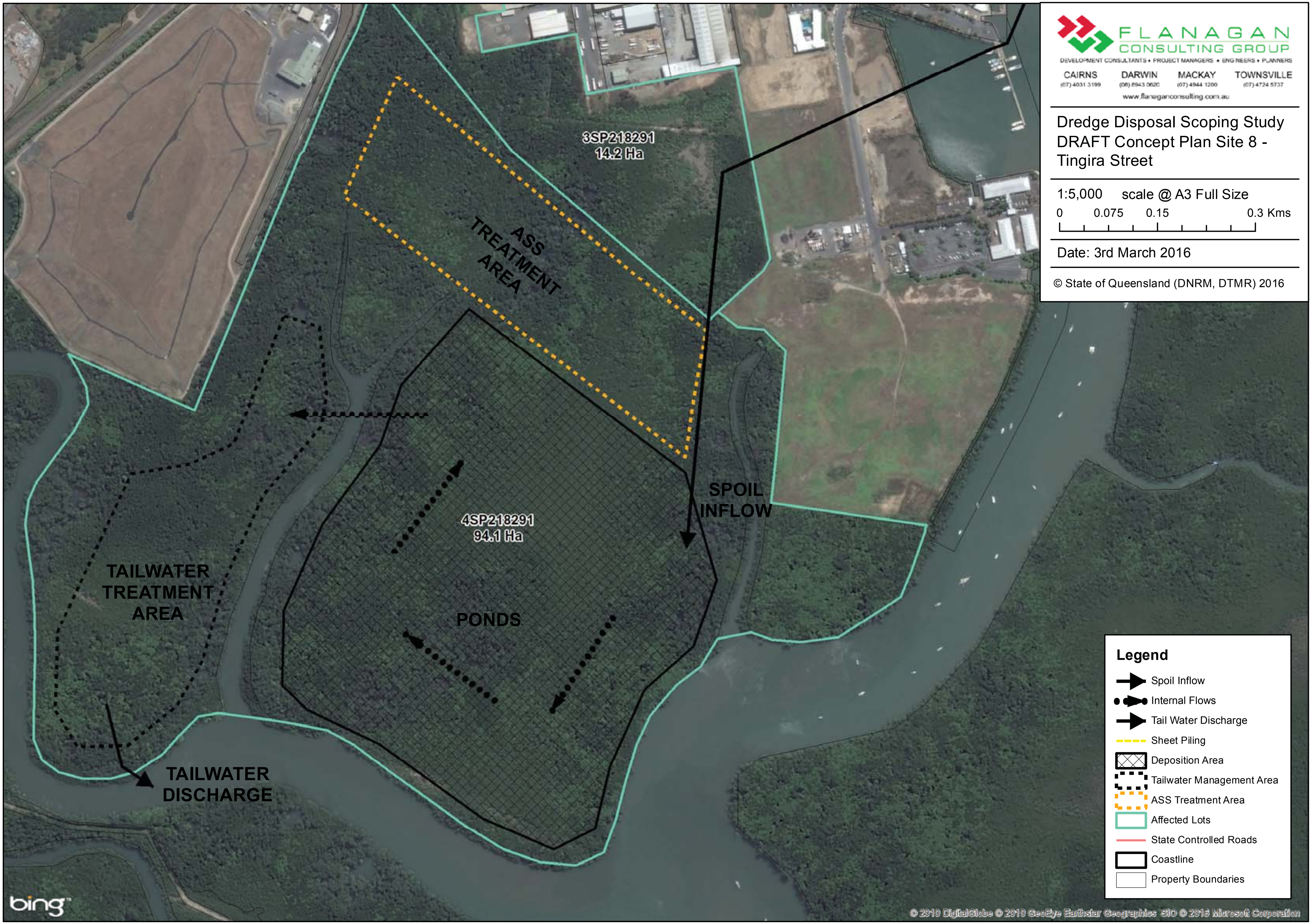
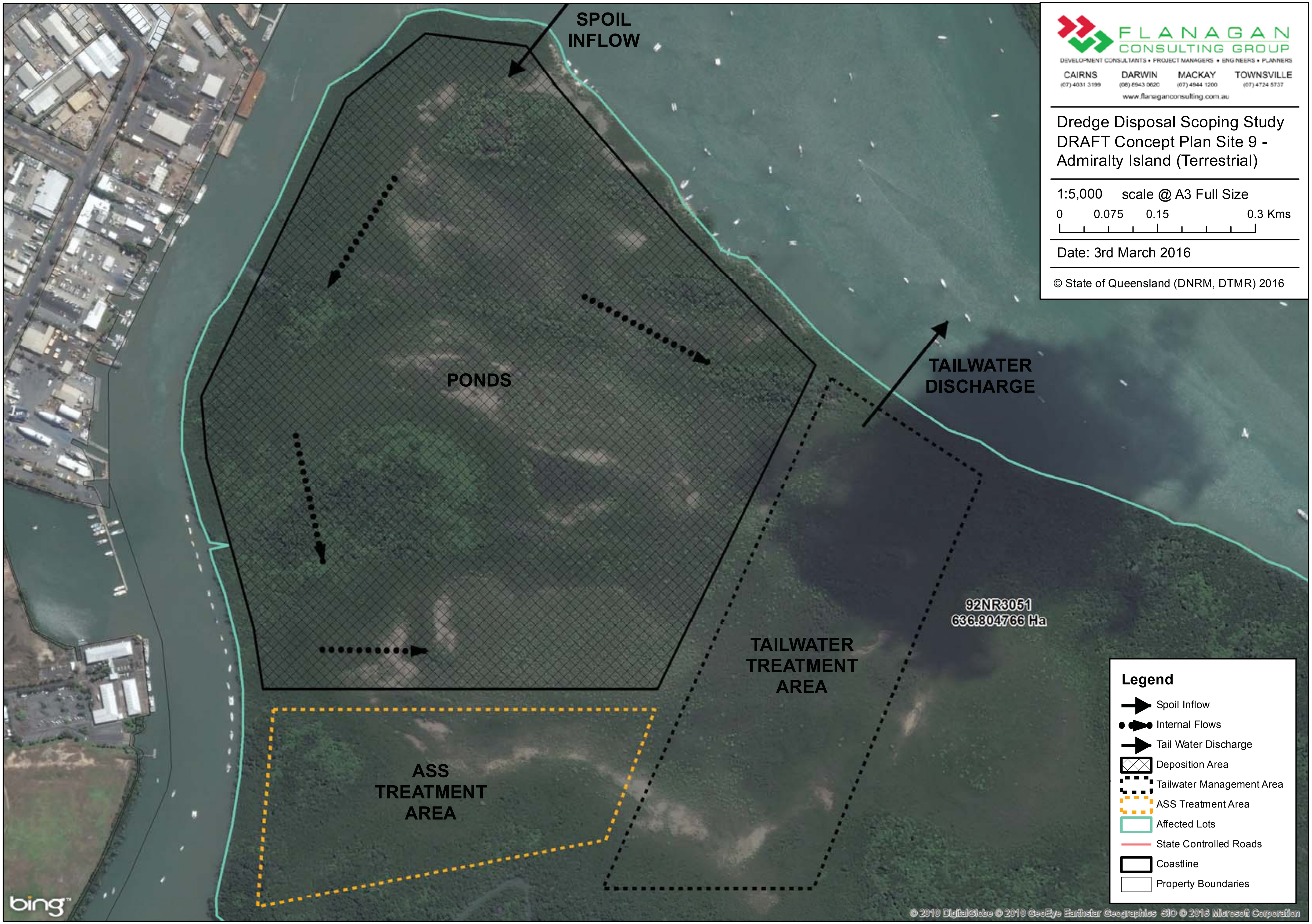
Dredge Disposal Scoping Study DRAFT Concept Plan Site 8 - Tingira Street

1:5,000 scale @ A3 Full Size

0 0.075 0.15 0.3 Kms

Date: 3rd March 2016





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Dredge Disposal Scoping Study
DRAFT Concept Plan Site 9 -
Admiralty Island (Terrestrial)

1:5,000 scale @ A3 Full Size
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Date: 3rd March 2016

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Dredge Disposal Scoping Study
DRAFT Concept Plan Site 10 -
East Trinity Option 1

1:10,000 scale @ A3 Full Size
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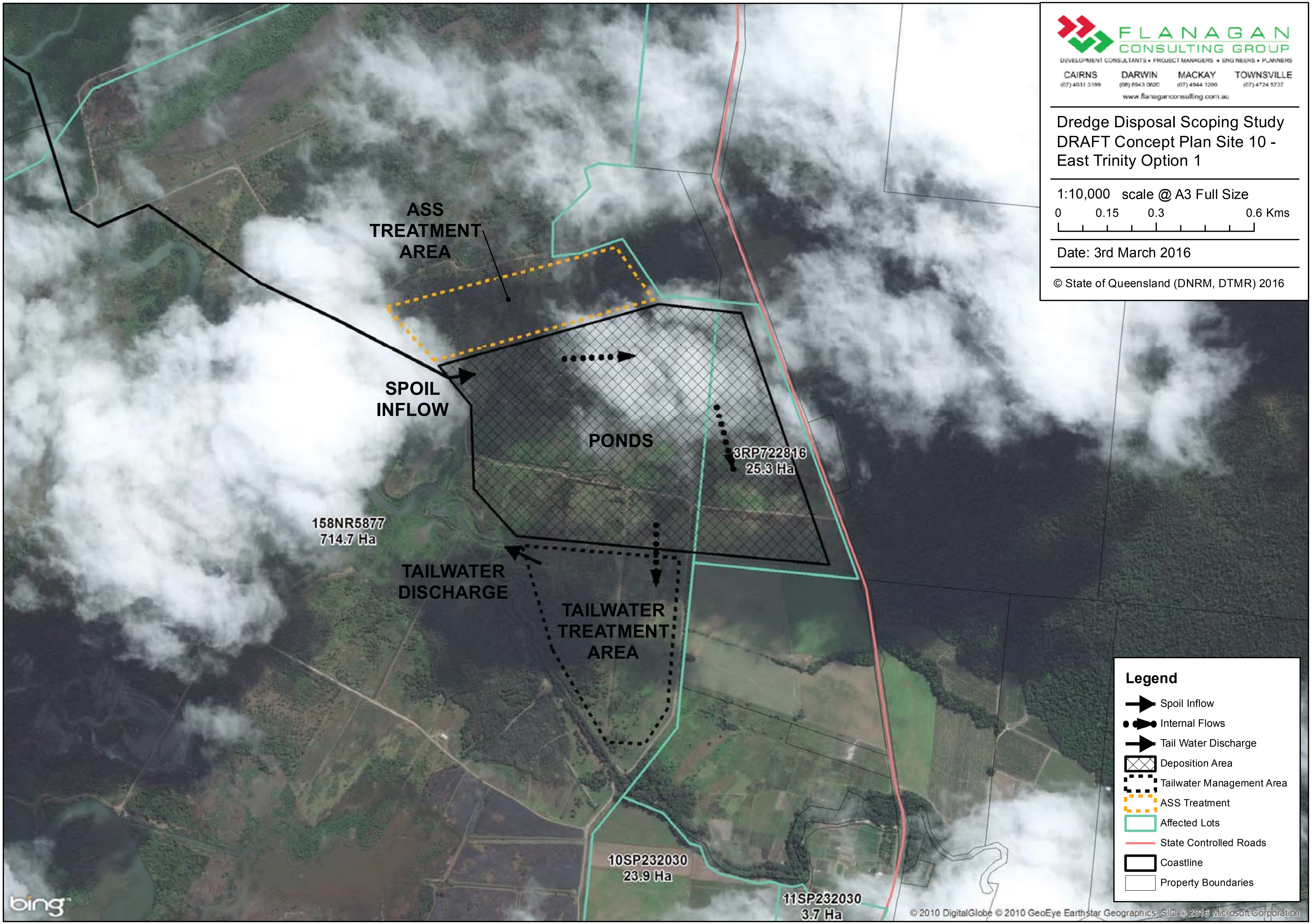
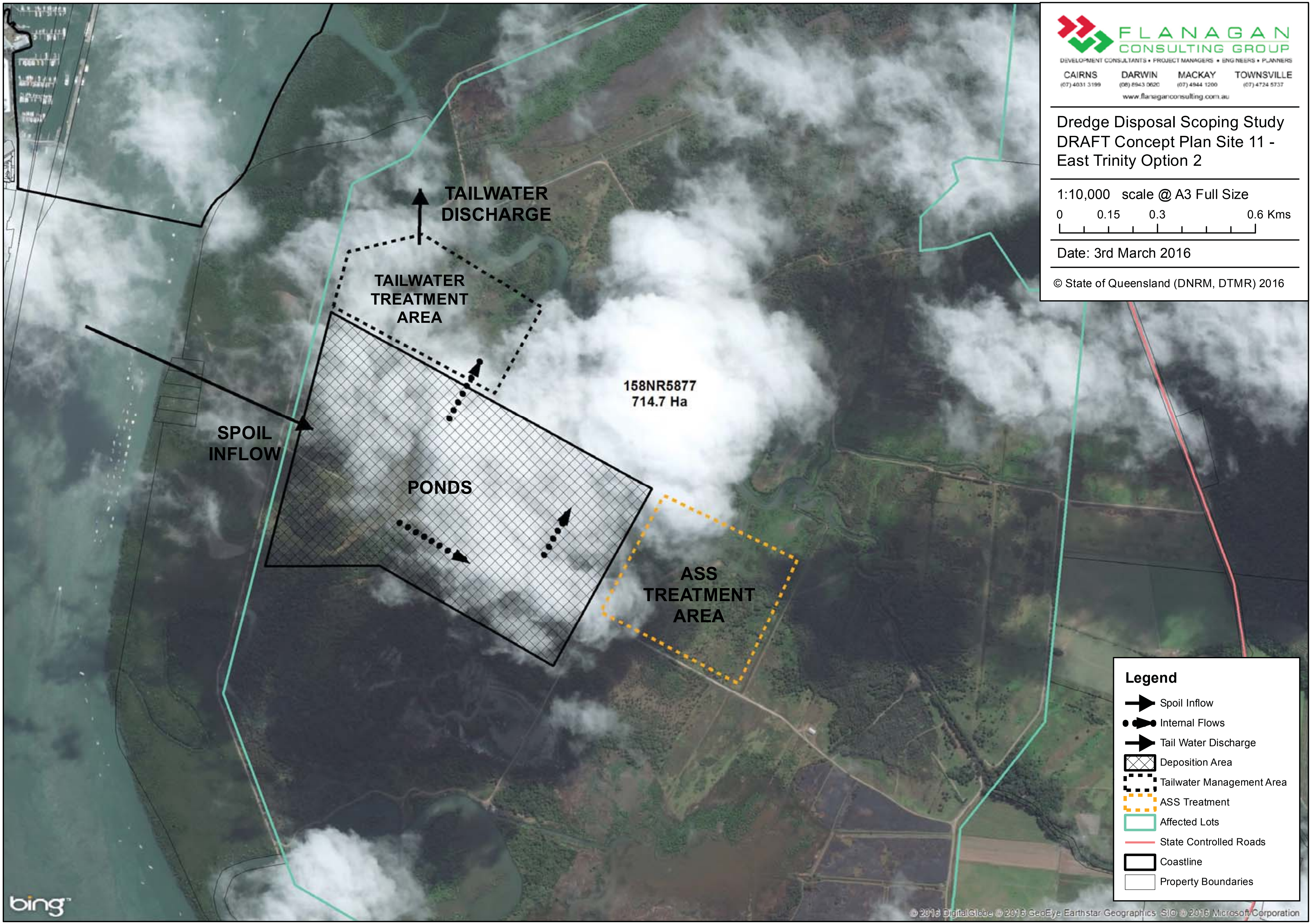
Date: 3rd March 2016





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Dredge Disposal Scoping Study DRAFT Concept Plan Site 11 - East Trinity Option 2

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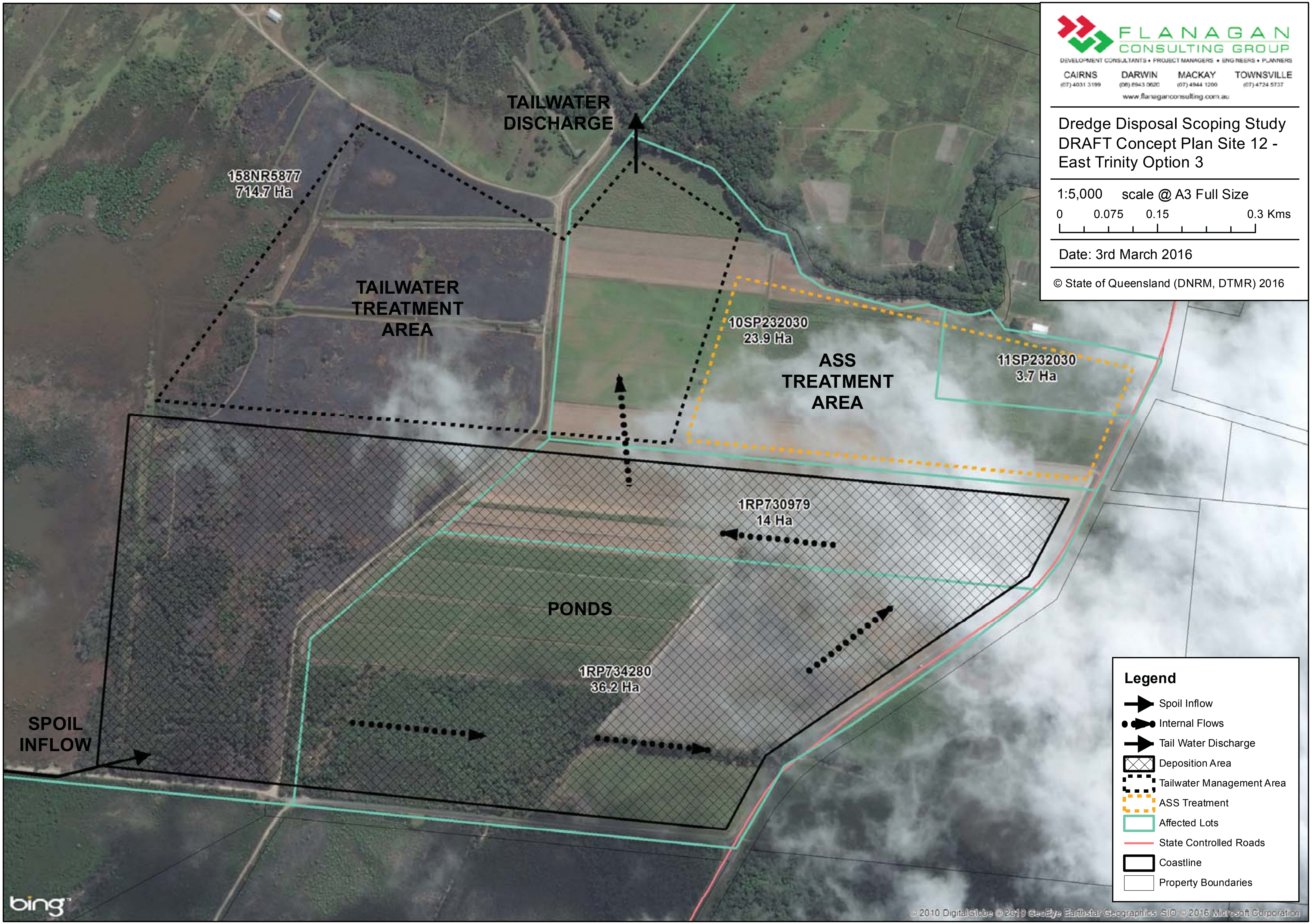
Date: 3rd March 2016



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Dredge Disposal Scoping Study
DRAFT Concept Plan Site 12 -
East Trinity Option 3

1:5,000 scale @ A3 Full Size

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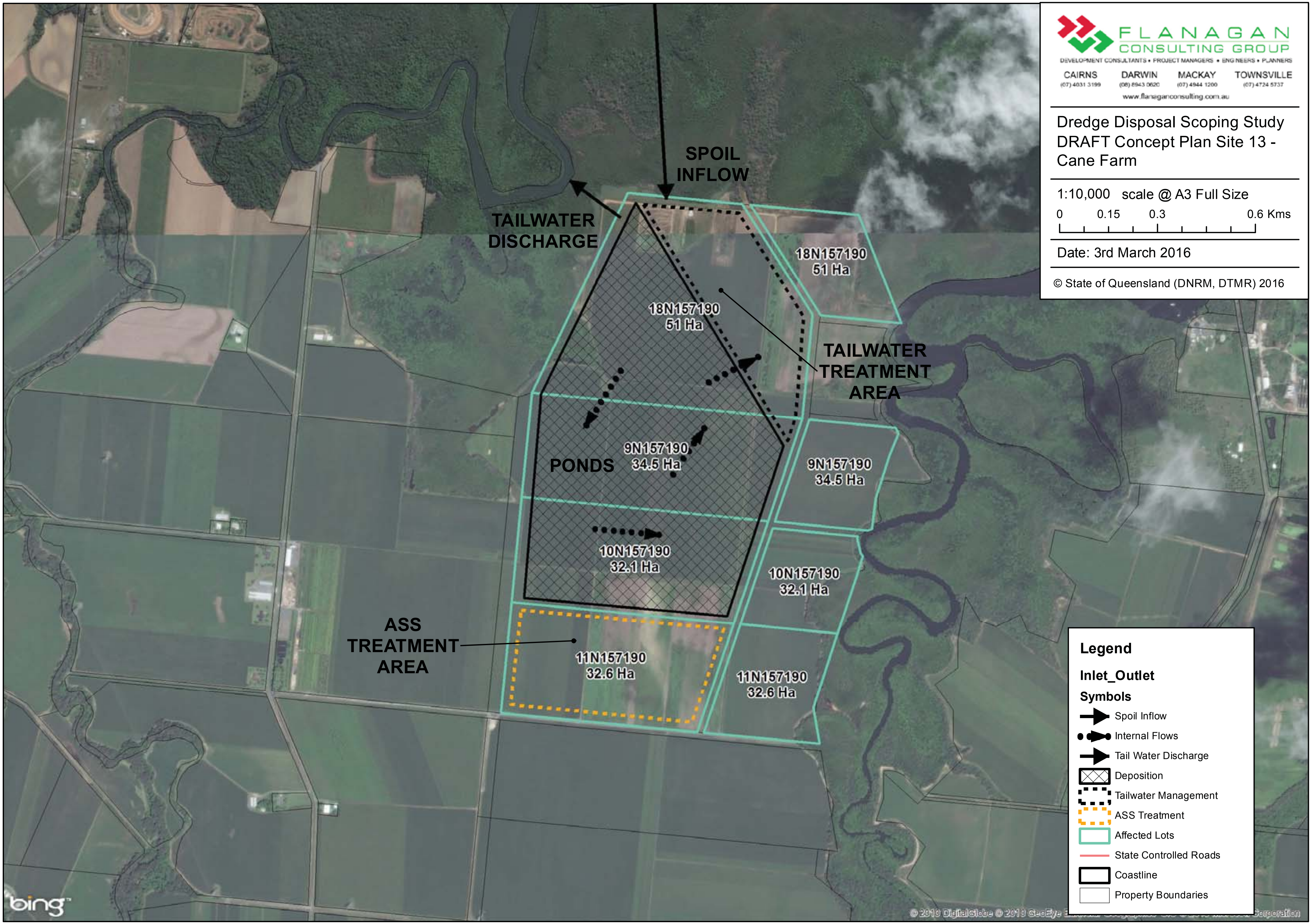
Date: 3rd March 2016



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Dredge Disposal Scoping Study DRAFT Concept Plan Site 13 - Cane Farm
1:10,000 scale @ A3 Full Size
0 0.15 0.3 0.6 Kms
Date: 3rd March 2016
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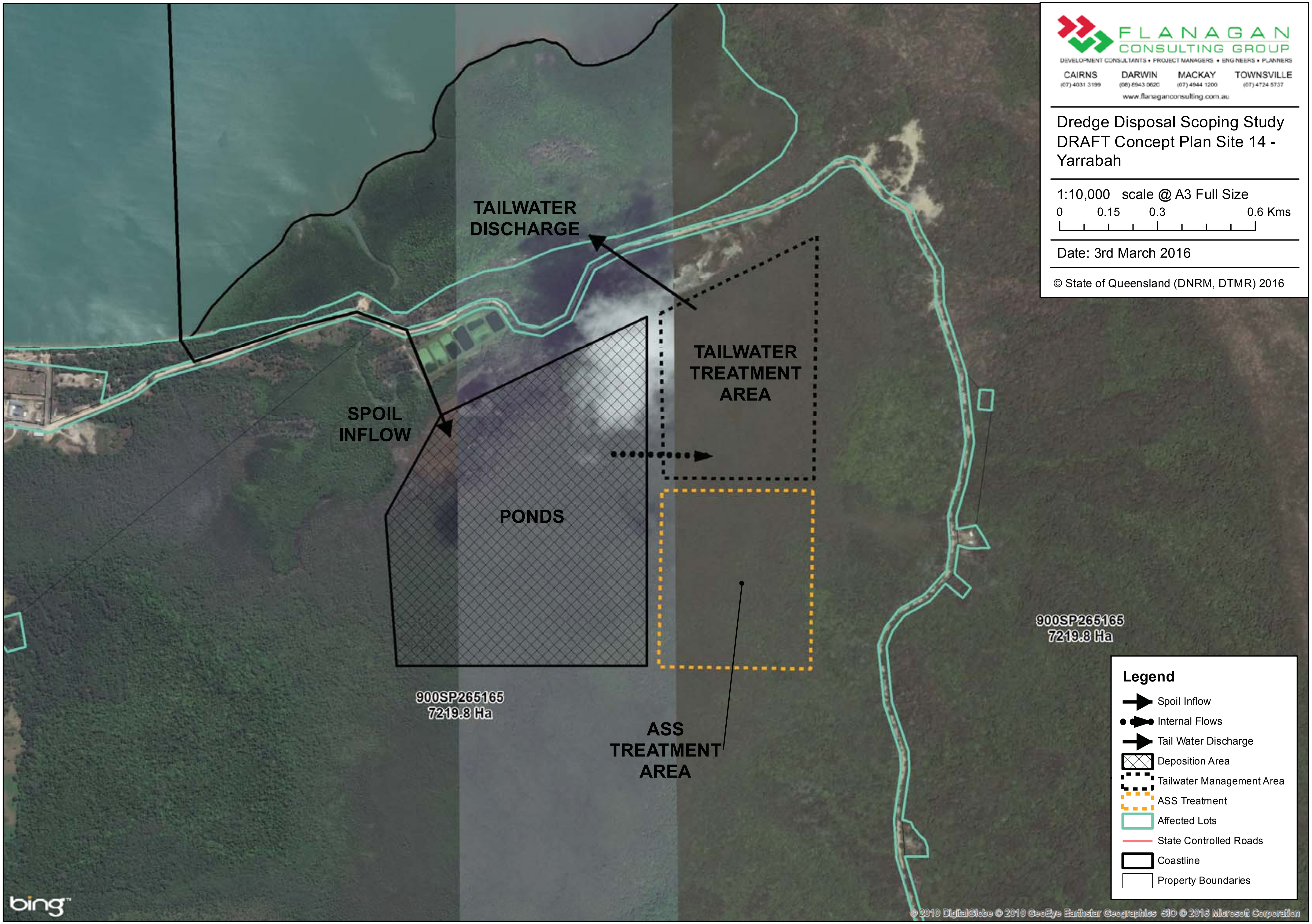
SPOIL INFLOW
TAILWATER DISCHARGE
TAILWATER TREATMENT AREA
PONDS
ASS TREATMENT AREA
18N157190 51 Ha
9N157190 34.5 Ha
10N157190 32.1 Ha
11N157190 32.6 Ha
Legend
Inlet_Outlet
Symbols
Spoil Inflow
Internal Flows
Tail Water Discharge
Deposition
Tailwater Management
ASS Treatment
Affected Lots
State Controlled Roads
Coastline
Property Boundaries
bing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Dredge Disposal Scoping Study DRAFT Concept Plan Site 14 - Yarrabah
1:10,000 scale @ A3 Full Size
0 0.15 0.3 0.6 Kms
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TAILWATER DISCHARGE
TAILWATER TREATMENT AREA
SPOIL INFLOW
PONDS
ASS TREATMENT AREA
900SP265165 7219.8 Ha
900SP265165 7219.8 Ha
Legend
Spoil Inflow
Internal Flows
Tail Water Discharge
Deposition Area
Tailwater Management Area
ASS Treatment
Affected Lots
State Controlled Roads
Coastline
Property Boundaries
bing
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APPENDIX D

RESULTS OF SITE EVALUATION

ID	TYPE	SITE	Void	Reclamation	Terrestrial	E1 – Surface Water	E2 – Groundwater	E3 – Biodiversity Values	E4 – Acid Sulfate Soil	E5 – Birdstrike	E6 – Coastal Hazards	P1 – Pumping Head	P2 – Placement Capacity	P3 – Tailwater Discharge	P4 – Ground Conditions & Stability	S2 – Important Agricultural Areas	S3 – Traffic	S4 - Appropriate Tenure (Ownership)	C - Standardised	E - Standardised
1	BV1	1 Northern Sands	X			0.67	0.83	1.00	0.67	0.67	1.00	0.05	0.70	0.50	1.00	1.00	1.00	0.50	0.69	1.00
2	BV2	2 Pioneer Sands	X			0.33	0.33	1.00	0.67	0.67	1.00	0.00	0.47	0.50	1.00	1.00	1.00	0.50	0.66	0.83
3	BB2	3 Ponderosa Prawn Farm			X	0.67	0.83	1.00	0.67	0.67	0.33	0.28	0.13	1.00	0.33	1.00	0.67	0.50	0.42	0.86
4	BB1	4 Pappalardo Ponds			X	0.67	1.00	0.97	0.67	0.67	0.25	0.37	0.09	0.50	0.00	0.12	0.67	0.50	0.31	0.87
5	CR1	5 Northern Esplanade		X		0.00	1.00	0.16	1.00	0.00	0.20	0.93	0.95	1.00	1.00	1.00	1.00	1.00	0.85	0.49
6	CR2	6 Bessie Point		X		0.00	1.00	0.00	1.00	0.67	0.20	0.97	0.95	1.00	1.00	1.00	1.00	1.00	0.93	0.59
7	WR1	7 Admiralty Island Recl.		X		0.67	1.00	0.99	1.00	0.67	0.25	1.00	0.49	1.00	1.00	1.00	1.00	1.00	1.00	0.95
8	WT2	8 Tingira Street			X	0.67	0.67	0.74	0.33	0.67	0.25	0.78	0.50	1.00	0.00	1.00	0.50	1.00	0.36	0.69
9	WT1	9 Admiralty Island			X	1.00	0.67	0.53	0.33	0.67	0.25	0.88	0.98	1.00	0.00	1.00	0.48	1.00	0.56	0.71
10	ET1	10 East Trinity Option 1			X	0.67	0.50	1.00	0.00	0.67	0.25	0.76	0.97	0.50	0.00	1.00	0.48	1.00	0.57	0.64
11	ET2	11 East Trinity Option 2			X	0.67	0.67	0.99	0.00	0.67	0.25	0.84	0.99	0.50	0.00	1.00	0.48	1.00	0.57	0.67
12	ET3	12 East Trinity Option 3			X	0.67	0.50	0.99	0.33	0.67	0.25	0.76	0.97	0.00	0.33	0.03	0.48	0.50	0.57	0.70
13	ST1	13 Cane Farm			X	0.67	0.50	1.00	1.00	1.00	0.25	0.28	0.95	0.00	0.67	0.01	0.80	0.50	0.58	0.91
14	YT1	14 Yarrabah			X	0.33	0.50	0.16	0.33	1.00	0.20	0.38	1.00	0.00	0.00	1.00	0.00	0.33	0.48	0.52

APPENDIX E

COST ESTIMATE RATES AND ASSUMPTIONS

Summary - Dredging Disposal Options

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1. Preliminaries

Dredging Site Options			Preliminaries			
Site Number	Dredging Option	Amount of Solid Dredged Material Processed (m3)	Planning and Approvals (EIS)	Project Management, Design Procurement, Management and Supervision	Total	Rate ($/m3)
1	**Northern Sands**	**645,000**	2,250,000	4,425,280	6,675,280	10.3
2	**Pioneer Sands**	**430,000**	1,500,000	3,125,344	4,625,344	10.8
3	**Ponderosa Prawn Farm**	**189,200**	660,000	2,183,659	2,843,659	15.0
4	**Pappalardo Ponds**	**86,000**	300,000	1,346,288	1,646,288	19.1
5	**Northern Esplanade**	**860,000**	3,000,000	4,794,890	7,794,890	9.1
6	**Bessie Point**	**860,000**	3,000,000	4,320,325	7,320,325	8.5
7	**Trinity Inlet**	**447,000**	1,559,302	2,874,915	4,434,218	9.9
8	**Tingira Street**	**430,000**	1,500,000	5,653,982	7,153,982	16.6
9	**Admirality Island (Terrestrial)**	**860,000**	3,000,000	7,034,245	10,034,245	11.7
10	**East Trinity Option 1**	**860,000**	3,000,000	7,191,779	10,191,779	11.9
11	**East Trinity Option 2**	**860,000**	3,000,000	7,203,405	10,203,405	11.9
12	**East Trinity Option 3**	**860,000**	3,000,000	7,237,025	10,237,025	11.9
13	**Cane Farm**	**860,000**	3,000,000	7,106,376	10,106,376	11.8
14	**Yarrabah**	**860,000**	3,000,000	8,578,225	11,578,225	13.5

2. Dredging Costs

Dredging Site Options			Dredging Costs				
Site Number	Dredging Option	Amount of Solid Dredged Material Processed (m3)	Establishment	Dredging and Pumping Costs	Demobilisation	Total	Rate ($/m3)
1	**Northern Sands**	**645,000**	2,700,000	25,606,500	487,500	28,794,000	44.6
2	**Pioneer Sands**	**430,000**	1,800,000	18,988,800	325,000	21,113,800	49.1
3	**Ponderosa Prawn Farm**	**189,200**	792,000	6,623,892	143,000	7,558,892	40.0
4	**Pappalardo Ponds**	**86,000**	360,000	2,690,080	65,000	3,115,080	36.2
5	**Northern Esplanade**	**860,000**	3,600,000	15,772,400	650,000	20,022,400	23.3
6	**Bessie Point**	**860,000**	3,600,000	15,609,000	650,000	19,859,000	23.1
7	**Trinity Inlet**	**447,000**	1,871,163	8,113,050	337,849	10,322,062	23.1
8	**Tingira Street**	**430,000**	1,800,000	9,275,100	325,000	11,400,100	26.5
9	**Admirality Island (Terrestrial)**	**860,000**	3,600,000	17,888,000	650,000	22,138,000	25.7
10	**East Trinity Option 1**	**860,000**	3,600,000	17,888,000	650,000	22,138,000	25.7
11	**East Trinity Option 2**	**860,000**	3,600,000	18,223,400	650,000	22,473,400	26.1
12	**East Trinity Option 3**	**860,000**	3,600,000	20,648,600	650,000	24,898,600	29.0
13	**Cane Farm**	**860,000**	3,600,000	24,269,200	650,000	28,519,200	33.2
14	**Yarrabah**	**860,000**	3,600,000	23,925,200	650,000	28,175,200	32.8

3. Containment Costs

Dredging Site Options			Containment Costs										
Site Number	Dredging Option	Amount of Solid Dredged Material Processed (m3)	Site Acquisition	Environmental Offsets and ILUA	Site Establishment (Fencing, Storage Sheds, Site Offices and Access Points)	Earthworks for Disposal Pond (including excavation and formation of perimeter bund)	Geosynthetic Liner and Geogrid	Import of Fill to Form Perimeter Bunds of Disposal Pond	Supply and Installation of Sheet Piling	Site Rehabilitation	Cutting Sheet Piles	Total	Rate ($/m3)
1	**Northern Sands**	**645,000**	10,000,000	600,000	295,800	0	0	0	0	444,000	0	11,339,800	17.6
2	**Pioneer Sands**	**430,000**	6,000,000	540,000	280,800	0	0	0	0	376,920	0	7,197,720	16.7
3	**Ponderosa Prawn Farm**	**189,200**	4,000,000	162,000	312,000	0	0	0	0	758,015	0	5,232,015	27.7
4	**Pappalardo Ponds**	**86,000**	4,000,000	190,000	238,800	0	0	0	0	470,500	0	4,899,300	57.0
5	**Northern Esplanade**	**860,000**	0	0	150,000	0	0	0	21,600,000	0	1,876,500	23,626,500	27.5
6	**Bessie Point**	**860,000**	0	0	150,000	0	0	0	17,200,000	0	1,494,250	18,844,250	21.9
7	**Trinity Inlet**	**447,000**	0	0	150,000	0	0	0	15,750,000	0	0	15,900,000	35.6
8	**Tingira Street**	**430,000**	0	6,790,000	277,200	1,441,831	14,475,000	2,883,662	0	2,933,062	0	28,800,755	67.0
9	**Admirality Island (Terrestrial)**	**860,000**	0	9,800,003	381,600	1,905,383	0	0	0	4,791,868	0	16,878,855	19.6
10	**East Trinity Option 1**	**860,000**	0	10,930,000	308,000	2,153,462	0	0	0	4,834,123	0	18,225,586	21.2
11	**East Trinity Option 2**	**860,000**	0	11,310,000	251,200	2,093,385	0	0	0	4,769,470	0	18,424,055	21.4
12	**East Trinity Option 3**	**860,000**	1,390,000	6,080,000	332,800	2,371,088	0	0	0	5,453,762	0	15,627,650	18.2
13	**Cane Farm**	**860,000**	1,926,000	1,926,000	318,000	2,184,623	0	0	0	4,558,336	0	10,912,959	12.7
14	**Yarrabah**	**860,000**	4,000,000	13,190,000	346,000	2,089,615	0	0	0	5,740,830	0	25,366,445	29.5

Summary - Dredging Disposal Options

4. Water Management Costs

Dredging Site Options			Water Management Costs					
Site Number	Dredging Option	Amount of Solid Dredged Material Processed (m3)	Topsoil Stripping and Respreading to Form Tailwater Treatment Bunds	Import of Fill to Form Tailwater Treatment Bunds	Tail Water control	Weir Boxes	Total	Rate ($/m3)
1	**Northern Sands**	**645,000**	294,000	0	3,825,000	0	4,119,000	6.4
2	**Pioneer Sands**	**430,000**	241,920	0	2,700,000	0	2,941,920	6.8
3	**Ponderosa Prawn Farm**	**189,200**	262,080	0	1,056,000	0	1,318,080	7.0
4	**Pappalardo Ponds**	**86,000**	220,500	0	390,000	0	610,500	7.1
5	**Northern Esplanade**	**860,000**	0	0	3,900,000	400,000	4,300,000	5.0
6	**Bessie Point**	**860,000**	0	0	3,900,000	600,000	4,500,000	5.2
7	**Trinity Inlet**	**447,000**	0	0	2,027,093	500,000	2,527,093	5.7
8	**Tingira Street**	**430,000**	0	1,360,800	1,950,000	0	3,310,800	7.7
9	**Admirality Island (Terrestrial)**	**860,000**	915,600	14	3,900,000	0	4,815,614	5.6
10	**East Trinity Option 1**	**860,000**	844,200	0	4,200,000	0	5,044,200	5.9
11	**East Trinity Option 2**	**860,000**	726,600	0	3,900,000	0	4,626,600	5.4
12	**East Trinity Option 3**	**860,000**	1,134,000	0	4,200,000	0	5,334,000	6.2
13	**Cane Farm**	**860,000**	621,600	0	4,500,000	0	5,121,600	6.0
14	**Yarrabah**	**860,000**	1,230,600	0	4,500,000	0	5,730,600	6.7

5. Treatment Costs

Dredging Site Options			Treatment Costs		
Site Number	Dredging Option	Amount of Solid Dredged Material Processed (m3)	ASS/PASS Land Farming and Neutralisation	Total	Rate ($/m3)
1	**Northern Sands**	**645,000**	0	0	0.0
2	**Pioneer Sands**	**430,000**	0	0	0.0
3	**Ponderosa Prawn Farm**	**189,200**	5,297,600	5,297,600	28.0
4	**Pappalardo Ponds**	**86,000**	2,408,000	2,408,000	28.0
5	**Northern Esplanade**	**860,000**	0	0	0.0
6	**Bessie Point**	**860,000**	0	0	0.0
7	**Trinity Inlet**	**447,000**	0	0	0.0
8	**Tingira Street**	**430,000**	12,040,000	12,040,000	28.0
9	**Admirality Island (Terrestrial)**	**860,000**	24,080,000	24,080,000	28.0
10	**East Trinity Option 1**	**860,000**	24,080,000	24,080,000	28.0
11	**East Trinity Option 2**	**860,000**	24,080,000	24,080,000	28.0
12	**East Trinity Option 3**	**860,000**	24,080,000	24,080,000	28.0
13	**Cane Farm**	**860,000**	24,080,000	24,080,000	28.0
14	**Yarrabah**	**860,000**	24,080,000	24,080,000	28.0

6. Operational Costs

Dredging Site Options			Operational Costs				
Site Number	Dredging Option	Amount of Solid Dredged Material Processed (m3)	Monitoring	Security	Management	TOTAL	Rate ($/m3)
1	**Northern Sands**	**645,000**	0	0	0	0	0.0
2	**Pioneer Sands**	**430,000**	0	0	0	0	0.0
3	**Ponderosa Prawn Farm**	**189,200**	810000	810000	810000	2430000	12.8
4	**Pappalardo Ponds**	**86,000**	810000	810000	810000	2430000	28.3
5	**Northern Esplanade**	**860,000**	0	0	0	0	0.0
6	**Bessie Point**	**860,000**	0	0	0	0	0.0
7	**Trinity Inlet**	**447,000**	0	0	0	0	0.0
8	**Tingira Street**	**430,000**	810000	810000	810000	2430000	5.7
9	**Admirality Island (Terrestrial)**	**860,000**	810000	810000	810000	2430000	2.8
10	**East Trinity Option 1**	**860,000**	810000	810000	810000	2430000	2.8
11	**East Trinity Option 2**	**860,000**	810000	810000	810000	2430000	2.8
12	**East Trinity Option 3**	**860,000**	810000	810000	810000	2430000	2.8
13	**Cane Farm**	**860,000**	810000	810000	810000	2430000	2.8
14	**Yarrabah**	**860,000**	810000	810000	810000	2430000	2.8

Summary - Dredging Disposal Options

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7. Contingency

Dredging Site Options			Contingency	
Site Number	Dredging Option	Amount of Solid Dredged Material Processed (m3)	TOTAL	Rate ($/m3)
1	**Northern Sands**	**645,000**	$7,639,212	11.8
2	**Pioneer Sands**	**430,000**	$5,381,818	12.5
3	**Ponderosa Prawn Farm**	**189,200**	$3,702,037	19.6
4	**Pappalardo Ponds**	**86,000**	$2,266,375	26.4
5	**Northern Esplanade**	**860,000**	$8,361,569	9.7
6	**Bessie Point**	**860,000**	$7,578,536	8.8
7	**Trinity Inlet**	**447,000**	$4,977,506	11.1
8	**Tingira Street**	**430,000**	$9,554,071	22.2
9	**Admirality Island (Terrestrial)**	**860,000**	$12,056,505	14.0
10	**East Trinity Option 1**	**860,000**	$12,316,435	14.3
11	**East Trinity Option 2**	**860,000**	$12,335,619	14.3
12	**East Trinity Option 3**	**860,000**	$12,391,091	14.4
13	**Cane Farm**	**860,000**	$12,175,520	14.2
14	**Yarrabah**	**860,000**	$14,604,070	17.0

Total Summary

Dredging Site Options			Summary	
Site Number	Dredging Option	Amount of Solid Dredged Material Processed (m3)	TOTAL	Rate ($/m3)
1	**Northern Sands**	**645,000**	58,567,292	$91
2	**Pioneer Sands**	**430,000**	41,260,602	$96
3	**Ponderosa Prawn Farm**	**189,200**	28,382,283	$150
4	**Pappalardo Ponds**	**86,000**	17,375,543	$202
5	**Northern Esplanade**	**860,000**	64,105,359	$75
6	**Bessie Point**	**860,000**	58,102,111	$68
7	**Trinity Inlet**	**447,000**	38,160,878	$85
8	**Tingira Street**	**430,000**	74,689,708	$174
9	**Admirality Island (Terrestrial)**	**860,000**	92,433,220	$107
10	**East Trinity Option 1**	**860,000**	94,425,999	$110
11	**East Trinity Option 2**	**860,000**	94,573,079	$110
12	**East Trinity Option 3**	**860,000**	94,998,366	$110
13	**Cane Farm**	**860,000**	93,345,655	$109
14	**Yarrabah**	**860,000**	111,964,540	$130

Option 1 - Northern Sands
Quantity Schedule

FLANAGAN CONSULTING GROUP
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1	**Site Name:**	Northern Sands
2	**Tenure:**	Freehold (Privately Owned)
3	**Location:**	Off Captain Cook Highway near the intersection that is the turn-off to Holloways Beach
4	**Capacity of Site to Process Solid Dredged Material (m3)**	645,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	75%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	1419000

1	**Disposal Pond**	**Quantity**
A	Area of Disposal Pond Area (m2)	236000
B	Amount of Discharged Material on Pond (m3)	1419000
C	Height of Material on Site (m)	6.013
2	**Perimeter Bunds of Disposal Pond**	**Quantity**
A	Freeboard (m)	0.50
B	Height of Bund (m)	6.51
C	Batter (1 in _)	2.00
D	Length of Top (m)	3.00
E	Length of Bottom (m)	29.05
F	Cross Sectional Area (m2)	104.37
G	Length of Perimeter Bunds (m)	0
H	Volume of Perimeter Bunds (m3)	0
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	60000
B	Length of Tailwater Treatment Area (m)	300
C	Width of Tailwater Treatment Area (m)	200
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	290
I	Number of Bunds	19
J	Volume of Internal Bunds (m3)	11020
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	1000
G	Volume of Perimeter Bunds (m3)	9000

Option 1 - Northern Sands Quantity Schedule

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6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.35
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	21000
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	0
B	Perimeter (m)	0
C	Amount of Solid Dredged Material to be Treated (m3)	0
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	0
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	21000
B	Hydromulching (m2)	60000
C	Depth of Material to Cover Disposal Pond (m)	0
D	Covering Disposal Pond (m3)	0
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). RE numbers advised by David Rivett (hectares)	0
E	Class E – Seagrass (shapefile provided by David Rivett) (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	6
H	Cane Land (hectares)	0
I	Indigenous Land Use Agreement (hectares)	0
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	3645
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 1 - Northern Sands
Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	645,000	0.75	$2,250,000

	Item	Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs	Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs	Total Amount
B	Project Management, Design Procurement and Supervision	10.00%	$44,252,800.00	$4,425,280.00

Total Preliminaries Cost	**$6,675,280**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Establishment	860,000	3,600,000	645,000	0.75	$2,700,000.00

	Item	Amount of Solid Material to be Pumped (m3)	Rate	Total Amount
B	Dredging and Pumping Costs	645,000	$ 39.70	$25,606,500.00

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
C	Demobilisation	860,000	650,000	645,000	0.75	$487,500.00

Total Dredging Costs	**$28,794,000.00**

Option 1 - Northern Sands
Cost Item Schedule

FLANAGAN CONSULTING GROUP
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3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	1	10,000,000	$10,000,000.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	0	20,000	0.00
	(i) Land that is not caneland	6	100,000	600,000.00
	(iii) ILUA's	0	1,000,000	0.00
			TOTAL	$600,000.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	3645	40	145,800.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	295,800.00
D	Earthworks for Disposal Pond	0	20	0.00
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	21000	14	294,000.00
	(ii) Hydromulching	60000	2.5	150,000.00
	(iii) Respreading of Perimeter Bund	0	14	0.00
			TOTAL	444,000.00
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00

Total Containment Costs	**$11,339,800.00**

Option 1 - Northern Sands
Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	21000	14	$294,000.00
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00

	Item	Total Amount of Solid Dredged Material	Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material	Number of Weeks of Pumping	Capacity of Site	Percent Capacity of Site	Total Amount
C	Tailwater Control	860,000	300,000	17	645,000	0.75	$3,825,000.00

	Item	Quantity	Rate	Total Amount
D	Weir Boxes	0	50,000	$0.00

Total Water Management Costs	**$4,119,000.00**

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	0	28	$0.00

Total Treatment Costs	**$0.00**

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	0	810,000	$0.00
B	Security	0	810,000	$0.00
C	Management	0	810,000	$0.00

Total Operational Costs	**$0.00**

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency Amount	**$50,928,080.00**	**15%**	$7,639,212.00

Option 2 - Pioneer Sands Quantity Schedule

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1	**Site Name:**	Pioneer Sands
2	**Tenure:**	Freehold (Privately Owned)
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	430,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	50%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	946000

1	Disposal Pond	Quantity
A	Area of Disposal Pond Area (m2)	150385
B	Amount of Discharged Material on Pond (m3)	946000
C	Height of Material on Site (m)	6.290520996
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	6.790520996
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	30.16208398
F	Cross Sectional Area (m2)	112.5939138
G	Length of Perimeter Bunds (m)	0
H	Volume of Perimeter Bunds (m3)	0
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	54000
B	Length of Tailwater Treatment Area (m)	300
C	Width of Tailwater Treatment Area (m)	180
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	290
I	Number of Bunds	17
J	Volume of Internal Bunds (m3)	9860
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	960
G	Volume of Perimeter Bunds (m3)	8640

Option 2 - Pioneer Sands Quantity Schedule

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6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.32
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	17280
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	0
B	Perimeter (m)	0
C	Amount of Solid Dredged Material to be Treated (m3)	0
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	0
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	17280
B	Hydromulching (m2)	54000
C	Depth of Material to Cover Disposal Pond (m)	0
D	Covering Disposal Pond (m3)	0
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE) (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	5.4
H	Cane Land (hectares)	0
I	Indigenous Land Use Agreement (hectares)	0
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	3270
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 2 - Pioneer Sands

Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	430,000	0.5	$1,500,000

	Item	Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs	Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs	Total Amount
B	Project Management, Design Procurement and Supervision	10.00%	$31,253,440.00	$3,125,344.00

Total Preliminaries Cost	**$4,625,344**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	430,000	0.5	$1,800,000.00

	Item	Amount of Solid Material to be Pumped (m3)	Rate	Total Amount
B	Dredging and Pumping Costs	430,000	44.16	$18,988,800.00

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
C	Demobilisation	860,000	650,000	430,000	0.5	$325,000.00

Total Dredging Costs	**$21,113,800.00**

Option 2 - Pioneer Sands

Cost Item Schedule

3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	1	6,000,000	$6,000,000.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	0	20,000	0.00
	(i) Land that is zoned for Agricultural but not cane land	5.4	100,000	540,000.00
	(iii) ILUA's	0	1,000,000	0.00
			TOTAL	$540,000.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	3270	40	130,800.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	280,800.00
D	Earthworks for Disposal Pond	0	20	0.00
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	17280	14	241,920.00
	(ii) Hydromulching	54000	2.5	135,000.00
	(iii) Respreading of Perimeter Bund	0	14	0.00
			TOTAL	376,920.00
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$7,197,720.00**		

Option 2 - Pioneer Sands

Cost Item Schedule

FLANAGAN CONSULTING GROUP
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4. Water Management Costs

	Item	Quantity	Rate	Total Amount			
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	17280	14	$241,920.00			
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00			
	Item	**Total Amount of Solid Dredged Material**	**Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material**	**Number of Weeks of Pumping**	**Capacity of Site**	**Percent Capacity of Site**	**Total Amount**
C	Tailwater Control	860,000	300,000	18	430,000	0.5	$2,700,000.00
	Item	**Quantity**	**Rate**	**Total Amount**			
D	Weir Boxes	0	50,000	$0.00			

Total Water Management Costs	**$2,941,920.00**

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	0	28	$0.00

Total Treatment Costs	**$0.00**

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	0	810,000	$0.00
B	Security	0	810,000	$0.00
C	Management	0	810,000	$0.00

Total Operational Costs	**$0.00**

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency Amount	$35,878,784.00	15%	5381817.6

Option 3 - Ponderosa Prawn Farm
Quantity Schedule

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1	**Site Name:**	Ponderosa Prawn Farm
2	**Tenure:**	Freehold (Privately Owned)
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	189,200
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	22%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	416240

1	**Disposal Pond**	**Quantity**
A	Area of Disposal Pond Area (m2)	146374
B	Amount of Discharged Material on Pond (m3)	416240
C	Height of Material on Site (m)	2.843674423
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	3.343674423
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	16.37469769
F	Cross Sectional Area (m2)	32.39134056
G	Length of Perimeter Bunds (m)	0
H	Volume of Perimeter Bunds (m3)	0
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	52000
B	Length of Tailwater Treatment Area (m)	520
C	Width of Tailwater Treatment Area (m)	100
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	510
I	Number of Bunds	9
J	Volume of Internal Bunds (m3)	9180
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	1240
G	Volume of Perimeter Bunds (m3)	11160

Option 3 - Ponderosa Prawn Farm
Quantity Schedule

6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.36
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	18720
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	81000
B	Perimeter (m)	1280
C	Amount of Solid Dredged Material to be Treated (m3)	189,200
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	189200
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	18720
B	Hydromulching (m2)	198374
C	Depth of Material to Cover Disposal Pond (m)	0.5
D	Covering Disposal Pond (m3)	0
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	0
H	Cane Land (hectares)	8.1
I	Indigenous Land Use Agreement (hectares)	0
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	4050
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 3 - Ponderosa Prawn Farm

Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	189,200	0.22	$660,000
	Item	**Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs**	**Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs**	**Total Amount**		
B	Project Management, Design Procurement and Supervision	10.00%	$21,836,587.00	$2,183,658.70		

Total Preliminaries Cost	**$2,843,659**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	189,200	0.22	$792,000.00
	Item	**Amount of Solid Material to be Pumped (m3)**	**Rate**	**Total Amount**		
B	Dredging and Pumping Costs	189,200	35.01	$6,623,892.00		
	Item	**Total Amount of Solid Dredged Material (m3)**	**Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material**	**Capacity of Site (m3)**	**Percent Capacity of Site (m3)**	**Total Amount**
C	Demobilisation	860,000	650,000	189,200	0.22	$143,000.00

Total Dredging Costs	**$7,558,892.00**

Option 3 - Ponderosa Prawn Farm

Cost Item Schedule

FLANAGAN CONSULTING GROUP
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3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	1	4,000,000	$4,000,000.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	8.1	20,000	162,000.00
	(i) Land that is zoned for Agricultural	0	100,000	0.00
	(iii) ILUA's	0	1,000,000	0.00
			TOTAL	$162,000.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	4050	40	162,000.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	312,000.00
D	Earthworks for Disposal Pond	0	20	0.00
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	18720	14	262,080.00
	(ii) Hydromulching	198374	2.5	495,935.00
	(iii) Respreading of Perimeter Bund	0	14	0.00
			TOTAL	758,015.00
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$5,232,015.00**		

Option 3 - Ponderosa Prawn Farm

Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount			
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	18720	14	$262,080.00			
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00			
	Item	**Total Amount of Solid Dredged Material**	**Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material**	**Number of Weeks of Pumping**	**Capacity of Site**	**Percent Capacity of Site**	**Total Amount**
C	Tailwater Control	860,000	300,000	16	189,200	0.22	$1,056,000.00
	Item	**Quantity**	**Rate**	**Total Amount**			
D	Weir Boxes	0	50,000	$0.00			

Total Water Management Costs	**$1,318,080.00**

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	189200	28	$5,297,600.00

Total Treatment Costs	**$5,297,600.00**

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	1	810,000	$810,000.00
B	Security	1	810,000	$810,000.00
C	Management	1	810,000	$810,000.00

Total Operational Costs	**$2,430,000.00**

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency Amount	$24,680,245.70	15%	3702036.855

Option 4 - Pappalados Ponds

Quantity Schedule

1	**Site Name:**	Pappalados
2	**Tenure:**	Freehold (Privately Owned)
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	86,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	10%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	189200

1	**Disposal Pond**	**Quantity**
A	Area of Disposal Pond Area (m2)	55000
B	Amount of Discharged Material on Pond (m3)	189200
C	Height of Material on Site (m)	3.44
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	3.94
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	18.76
F	Cross Sectional Area (m2)	42.8672
G	Length of Perimeter Bunds (m)	0
H	Volume of Perimeter Bunds (m3)	0
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	45000
B	Length of Tailwater Treatment Area (m)	300
C	Width of Tailwater Treatment Area (m)	150
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	290
I	Number of Bunds	14
J	Volume of Internal Bunds (m3)	8120
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	900
G	Volume of Perimeter Bunds (m3)	8100

Option 4 - Pappalados Ponds

Quantity Schedule

6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.35
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	15750
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	50000
B	Perimeter (m)	990
C	Amount of Solid Dredged Material to be Treated (m3)	86,000
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	86000
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	15750
B	Hydromulching (m2)	100000
C	Depth of Material to Cover Disposal Pond (m)	0.5
D	Covering Disposal Pond (m3)	0
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	0
H	Cane Land (hectares)	9.5
I	Indigenous Land Use Agreement (hectares)	0
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	2220
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 4 - Pappalados Ponds

Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	86,000	0.1	$300,000
	Item	**Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs**	**Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs**	**Total Amount**		
B	Project Management, Design Procurement and Supervision	10.00%	$13,462,880.00	$1,346,288.00		

Total Preliminaries Cost	**$1,646,288**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	86,000	0.1	$360,000.00
	Item	**Amount of Solid Material to be Pumped (m3)**	**Rate**	**Total Amount**		
B	Dredging and Pumping Costs	86,000	31.28	$2,690,080.00		
	Item	**Total Amount of Solid Dredged Material (m3)**	**Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material**	**Capacity of Site (m3)**	**Percent Capacity of Site (m3)**	**Total Amount**
C	Demobilisation	860,000	650,000	86,000	0.1	$65,000.00

Total Dredging Costs	**$3,115,080.00**

Option 4 - Pappalados Ponds

Cost Item Schedule

3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	1	4,000,000	$4,000,000.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	9.5	20,000	190,000.00
	(i) Land that is zoned for Agricultural	0	100,000	0.00
	(iii) ILUA's	0	1,000,000	0.00
			TOTAL	$190,000.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	2220	40	88,800.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	238,800.00
D	Earthworks for Disposal Pond	0	20	0.00
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	15750	14	220,500.00
	(ii) Hydromulching	100000	2.5	250,000.00
	(iii) Respreading of Perimeter Bund	0	14	0.00
			TOTAL	470,500.00
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$4,899,300.00**		

Option 4 - Pappalados Ponds

Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	15750	14	$220,500.00
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00

	Item	Total Amount of Solid Dredged Material	Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material	Number of Weeks of Pumping	Capacity of Site	Percent Capacity of Site	Total Amount
C	Tailwater Control	860,000	300,000	13	86,000	0.1	$390,000.00

	Item	Quantity	Rate	Total Amount
D	Weir Boxes	0	50,000	$0.00

Total Water Management Costs	$610,500.00

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	86000	28	$2,408,000.00

Total Treatment Costs	$2,408,000.00

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	1	810,000	$810,000.00
B	Security	1	810,000	$810,000.00
C	Management	1	810,000	$810,000.00

Total Operational Costs	$2,430,000.00

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency Amount	$15,109,168.00	15%	2266375.2

Option 5 - North of Esplanade

Quantity Schedule

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1	**Site Name:**	North of Esplanade
2	**Tenure:**	Water (Ocean)
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	860,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	100%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	1892000

1	**Disposal Pond**	**Quantity**
A	Area of Disposal Pond Area (m2)	0
B	Amount of Discharged Material on Pond (m3)	1892000
C	Height of Material on Site (m)	0
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	0.5
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	5
F	Cross Sectional Area (m2)	2
G	Length of Perimeter Bunds (m)	0
H	Volume of Perimeter Bunds (m3)	0
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	0
B	Length of Tailwater Treatment Area (m)	0
C	Width of Tailwater Treatment Area (m)	0
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	0
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	0
D	Batter (1 in _)	0
E	Length of Top (m)	0
F	Length of Bottom (m)	0
G	Cross Sectional Area (m2)	0
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	0
I	Number of Bunds	0
J	Volume of Internal Bunds (m3)	0
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	0
B	Batter (1 in _)	0
C	Length of Top (m)	0
D	Length of Bottom (m)	0
E	Cross Sectional Area (m2)	0
F	Length of Bunds (m)	0
G	Volume of Perimeter Bunds (m3)	0

Option 5 - North of Esplanade

Quantity Schedule

6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	0
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	0
B	Perimeter (m)	0
C	Amount of Solid Dredged Material to be Treated (m3)	0
D	Treatment Factor	0
E	Amount of Material to be Treated (including bulking factor) (m3)	0
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	8
B	Length of Sheet Piles (m)	10800
C	Cutting Off Sheet Piles (m)	10800
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	0
B	Hydromulching (m2)	0
C	Depth of Material to Cover Disposal Pond (m)	0
D	Covering Disposal Pond (m3)	0
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	0
H	Cane Land (hectares)	0
I	Indigenous Land Use Agreement (hectares)	0
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	0
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 5 - North of Esplanade
Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	860,000	1	$3,000,000

	Item	Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs	Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs	Total Amount
B	Project Management, Design Procurement and Supervision	10.00%	$47,948,900.00	$4,794,890.00

Total Preliminaries Cost	**$7,794,890**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	860,000	1	$3,600,000.00

	Item	Amount of Solid Material to be Pumped (m3)	Rate	Total Amount
B	Dredging and Pumping Costs	860,000	18.34	$15,772,400.00

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
C	Demobilisation	860,000	650,000	860,000	1	$650,000.00

Total Dredging Costs	**$20,022,400.00**

Option 5 - North of Esplanade
Cost Item Schedule

3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	1	0	$0.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	0	20,000	0.00
	(i) Land that is zoned for Agricultural	0	100,000	0.00
	(iii) ILUA's	0	1,000,000	0.00
			TOTAL	$0.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	0	40	0.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	150,000.00
D	Earthworks for Disposal Pond	0	20	0.00
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	10800	2000	21,600,000.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	0	14	0.00
	(ii) Hydromulching	0	2.5	0.00
	(iii) Respreading of Perimeter Bund	0	14	0.00
			TOTAL	0.00
I	Cutting of Sheet Piles at Conclusion of Project	10800	173.75	1,876,500.00
	Total Containment Costs	**$23,626,500.00**		

Option 5 - North of Esplanade

Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	0	14	$0.00
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00

	Item	Total Amount of Solid Dredged Material	Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material	Number of Weeks of Pumping	Capacity of Site	Percent Capacity of Site	Total Amount
C	Tailwater Control	860,000	300,000	13	860,000	1	$3,900,000.00

	Item	Quantity	Rate	Total Amount
D	Weir Boxes	8	50,000	$400,000.00

Total Water Management Costs	**$4,300,000.00**

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	0	28	$0.00

Total Treatment Costs	**$0.00**

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	0	810,000	$0.00
B	Security	0	810,000	$0.00
C	Management	0	810,000	$0.00

Total Operational Costs	**$0.00**

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency Amount	$55,743,790.00	15%	8361568.5

Option 6 - Bessie Point

Quantity Schedule

1	**Site Name:**	Bessie Point
2	**Tenure:**	Water (Ocean)
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	860,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	100%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	1892000

1	Disposal Pond	Quantity
A	Area of Disposal Pond Area (m2)	55000
B	Amount of Discharged Material on Pond (m3)	1892000
C	Height of Material on Site (m)	34.4
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	34.9
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	142.6
F	Cross Sectional Area (m2)	2540.72
G	Length of Perimeter Bunds (m)	0
H	Volume of Perimeter Bunds (m3)	0
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	45000
B	Length of Tailwater Treatment Area (m)	300
C	Width of Tailwater Treatment Area (m)	150
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	290
I	Number of Bunds	14
J	Volume of Internal Bunds (m3)	8120
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	900
G	Volume of Perimeter Bunds (m3)	8100

Option 6 - Bessie Point

Quantity Schedule

6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	0
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	0
B	Perimeter (m)	990
C	Amount of Solid Dredged Material to be Treated (m3)	0
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	0
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	12
B	Length of Sheet Piles (m)	8600
C	Cutting Off Sheet Piles (m)	8600
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	0
B	Hydromulching (m2)	0
C	Depth of Material to Cover Disposal Pond (m)	0
D	Covering Disposal Pond (m3)	0
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	0
H	Cane Land (hectares)	0
I	Indigenous Land Use Agreement (hectares)	0
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	0
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 6 - Bessie Point

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Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	860,000	1	$3,000,000
	Item	**Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs**	**Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs**	**Total Amount**		
B	Project Management, Design Procurement and Supervision	10.00%	$43,203,250.00	$4,320,325.00		

Total Preliminaries Cost	**$7,320,325**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	860,000	1	$3,600,000.00
	Item	**Amount of Solid Material to be Pumped (m3)**	**Rate**	**Total Amount**		
B	Dredging and Pumping Costs	860,000	18.15	$15,609,000.00		
	Item	**Total Amount of Solid Dredged Material (m3)**	**Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material**	**Capacity of Site (m3)**	**Percent Capacity of Site (m3)**	**Total Amount**
C	Demobilisation	860,000	650,000	860,000	1	$650,000.00

Total Dredging Costs	**$19,859,000.00**

Option 6 - Bessie Point

Cost Item Schedule

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3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	1	0	$0.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	0	20,000	0.00
	(i) Land that is zoned for Agricultural	0	100,000	0.00
	(iii) ILUA's	0	1,000,000	0.00
			TOTAL	$0.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	0	40	0.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	150,000.00
D	Earthworks for Disposal Pond	0	20	0.00
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	8600	2000	17,200,000.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	0	14	0.00
	(ii) Hydromulching	0	2.5	0.00
	(iii) Respreading of Perimeter Bund	0	14	0.00
			TOTAL	0.00
I	Cutting of Sheet Piles at Conclusion of Project	8600	173.75	1,494,250.00
	Total Containment Costs	**$18,844,250.00**		

Option 6 - Bessie Point

Cost Item Schedule

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4. Water Management Costs

	Item	Quantity	Rate	Total Amount			
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	0	14	$0.00			
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00			
	Item	**Total Amount of Solid Dredged Material**	**Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material**	**Number of Weeks of Pumping**	**Capacity of Site**	**Percent Capacity of Site**	**Total Amount**
C	Tailwater Control	860,000	300,000	13	860,000	1	$3,900,000.00
	Item	**Quantity**	**Rate**	**Total Amount**			
D	Weir Boxes	12	50,000	$600,000.00			

Total Water Management Costs	**$4,500,000.00**

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	0	28	$0.00

Total Treatment Costs	**$0.00**

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	0	810,000	$0.00
B	Security	0	810,000	$0.00
C	Management	0	810,000	$0.00

Total Operational Costs	**$0.00**

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency Amount	$50,523,575.00	15%	7578536.25

Option 7 - Trinity Inlet
Quantity Schedule

1	**Site Name:**	Trinity Inlet
2	**Tenure:**	Water (Ocean)
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	447,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	52%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	983400

1	**Disposal Pond**	**Quantity**
A	Area of Disposal Pond Area (m2)	55000
B	Amount of Discharged Material on Pond (m3)	983400
C	Height of Material on Site (m)	17.88
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	18.38
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	76.52
F	Cross Sectional Area (m2)	730.7888
G	Length of Perimeter Bunds (m)	0
H	Volume of Perimeter Bunds (m3)	0
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	45000
B	Length of Tailwater Treatment Area (m)	300
C	Width of Tailwater Treatment Area (m)	150
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	290
I	Number of Bunds	14
J	Volume of Internal Bunds (m3)	8120
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	900
G	Volume of Perimeter Bunds (m3)	8100

Option 7 - Trinity Inlet
Quantity Schedule

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6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	0
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	0
B	Perimeter (m)	990
C	Amount of Solid Dredged Material to be Treated (m3)	0
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	0
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	10
B	Length of Sheet Piles (m)	3500
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	0
B	Hydromulching (m2)	0
C	Depth of Material to Cover Disposal Pond (m)	0
D	Covering Disposal Pond (m3)	0
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	0
H	Cane Land (hectares)	0
I	Indigenous Land Use Agreement (hectares)	0
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	0
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 7 - Trinity Inlet

FLANAGAN CONSULTING GROUP
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Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	447,000	0.519767442	$1,559,302

	Item	Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs	Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs	Total Amount
B	Project Management, Design Procurement and Supervision	10.00%	$28,749,154.65	$2,874,915.47

Total Preliminaries Cost	$4,434,218

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	447,000	0.519767442	$1,871,162.79

	Item	Amount of Solid Material to be Pumped (m3)	Rate	Total Amount
B	Dredging and Pumping Costs	447,000	18.15	$8,113,050.00

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
C	Demobilisation	860,000	650,000	447,000	0.519767442	$337,848.84

Total Dredging Costs	$10,322,061.63

Option 7 - Trinity Inlet

Cost Item Schedule

3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	1	0	$0.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	0	20,000	0.00
	(i) Land that is zoned for Agricultural	0	100,000	0.00
	(iii) ILUA's	0	1,000,000	0.00
			TOTAL	$0.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	0	40	0.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	150,000.00
D	Earthworks for Disposal Pond	0	20	0.00
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	3500	4500	15,750,000.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	0	14	0.00
	(ii) Hydromulching	0	2.5	0.00
	(iii) Respreading of Perimeter Bund	0	14	0.00
			TOTAL	0.00
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$15,900,000.00**		

Option 7 - Trinity Inlet

Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	0	14	$0.00
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00

	Item	Total Amount of Solid Dredged Material	Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material	Number of Weeks of Pumping	Capacity of Site	Percent Capacity of Site	Total Amount
C	Tailwater Control	860,000	300,000	13	447,000	0.519767442	$2,027,093.02

	Item	Quantity	Rate	Total Amount
D	Weir Boxes	10	50,000	$500,000.00

Total Water Management Costs	$2,527,093.02

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	0	28	$0.00

Total Treatment Costs	$0.00

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	0	810,000	$0.00
B	Security	0	810,000	$0.00
C	Management	0	810,000	$0.00

Total Operational Costs	$0.00

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency Amount	$33,183,372.44	15%	4977505.866

Option 8 - Tingira Street
Quantity Schedule

FLANAGAN CONSULTING GROUP
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1	**Site Name:**	Tingira Street
2	**Tenure:**	State Land
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	430,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	50%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	946000

1	**Disposal Pond**	**Quantity**
A	Area of Disposal Pond Area (m2)	330000
B	Amount of Discharged Material on Pond (m3)	946000
C	Height of Material on Site (m)	2.9
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	3.4
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	16.5
F	Cross Sectional Area (m2)	32.8
G	Length of Perimeter Bunds (m)	2200
H	Volume of Perimeter Bunds (m3)	72092
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	110000
B	Length of Tailwater Treatment Area (m)	550
C	Width of Tailwater Treatment Area (m)	200
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	540
I	Number of Bunds	19
J	Volume of Internal Bunds (m3)	20520
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	1500
G	Volume of Perimeter Bunds (m3)	13500

Option 8 - Tingira Street
Quantity Schedule

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6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.31
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	34020
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	139000
B	Perimeter (m)	1700
C	Amount of Solid Dredged Material to be Treated (m3)	430,000
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	430000
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	34020
B	Hydromulching (m2)	579000
C	Depth of Material to Cover Disposal Pond (m)	0.5
D	Covering Disposal Pond (m3)	72092
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	57.9
H	Cane Land (hectares)	0
I	Indigenous Land Use Agreement	1
11		**Quantity**
A	Perimeter Fencing (m)	3180
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 8 - Tingira Street
Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	430,000	0.5	$1,500,000

	Item	Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs	Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs	Total Amount
B	Project Management, Design Procurement and Supervision	10.00%	$56,539,824.00	$5,653,982.40

Total Preliminaries Cost	$7,153,982

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	430,000	0.5	$1,800,000.00

	Item	Amount of Solid Material to be Pumped (m3)	Rate	Total Amount
B	Dredging and Pumping Costs	430,000	$ 21.57	$9,275,100.00

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
C	Demobilisation	860,000	650,000	430,000	0.5	$325,000.00

Total Dredging Costs	$11,400,100.00

Option 8 - Tingira Street
Cost Item Schedule

FLANAGAN CONSULTING GROUP
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3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	1	0	$0.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	0	20,000	0.00
	(i) Land that is not cane land	57.9	100,000	5,790,000.00
	(iii) ILUA's	1	1,000,000	1,000,000.00
			TOTAL	$6,790,000.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	3180	40	127,200.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	277,200.00
D	Earthworks for Disposal Pond	72091.55556	20	1,441,831.11
E	Geosynthetic Liner	579000	25	14,475,000.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	72091.55556	40	2,883,662.22
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	34020	14	476,280.00
	(ii) Hydromulching	579000	2.5	1,447,500.00
	(iii) Respreading of Perimeter Bund	72091.55556	14	1,009,281.78
			TOTAL	2,933,061.78
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$27,358,924.00**		

Option 8 - Tingira Street
Cost Item Schedule

FLANAGAN CONSULTING GROUP
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4. Water Management Costs

	Item	Quantity	Rate	Total Amount			
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	0	14	$0.00			
B	Import of Fill to Form Tailwater Treatment Area Bunds	34020	40	$1,360,800.00			
	Item	Total Amount of Solid Dredged Material	Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material	Number of Weeks of Pumping	Capacity of Site	Percent Capacity of Site	Total Amount
C	Tailwater Control	860,000	300,000	13	430,000	0.5	$1,950,000.00
	Item	Quantity	Rate	Total Amount			
D	Weir Boxes	0	50,000	$0.00			

Total Water Management Costs	**$3,310,800.00**

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	430000	28	$12,040,000.00

Total Treatment Costs	**$12,040,000.00**

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	1	810,000	$810,000.00
B	Security	1	810,000	$810,000.00
C	Management	1	810,000	$810,000.00

Total Operational Costs	**$2,430,000.00**

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency	$63,693,806	15%	9554070.96

Option 9 - Admirality Island

Quantity Schedule

1	**Site Name:**	Admirality Island
2	**Tenure:**	Freehold (Privately Owned)
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	860,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	100%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	1892000

1	**Disposal Pond**	**Quantity**
A	Area of Disposal Pond Area (m2)	662000
B	Amount of Discharged Material on Pond (m3)	1892000
C	Height of Material on Site (m)	2.858006042
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	3.358006042
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	16.43202417
F	Cross Sectional Area (m2)	32.62642729
G	Length of Perimeter Bunds (m)	2920
H	Volume of Perimeter Bunds (m3)	95269.16768
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	218000
B	Length of Tailwater Treatment Area (m)	830
C	Width of Tailwater Treatment Area (m)	260
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	820
I	Number of Bunds	25
J	Volume of Internal Bunds (m3)	41000
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	2180
G	Volume of Perimeter Bunds (m3)	19620

Option 9 - Admirality Island

Quantity Schedule

6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.3
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	65400
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	137000
B	Perimeter (m)	1580
C	Amount of Solid Dredged Material to be Treated (m3)	860,000
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	860000
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	65400
B	Hydromulching (m2)	1017000
C	Depth of Material to Cover Disposal Pond (m)	0.5
D	Covering Disposal Pond (m3)	95269.16768
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	88.00003
H	Cane Land (hectares)	0
I	Indigenous Land Use Agreement (hectares)	1
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	3790
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 9 - Admirality Island

Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	860,000	1	$3,000,000

	Item	Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs	Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs	Total Amount
B	Project Management, Design Procurement and Supervision	10.00%	$70,342,454.70	$7,034,245.47

Total Preliminaries Cost	**$10,034,245**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	860,000	1	$3,600,000.00

	Item	Amount of Solid Material to be Pumped (m3)	Rate	Total Amount
B	Dredging and Pumping Costs	860,000	20.8	$17,888,000.00

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
C	Demobilisation	860,000	650,000	860,000	1	$650,000.00

Total Dredging Costs	**$22,138,000.00**

Option 9 - Admirality Island

Cost Item Schedule

3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	1	0	$0.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	0	20,000	0.00
	(i) Land that is not cane land	88.00003	100,000	8,800,003.00
	(iii) ILUA's	1	1,000,000	1,000,000.00
			TOTAL	$9,800,003.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	3790	40	151,600.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	100000	100,000.00
			TOTAL	381,600.00
D	Earthworks for Disposal Pond	95269.16768	20	1,905,383.35
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	65400	14	915,600.00
	(ii) Hydromulching	1017000	2.5	2,542,500.00
	(iii) Respreading of Perimeter Bund	95269.16768	14	1,333,768.35
			TOTAL	4,791,868.35
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$16,878,854.70**		

Option 9 - Admirality Island

Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount			
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area	65400	14	$915,600.00			
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00			
	Item	Total Amount of Solid Dredged Material	Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material	Number of Weeks of Pumping	Capacity of Site	Percent Capacity of Site	Total Amount
C	Tailwater Control	860,000	300,000	13	860,000	1	$3,900,000.00
	Item	Quantity	Rate	Total Amount			
D	Weir Boxes	0	50,000	$0.00			

Total Water Management Costs	$4,815,600.00

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	860000	28	$24,080,000.00

Total Treatment Costs	$24,080,000.00

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	1	810,000	$810,000.00
B	Security	1	810,000	$810,000.00
C	Management	1	810,000	$810,000.00

Total Operational Costs	$2,430,000.00

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency	$80,376,700	15%	12056505.03

Option 10 - East Trinity Option 1
Quantity Schedule

1	**Site Name:**	East Trinity Option 1
2	**Tenure:**	Reserve
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	860,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	100%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	1892000

1	**Disposal Pond**	**Quantity**
A	Area of Disposal Pond Area (m2)	655000
B	Amount of Discharged Material on Pond (m3)	1892000
C	Height of Material on Site (m)	2.888549618
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	3.388549618
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	16.55419847
F	Cross Sectional Area (m2)	33.13018589
G	Length of Perimeter Bunds (m)	3250
H	Volume of Perimeter Bunds (m3)	107673.1041
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	201000
B	Length of Tailwater Treatment Area (m)	650
C	Width of Tailwater Treatment Area (m)	310
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	640
I	Number of Bunds	30
J	Volume of Internal Bunds (m3)	38400
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	1920
G	Volume of Perimeter Bunds (m3)	17280

Option 10 - East Trinity Option 1
Quantity Schedule

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6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.3
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	60300
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	137000
B	Perimeter (m)	1780
C	Amount of Solid Dredged Material to be Treated (m3)	860,000
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	860000
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	60300
B	Hydromulching (m2)	993000
C	Depth of Material to Cover Disposal Pond (m)	0.5
D	Covering Disposal Pond (m3)	107673.1041
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	99.3
H	Cane Land (hectares)	0
I	Indigenous Land Use Agreement (hectares)	1
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	3950
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 10 - East Trinity Option 1

Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	860,000	1	$3,000,000
	Item	**Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs**	**Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs**	**Total Amount**		
B	Project Management, Design Procurement and Supervision	10.00%	$71,917,785.54	$7,191,778.55		

Total Preliminaries Cost	**$10,191,779**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	860,000	1	$3,600,000.00
	Item	**Amount of Solid Material to be Pumped (m3)**	**Rate**	**Total Amount**		
B	Dredging and Pumping Costs	860,000	20.8	$17,888,000.00		
	Item	**Total Amount of Solid Dredged Material (m3)**	**Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material**	**Capacity of Site (m3)**	**Percent Capacity of Site (m3)**	**Total Amount**
C	Demobilisation	860,000	650,000	860,000	1	$650,000.00

Total Dredging Costs	**$22,138,000.00**

Option 10 - East Trinity Option 1

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Cost Item Schedule

3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	0	20,000	$0.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	0	20,000	0.00
	(i) Land that is not cane land	99.3	100,000	9,930,000.00
	(iii) ILUA's	1	1,000,000	1,000,000.00
			TOTAL	$10,930,000.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	3950	40	158,000.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	308,000.00
D	Earthworks for Disposal Pond	107673.1041	20	2,153,462.08
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	60300	14	844,200.00
	(ii) Hydromulching	993000	2.5	2,482,500.00
	(iii) Respreading of Perimeter Bund	107673.1041	14	1,507,423.46
			TOTAL	4,834,123.46
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$18,225,585.54**		

Option 10 - East Trinity Option 1

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Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount			
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	60300	14	$844,200.00			
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00			
	Item	**Total Amount of Solid Dredged Material**	**Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material**	**Number of Weeks of Pumping**	**Capacity of Site**	**Percent Capacity of Site**	**Total Amount**
C	Tailwater Control	860,000	300,000	14	860,000	1	$4,200,000.00
	Item	**Quantity**	**Rate**	**Total Amount**			
D	Weir Boxes	0	50,000	$0.00			

Total Water Management Costs	**$5,044,200.00**

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	860000	28	$24,080,000.00

Total Treatment Costs	**$24,080,000.00**

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	1	810,000	$810,000.00
B	Security	1	810,000	$810,000.00
C	Management	1	810,000	$810,000.00

Total Operational Costs	**$2,430,000.00**

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency	$82,109,564	15%	12316434.61

Option 11 - East Trinity Option 2

Quantity Schedule

1	**Site Name:**	East Trinity Option 2
2	**Tenure:**	Reserve
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	860,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	100%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	1892000

1	Disposal Pond	Quantity
A	Area of Disposal Pond Area (m2)	668000
B	Amount of Discharged Material on Pond (m3)	1892000
C	Height of Material on Site (m)	2.832335329
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	3.332335329
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	16.32934132
F	Cross Sectional Area (m2)	32.20592348
G	Length of Perimeter Bunds (m)	3250
H	Volume of Perimeter Bunds (m3)	104669.2513
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	173000
B	Length of Tailwater Treatment Area (m)	550
C	Width of Tailwater Treatment Area (m)	315
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	540
I	Number of Bunds	30.5
J	Volume of Internal Bunds (m3)	32940
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	1730
G	Volume of Perimeter Bunds (m3)	15570

Option 11 - East Trinity Option 2

Quantity Schedule

6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.3
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	51900
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	190000
B	Perimeter (m)	1700
C	Amount of Solid Dredged Material to be Treated (m3)	860,000
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	860000
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	51900
B	Hydromulching (m2)	1031000
C	Depth of Material to Cover Disposal Pond (m)	0.5
D	Covering Disposal Pond (m3)	104669.2513
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	103.1
H	Cane Land (hectares)	0
I	Indigenous Land Use Agreement (hectares)	1
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	2530
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 11 - East Trinity Option 2

Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	860,000	1	$3,000,000
	Item	**Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs**	**Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs**	**Total Amount**		
B	Project Management, Design Procurement and Supervision	10.00%	$72,034,054.54	$7,203,405.45		

Total Preliminaries Cost	**$10,203,405**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	860,000	1	$3,600,000.00
	Item	**Amount of Solid Material to be Pumped (m3)**	**Rate**	**Total Amount**		
B	Dredging and Pumping Costs	860,000	21.19	$18,223,400.00		
	Item	**Total Amount of Solid Dredged Material (m3)**	**Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material**	**Capacity of Site (m3)**	**Percent Capacity of Site (m3)**	**Total Amount**
C	Demobilisation	860,000	650,000	860,000	1	$650,000.00

Total Dredging Costs	**$22,473,400.00**

Option 11 - East Trinity Option 2

Cost Item Schedule

3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	0	20,000	$0.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	0	20,000	0.00
	(i) Land that is zoned for Agricultural	103.1	100,000	10,310,000.00
	(iii) ILUA's	1	1,000,000	1,000,000.00
			TOTAL	$11,310,000.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	2530	40	101,200.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	251,200.00
D	Earthworks for Disposal Pond	104669.2513	20	2,093,385.03
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	51900	14	726,600.00
	(ii) Hydromulching	1031000	2.5	2,577,500.00
	(iii) Respreading of Perimeter Bund	104669.2513	14	1,465,369.52
			TOTAL	4,769,469.52
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$18,424,054.54**		

Option 11 - East Trinity Option 2

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Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount			
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	51900	14	$726,600.00			
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00			
	Item	Total Amount of Solid Dredged Material	Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material	Number of Weeks of Pumping	Capacity of Site	Percent Capacity of Site	Total Amount
C	Tailwater Control	860,000	300,000	13	860,000	1	$3,900,000.00
	Item	Quantity	Rate	Total Amount			
D	Weir Boxes	0	50,000	$0.00			

Total Water Management Costs	$4,626,600.00

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	860000	28	$24,080,000.00

Total Treatment Costs	$24,080,000.00

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	1	810,000	$810,000.00
B	Security	1	810,000	$810,000.00
C	Management	1	810,000	$810,000.00

Total Operational Costs	$2,430,000.00

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency	$82,237,460	15%	12335619

Option 12 - East Trinity Option 3

Quantity Schedule

1	**Site Name:**	East Trinity Option 3
2	**Tenure:**	Freehold and Reserve
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	860,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	100%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	1892000

1	Disposal Pond	Quantity
A	Area of Disposal Pond Area (m2)	659000
B	Amount of Discharged Material on Pond (m3)	1892000
C	Height of Material on Site (m)	2.871016692
2	**Perimeter Bunds of Disposal Pond**	**Quantity**
A	Freeboard (m)	0.5
B	Height of Bund (m)	3.371016692
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	16.48406677
F	Cross Sectional Area (m2)	32.84055715
G	Length of Perimeter Bunds (m)	3610
H	Volume of Perimeter Bunds (m3)	118554.4113
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	270000
B	Length of Tailwater Treatment Area (m)	770
C	Width of Tailwater Treatment Area (m)	350
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	760
I	Number of Bunds	34
J	Volume of Internal Bunds (m3)	51680
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	2240
G	Volume of Perimeter Bunds (m3)	20160

Option 12 - East Trinity Option 3

Quantity Schedule

6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.3
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	81000
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	135000
B	Perimeter (m)	1625
C	Amount of Solid Dredged Material to be Treated (m3)	860,000
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	860000
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	81000
B	Hydromulching (m2)	1064000
C	Depth of Material to Cover Disposal Pond (m)	0.5
D	Covering Disposal Pond (m3)	118554.4113
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	36.9
H	Cane Land (hectares)	69.5
I	Indigenous Land Use Agreement (hectares)	1
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	4570
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 12 - East Trinity Option 3

Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	860,000	1	$3,000,000

	Item	Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs	Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs	Total Amount
B	Project Management, Design Procurement and Supervision	10.00%	$72,370,249.98	$7,237,025.00

Total Preliminaries Cost	$10,237,025

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	860,000	1	$3,600,000.00

	Item	Amount of Solid Material to be Pumped (m3)	Rate	Total Amount
B	Dredging and Pumping Costs	860,000	24.01	$20,648,600.00

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
C	Demobilisation	860,000	650,000	860,000	1	$650,000.00

Total Dredging Costs	$24,898,600.00

Option 12 - East Trinity Option 3

Cost Item Schedule

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3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	69.5	20,000	$1,390,000.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	69.5	20,000	1,390,000.00
	(i) Land that is zoned for Agricultural	36.9	100,000	3,690,000.00
	(iii) ILUA's	1	1,000,000	1,000,000.00
			TOTAL	$6,080,000.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	4570	40	182,800.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	332,800.00
D	Earthworks for Disposal Pond	118554.4113	20	2,371,088.23
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	81000	14	1,134,000.00
	(ii) Hydromulching	1064000	2.5	2,660,000.00
	(iii) Respreading of Perimeter Bund	118554.4113	14	1,659,761.76
			TOTAL	5,453,761.76
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$15,627,649.98**		

Option 12 - East Trinity Option 3

Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount			
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	81000	14	$1,134,000.00			
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00			
	Item	Total Amount of Solid Dredged Material	Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material	Number of Weeks of Pumping	Capacity of Site	Percent Capacity of Site	Total Amount
C	Tailwater Control	860,000	300,000	14	860,000	1	$4,200,000.00
	Item	Quantity	Rate	Total Amount			
D	Weir Boxes	0	50,000	$0.00			

Total Water Management Costs	$5,334,000.00

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	860000	28	$24,080,000.00

Total Treatment Costs	$24,080,000.00

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	1	810,000	$810,000.00
B	Security	1	810,000	$810,000.00
C	Management	1	810,000	$810,000.00

Total Operational Costs	$2,430,000.00

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency	$82,607,275	15%	12391091.25

Option 13 - Cane Farm

Quantity Schedule

1	**Site Name:**	Cane Farm
2	**Tenure:**	Freehold
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	860,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	100%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	1892000

1	**Disposal Pond**	**Quantity**
A	Area of Disposal Pond Area (m2)	643000
B	Amount of Discharged Material on Pond (m3)	1892000
C	Height of Material on Site (m)	2.942457232
2	**Perimeter Bunds of Disposal Pond**	
A	Freeboard (m)	0.5
B	Height of Bund (m)	3.442457232
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	16.76982893
F	Cross Sectional Area (m2)	34.02839528
G	Length of Perimeter Bunds (m)	3210
H	Volume of Perimeter Bunds (m3)	109231.1488
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	148000
B	Length of Tailwater Treatment Area (m)	500
C	Width of Tailwater Treatment Area (m)	296
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	490
I	Number of Bunds	28.6
J	Volume of Internal Bunds (m3)	28028
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	1592
G	Volume of Perimeter Bunds (m3)	14328

Option 13 - Cane Farm

Quantity Schedule

6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.3
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	44400
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	172000
B	Perimeter (m)	1730
C	Amount of Solid Dredged Material to be Treated (m3)	860,000
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	860000
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	44400
B	Hydromulching (m2)	963000
C	Depth of Material to Cover Disposal Pond (m)	0.5
D	Covering Disposal Pond (m3)	109231.1488
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	0
H	Cane Land (hectares)	96.3
I	Indigenous Land Use Agreement (hectares)	0
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	4200
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 13 - Cane Farm

Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	860,000	1	$3,000,000

	Item	Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs	Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs	Total Amount
B	Project Management, Design Procurement and Supervision	10.00%	$71,063,759.06	$7,106,375.91

Total Preliminaries Cost	**$10,106,376**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	nt Capacity of Sit	Total Amount
A	Establishment	860,000	3,600,000	860,000	1	$3,600,000.00

	Item	Amount of Solid Material to be Pumped (m3)	Rate	Total Amount
B	Dredging and Pumping Costs	860,000	28.22	$24,269,200.00

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
C	Demobilisation	860,000	650,000	860,000	1	$650,000.00

Total Dredging Costs	**$28,519,200.00**

Option 13 - Cane Farm

FLANAGAN CONSULTING GROUP
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Cost Item Schedule

3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	96.3	20,000	$1,926,000.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	96.3	20,000	1,926,000.00
	(i) Land that is zoned for Agricultural	0	100,000	0.00
	(iii) ILUA's	0	1,000,000	0.00
			TOTAL	$1,926,000.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	4200	40	168,000.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	318,000.00
D	Earthworks for Disposal Pond	109231.1488	20	2,184,622.98
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	44400	14	621,600.00
	(ii) Hydromulching	963000	2.5	2,407,500.00
	(iii) Respreading of Perimeter Bund	109231.1488	14	1,529,236.08
			TOTAL	4,558,336.08
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$10,912,959.06**		

Option 13 - Cane Farm

Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	44400	14	$621,600.00
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00

	Item	Total Amount of Solid Dredged Material	Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material	Number of Weeks of Pumping	Capacity of Site	Percent Capacity of Site	Total Amount
C	Tailwater Control	860,000	300,000	15	860,000	1	$4,500,000.00

	Item	Quantity	Rate	Total Amount
D	Weir Boxes	0	50,000	$0.00

Total Water Management Costs	**$5,121,600.00**

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	860000	28	$24,080,000.00

Total Treatment Costs	**$24,080,000.00**

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	1	810,000	$810,000.00
B	Security	1	810,000	$810,000.00
C	Management	1	810,000	$810,000.00

Total Operational Costs	**$2,430,000.00**

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency	$81,170,135	15%	12175520.25

Option 14 - Yarrabah
Quantity Schedule

1	**Site Name:**	Yarrabah
2	**Tenure:**	Aboriginal Freehold
3	**Location:**	-
4	**Capacity of Site to Process Solid Dredged Material (m3)**	860,000
5	**Required Capacity to Process Solid Dredged Material (m3)**	860,000
6	**Percent Capacity of Site (%)**	100%
7	**Bulking Factor to Placement Volume**	2.2
8	**Bulk Volume (m3)**	1892000

1	Disposal Pond	Quantity
A	Area of Disposal Pond Area (m2)	676000
B	Amount of Discharged Material on Pond (m3)	1892000
C	Height of Material on Site (m)	2.798816568
2	**Perimeter Bunds of Disposal Pond**	**Quantity**
A	Freeboard (m)	0.5
B	Height of Bund (m)	3.298816568
C	Batter (1 in _)	2
D	Length of Top (m)	3
E	Length of Bottom (m)	16.19526627
F	Cross Sectional Area (m2)	31.6608312
G	Length of Perimeter Bunds (m)	3300
H	Volume of Perimeter Bunds (m3)	104480.743
3	**Tailwater Treatment Area**	**Quantity**
A	Area of Tailwater Treatment Area (m2)	293000
B	Length of Tailwater Treatment Area (m)	651
C	Width of Tailwater Treatment Area (m)	450
4	**Internal Bunds in Tailwater Treatment Area**	**Quantity**
A	Spacing of Bunds in Tailwater Treatment Area (m)	10
B	Orientation of Bunds	Parallel to Length of Tailwater Treatment Facility
C	Height of Bund (m)	1
D	Batter (1 in _)	1
E	Length of Top (m)	1
F	Length of Bottom (m)	3
G	Cross Sectional Area (m2)	2
H	Length of Single Bund Parallel to Length of Tailwater Treatment Area (m)	641
I	Number of Bunds	44
J	Volume of Internal Bunds (m3)	56408
5	**Perimeter Bunds in Tailwater Treatment Area**	**Quantity**
A	Height of Bund (m)	1.5
B	Batter (1 in _)	2
C	Length of Top (m)	3
D	Length of Bottom (m)	9
E	Cross Sectional Area (m2)	9
F	Length of Bunds (m)	2202
G	Volume of Perimeter Bunds (m3)	19818

Option 14 - Yarrabah
Quantity Schedule

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6	Summary Tailwater Treatment Facility	Quantity
A	Topsoil Stripping Depth	0.3
B	Volume to be Sripped and Respread to Form Internal and Perimeter Bunds (m3)	87900
7	**ASS/PASS Treatment Area**	**Quantity**
A	Area (m2)	250000
B	Perimeter (m)	2000
C	Amount of Solid Dredged Material to be Treated (m3)	860,000
D	Treatment Factor	1
E	Amount of Material to be Treated (including bulking factor) (m3)	860000
8	**Marine and Reclamation and Sites**	**Quantity**
A	Weir Boxes (n.o.)	0
B	Length of Sheet Piles (m)	0
C	Cutting Off Sheet Piles (m)	0
9	**Site Rehabilitation**	**Quantity**
A	Respreading of Topsoil (m3)	87900
B	Hydromulching (m2)	1219000
C	Depth of Material to Cover Disposal Pond (m)	0.5
D	Covering Disposal Pond (m3)	104480.743
10	**Biodiversity Areas of Site and Farming Land**	**Quantity**
A	Class A – Endangered (BD_Status – E) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
B	Class B – Of Concern (BD_Status – OC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
C	Class C – Not of Concern (BD_Status – NC) REs (but not Mangroves, Saltmarsh or GDE) (hectares)	0
D	Class D – Mangroves and Saltmarsh REs (but not GDE). (hectares)	0
E	Class E – Seagrass (hectares)	0
F	Class F – GDE (provided by BOM) (hectares)	0
G	Land that is not Cane land (hectares)	121.9
H	Cane Land (hectares)	0
I	Indigenous Land Use Agreement (hectares)	1
11	**Site Establishment**	**Quantity**
A	Perimeter Fencing (m)	4900
B	Storage Sheds for Housing (n.o.)	5
C	Site Offices (n.o.)	2
D	Access Points (Item)	1

Option 14 - Yarrabah

Cost Item Schedule

1. Preliminaries

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Planning and Approvals for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Planning and Approvals	860,000	$3,000,000	860,000	1	$3,000,000

	Item	Percentage of Dredging, Containment, Water Management, Treatment and Operational Costs	Total Cost of Dredging Costs, Containment, Water Management, Treatment and Operational Costs	Total Amount
B	Project Management, Design Procurement and Supervision	10.00%	$85,782,245.26	$8,578,224.53

Total Preliminaries Cost	**$11,578,225**

2. Dredging Costs

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Establishment for Processing 860,000 m3 of Solid Dredged Material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
A	Establishment	860,000	3,600,000	860,000	1	$3,600,000.00

	Item	Amount of Solid Material to be Pumped (m3)	Rate	Total Amount
B	Dredging and Pumping Costs	860,000	27.82	$23,925,200.00

	Item	Total Amount of Solid Dredged Material (m3)	Cost of Demobilising a Site that is Capable of Processing 860,000 m3 of material	Capacity of Site (m3)	Percent Capacity of Site (m3)	Total Amount
C	Demobilisation	860,000	650,000	860,000	1	$650,000.00

Total Dredging Costs	**$28,175,200.00**

Option 14 - Yarrabah

Cost Item Schedule

3. Containment Costs

	Item	Quantity	Rate	Total Amount
A	Site Acquisition	1	4,000,000	$4,000,000.00
B	Environmental Offsets and ILUAS			
	(i) Cane Land (hectares)	0	20,000	0.00
	(i) Land that is zoned for Agricultural	121.9	100,000	12,190,000.00
	(iii) ILUA's	1	1,000,000	1,000,000.00
			TOTAL	$13,190,000.00
C	Site Establishment			
	(i) Perimeter Fencing (m)	4900	40	196,000.00
	(ii) Storage Sheds for Housing Equipment (n.o.)	5	20000	100,000.00
	(iii) Site Offices (n.o)	2	15000	30,000.00
	(iv) Access Point (lump sum)	1	20000	20,000.00
			TOTAL	346,000.00
D	Earthworks for Disposal Pond	104480.743	20	2,089,614.86
E	Geosynthetic Liner	0	25	0.00
F	Import of Fill to Form Perimeter Bunds of Disposal Pond	0	40	0.00
G	Supply and Installation of Sheet Piling	0	2000	0.00
H	Site Rehabilitation			
	(i) Respreading of Topsoil for Tailwater Treatment Facility	87900	14	1,230,600.00
	(ii) Hydromulching	1219000	2.5	3,047,500.00
	(iii) Respreading of Perimeter Bund	104480.743	14	1,462,730.40
			TOTAL	5,740,830.40
I	Cutting of Sheet Piles at Conclusion of Project	0	173.75	0.00
	Total Containment Costs	**$25,366,445.26**		

Option 14 - Yarrabah

Cost Item Schedule

4. Water Management Costs

	Item	Quantity	Rate	Total Amount			
A	Topsoil stripping and respreading to form bunds of Tailwater Treatment Area Bunds	87900	14	$1,230,600.00			
B	Import of Fill to Form Tailwater Treatment Area Bunds	0	40	$0.00			
	Item	**Total Amount of Solid Dredged Material**	**Pumping Rate per Week for a Facility Capable of Processing 860,000 m3 of solid dredged material**	**Number of Weeks of Pumping**	**Capacity of Site**	**Percent Capacity of Site**	**Total Amount**
C	Tailwater Control	860,000	300,000	15	860,000	1	$4,500,000.00
	Item	**Quantity**	**Rate**	**Total Amount**			
D	Weir Boxes	0	50,000	$0.00			

Total Water Management Costs	**$5,730,600.00**

5. Treatment Costs

	Item	Quantity	Rate	Total Amount
A	ASS/PASS Neutralisation and Land Farming	860000	28	$24,080,000.00

Total Treatment Costs	**$24,080,000.00**

6. Operational Costs

	Item	Quantity	Rate	Total Amount
A	Monitoring	1	810,000	$810,000.00
B	Security	1	810,000	$810,000.00
C	Management	1	810,000	$810,000.00

Total Operational Costs	**$2,430,000.00**

7. Contingency Costs

	Item	Total Amount	Rate	Amount
A	Contingency	$97,360,470	15%	14604070.47