A3

BACKGROUND TO THE PROJECT

OPTIONS AND ALTERNATIVES

CONTENTS

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3.1 INTRODUCTION

This chapter of the Draft Environmental Impact Statement (EIS) covers the following two key areas where options and alternatives have been considered during the development of the Sunshine Coast Airport (SCA) Expansion Project (the Project) proposal:

1) Airport and runway options

2) Fill source options.

3.1.1 Airport and runway options

3.1.1.1 Design standards

The International Standards and recommended practices for runway design are formalised in Annex 14 of the Convention on International Civil Aviation, adopted by the International Civil Aviation Organisation (ICAO). The national aviation standards and advisory publications are administered in Australia by the Civil Aviation Safety Authority (CASA) under the *Civil Aviation Act 1988, the Civil Aviation Regulations 1988* (CAR 1988) and the *Civil Aviation Safety Regulations 1998* (CASR 1998).

Many parts of the CASR 1998 are supported by a Manual of Standards (MOS), which contains detailed technical material, such as technical specifications or standards. The relevant parts of MOS are:

- MOS Part 139-Aerodromes (MOS 139) – The requirements for aerodromes used in air transport operations are prescribed in the CASA policy manual
- MOS Part 172-Air Traffic Services (MOS 172) – The requirements and standards for compliance by an air traffic service (ATS) provider, including the facilities and equipment required.

The planning and design standards for the geometry of the new runway are generally the requirements and recommendations set out in ICAO Annex 14 and MOS Part 139.

Advisory Circulars (ACs) are published by CASA, and are intended to provide recommendations and guidance to illustrate a means of complying with the Regulations.

3.1.1.2 Current runway exemption

Sub-regulation CAR235A of CAR 1988 requires a minimum runway width of 45 m to operate Code 4C aircraft (including Boeing 737-800 and A320). SCA currently operates under an exemption for the existing RWY 18/36, which is a 30 m wide Code 3C runway, under CASA Instrument EX34/12 to operate Code 4C aircraft. The Instrument was issued in March 2012 and is current until February 2015.

The conditions attached to the exemption are:

1. The runway must not be less than 30 m wide
2. The movement area, in particular markings, markers, signals and lighting, must be maintained to the standard required under MOS 139
3. The aerodrome operator must provide specialised maintenance activities (rubber removal and friction testing)
4. The operator must ensure that the obstacle limitation surfaces (OLS) are regularly monitored to a 300 m inner edge as required for Code 4 operations (MOS 139, paragraph 7.1.4.).

There is a risk that the exemption may not be renewed into the future. However, it is anticipated that, given progress on the Project, a further extension would be granted to SCA.

3.1.2 Master planning options

3.1.2.1 Introduction

The current SCA Master Plan was adopted by Sunshine Coast Council (SCC) in 2007. The preparation of the Master Plan between 2005 and 2007 involved consideration of a range of options to best meet the infrastructure needs of the airport and Council's social, economic and environmental objectives.

The minimum requirements for a runway development include:

- Relatively flat topography at the site
- Relatively flat topography surrounding the site to enable safe landing and take-off.

Desirable criteria for a new runway/airport include:

- Located to reduce noise impacts on residents and businesses
- Located to minimise the number of residential properties in Public Safety Areas
- Increase access to existing destinations and support the economy of the Sunshine Coast by opening up new markets in destinations that are unachievable from the current runway
- Cause minimal environmental impact during delivery and operation.

The topography of the Sunshine Coast region is the primary constraint to establishing a runway in a new location. The only available relatively flat topography in the region is within the floodplain of the Maroochy River. The surrounding mountain ranges present additional constraints to runway alignment, as they may interfere with approach and take off paths.

The master planning process included analysis of several options that can be categorised as follows:

- A 2450 m long x 45 m wide runway on a north-west to south-east alignment, co-located with the existing airport infrastructure and contained within land already identified by Council for airport purposes or land adjoining the land already identified for airport purposes

- Sites remote from the current SCA site. Potential sites were investigated for the development of a new airport to accommodate a 2450 m long x 45 m runway, new terminal complex, hangarage and supporting infrastructure
- The lengthening and widening of the current main runway at SCA (RWY 18/36) to achieve a 2450 m long x 45 m wide Code E runway.

3.1.2.2 Conclusion

In completing the Master Plan process in 2007, SCC determined that further development of RWY 18/36 would not achieve the stated objectives with respect to reducing noise impact, or addressing the number of existing dwellings within the existing Public Safety Areas. Further testing of this option also highlighted the high cost arising largely from the need to "tunnel" a realigned David Low Way under a southern extension of the runway.

The 'new site options' had significant disadvantages with respect to the cost of connections to, and the provision of, supporting infrastructure and additional concern was the dislocation of business activity allied to the airport and the inability to build upon the investment in existing airport assets.

It was concluded that the development of a new north-west to south-east Code E runway within the existing airport site presented the best opportunity to achieve SCC's social, environmental and economic objectives as they relate to the SCA. This option was included in the 2007 Master Plan and Subsequent Planning Schemes.

3.1.3 Options considered in the EIS

3.1.3.1 Do Nothing option

In accordance with current CASA advice (see **Section 3.1.1.1**), there is some risk that in 2015 the existing exemption for Code 4C aircraft could be withdrawn and these aircraft would no longer be able to operate from the airport. This scenario would considerably reduce the viability of the airport.

Eliminating Code 4C aircraft operations would restrict operations to Code 3C aircraft (such as Jetstream, Fokker 50 and 100, Embraer 120 and 170 and Bombardier Q-400[1]), which have limited capacity to service distant destinations or large passenger numbers. The largest of the Code 3C aircraft have up to 100 seats and a range of approximately 2,500 km to 3,000 km depending on engine types, payload, runway length and prevailing conditions.

Under this scenario, SCA would become an unattractive proposition for airlines as they would have to operate the smaller Code 3C, aircraft which are more expensive to operate on a per seat basis. Consequently, the airport would effectively become a smaller regional airport with no international markets and higher costs for travellers.

This option would present a considerable reduction in passenger numbers should CASA revoke the exemption, which would represent a considerable loss to the regional economy.

Should the exemption not be revoked, the airport would continue to operate with the current restrictions.

The Do Nothing option exposes SCA to the risk of having their current operational exemptions revoked at some time in the future, which would severely reduce the capacity and viability of the airport. This option was discounted on this basis.

Furthermore, the Do Nothing option is not consistent with the SCC's objectives support the region's economy through increased access to domestic and international destinations and be a stimulus to tourism and commercial activities.

3.1.3.2 Do Minimum option

In accordance with CASA's advice, CASA may renew SCA's exemption to operate Code 4C aircraft if there are definite plans to comply with MOS 139 requirements. Therefore, the Do Minimum option involves satisfying the minimum requirements to comply with MOS 139 to ensure that RWY 18/36 can operate as a Code 4C runway after 2022. The upgrades required to comply with MOS 139 are:

- Widen the runway from 30 m to 45 m
- Extend the runway strip 60 m beyond the ends of the runway
- Increase the Runway End Safety Area (RESA) at both ends to be 90 m wide and 90 m long measured from the end of the runway strip.

Although CASA generally requires a 300 m runway strip for Code 4C operations, where it is not practicable to provide the full runway strip width, a lesser strip width may be provided subject to landing minima adjustments.

In this Do Minimum case, a minor shift of the runway north approximately 30 m is required to accommodate the southern RESA within the property boundary. This shift would require an additional 30 m of runway pavement to be built at the northern end of the runway in addition to the pavement required to widen the runway to 45 m (see **Figure 3.1a**).

Whilst the graded runway strip can be widened to comply with MOS 139 the flyover area would be restricted to 150 m rather than the preferred 300 m. Consequently, the runway would be operated with landing minima restrictions.

The Do Minimum option would require capital expenditure estimated between $70 M and $80 M, generating a positive benefit cost ratio. However, this expenditure would just maintain access to the existing limited mainly east coast domestic markets, with no potential for expansion to new domestic or international markets not able to be serviced by this length of runway.

1 *The Bombardier Q-400 is a wide-bodied (Code 3D) aircraft; however, CASA allows it to be operated on Code 3C aerodromes with no restrictions.*

Figure 3.1a: Do Minimum option (widen RWY 18/36)

Seasonal international flights to Auckland have operated since 2012 with aircraft operating with weight restrictions because of the existing short runway length (1,797 m). There is a commitment from Air New Zealand to run these seasonal flights until at least 2016.

Whilst this option would remove economic risk that arises from the present CASA exemption, the Do Minimum option is not consistent with the SCC's objectives to support the region's economy through increased access to domestic and international destinations, and be a stimulus to tourism and commercial activities. This option was discounted on this basis.

3.1.3.3 New Runway 13/31 (original option)

This option was a refinement of the preferred option identified in the SCA Master Plan, 2007. The option involved construction of a runway on a 128/308 degrees alignment co-located with the existing airport. The new runway is proposed to be a 45 m wide and 2,450 m long Code 4E runway, capable of servicing aircraft such as the A330 and Boeing 787. The new runway would replace the existing RWY 12/30 and the existing RWY 18/36 would be retained for General Aviation use. It will be described as RWY 13/31.

The preliminary design of the proposed runway was prepared as part of the Master Plan Implementation Project (AECOM, 2010). This proposal was then described in the Initial Advice Statement (IAS) and *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act) referral, and has subsequently been taken into the EIS process. The following sections describe this option.

The original Project design that was the subject of the Initial Advice Statement (IAS) and referrals under the EPBC Act included the following key Project elements:

- A new main Code E south-east/north-west runway (Runway 13/31) 2,450 m long by 45 m wide, including a full parallel taxiway system and rapid exit taxiways
- Expansion of the apron at the existing terminal
- A new terminal precinct, including support facilities such as Air Traffic Control (ATC) tower, Aviation Rescue and Fire Fighting Services (ARFFS) station, security and airside operations facilities, freight handling, ground equipment storage and fuel storage
- Access road and utilities to the new terminal precinct
- Redevelopment of the existing terminal area for aviation related businesses.

During the EIS process, a number of opportunities to improve the runway design and reduce the overall capital cost of the Project were identified, as discussed in **Section 3.1 .3.4**.

3.1.3.4 New Runway 13/31 (EIS option)

During the EIS process, as more detailed investigations were undertaken, constraints that presented significant cost and program implications to the Project were identified. To address this, a value engineering exercise was undertaken with the Project team and SCA.

The key issues arising which influenced the development of a revised design included:

- Poor ground conditions at the north-west end of the site (resulting from more detailed ground investigations undertaken for the Project)
- Potential flood impacts
- Project staging requirements (delaying the need for a new terminal to beyond 2040 with consequent reduction in fill requirements and associated costs).

Through the process of the value engineering exercise, a variant on the preferred option was developed that shifted the runway ends 310 m south-east along the same alignment offering the benefits discussed below.

<u>Ground conditions and bulk fill requirements</u>

Geotechnical investigations at the site identified a thick layer of poorly consolidated clay in the north-western part of the site. To accelerate consolidation of the soils, it was proposed to place approximately 2.5 m of additional surcharge fill across part of the site. Approximately 500,000 m^3 of fill was predicted to be 'lost' to settlement. Moving the runway 310 m south-east avoided the area underlain by the thickest layer of soft materials and significantly reduced the amount of fill required to address poor ground conditions beneath the proposed runway.

<u>Flood mitigation requirements</u>

Modelling undertaken to assess the potential flood impacts of the Project indicated that a large area of Marcoola would experience an increase in peak flood levels of between 25 and 50 mm in a 100 year annual recurrence interval (ARI) flood event. Many mitigation options were investigated to address this; however, the assessment indicated the requirement for significant flood mitigation infrastructure, which would need ongoing maintenance and operation.

<u>Project staging requirements</u>

Requirement for a new terminal	Developing the earthworks platform for the new terminal precinct required approximately 1 M m^3 of fill. As the terminal was not forecast to be required until after 2040, the opportunity to expand the existing terminal was investigated as an alternative to a new terminal. It was determined that a new terminal would not be required within the timeframes for the Project. Instead, there was opportunity to upgrade the existing terminal to provide sufficient capacity until after 2040. Upgrading the existing terminal reduces the area of disturbance from the Project, significantly reduces the amount of fill needed and consequently significantly reduced the capital cost of the Project.

Requirement for a parallel taxiway system	The Project included the development of a full parallel taxiway system, including rapid exit taxiways. Developing the taxiways required a significant amount of additional fill, which also contributed to the overall capital cost. The requirements for a full taxiway system was reviewed, taking into consideration the proposal to expand the existing terminal rather than establishing a new terminal precinct. An assessment of the runway capacity indicated that the required number of aircraft movements could be achieved by establishing turning loops at each end of the runway. These loops enable aircraft to queue on the taxiway loop while another aircraft is landing or taking off, which provides a significant increase in runway capacity. Establishing the loops, rather than a full parallel system, significantly reduced the fill and pavement requirements, and therefore the cost of the Project, with minimal change to the performance of the runway.

All of these aspects influenced the Project cost estimate. As outlined below, these options were developed and adopted on the basis of reducing cost of the Project as well as realising opportunities to further avoid and/or minimise environmental impacts.

The design assessed in this EIS includes the following key aspects:

- A new main Code E south-east/north-west runway (RWY 13/31) 2,450 m long by 45 m wide, including two end turning loop taxiways and navigation aids
- Expansion of the apron at the existing terminal
- Staged expansion of the existing terminal
- A new combined ATC tower and ARFFS station, access road and utilities.

The EIS design:

- Achieves the overall SCC objective of supporting the region's economy through increased access to domestic and international destinations, and stimulus to tourism and commercial activities
- Reduces environmental impacts, dredging and land disturbance
- Reduces the costs of the Project to approximately $350M, which makes the Project viable.

Consequently, this is the option being progressed by SCA, assessed in this EIS and which is described in greater detail in Chapter A4 – Project Description.

3.2 FILL SOURCE OPTIONS

3.2.1 Overall fill requirements

The Project requires fill to achieve the desired flood immunity and to construct a safe, low maintenance runway pavement. A significant quantity of fill is required for the Project, as outlined in **Table 3.2a**. Subgrade fill (or bulk fill) is required to establish a solid earthworks platform for the construction of the runway. Pavement fill includes high quality fine crushed rock, which is required to provide a suitable strength pavement for aircraft operations.

Figure 3.2a shows a cross section of the runway and taxiway, showing the placement of the major fill types required for construction of the new runway and taxiways.

3.2.2 Bulk fill options

3.2.2.1 Requirements

Aircraft movement areas (runway, taxiways and aprons) require high-strength pavements to reduce the potential for deformation. Deformation is caused by loads associated with aircraft landing, take off and manoeuvring. Airports cannot afford to have pavement failures or intensive maintenance regimes, due to safety and scheduling issues.

The subgrade fill for aircraft movement areas will need to be:

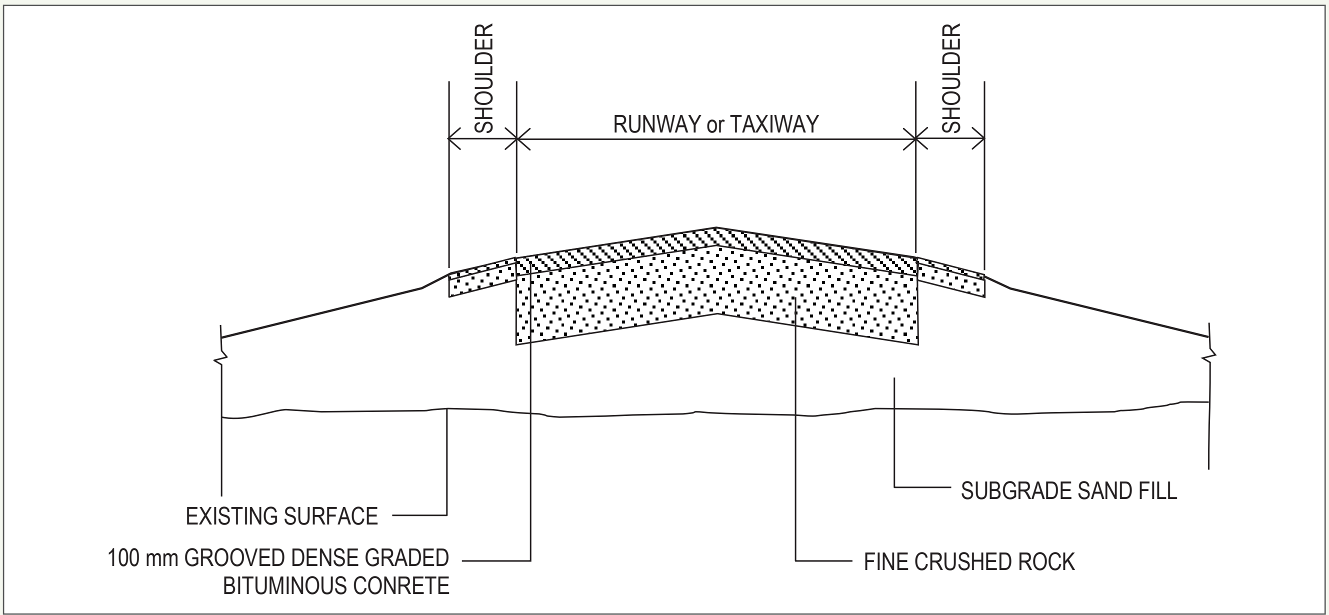
1) Homogeneous: A homogeneous fill material reduces the potential for differential settlement within the fill platform
2) High strength: Increasing the strength of subgrade fill will reduce the thickness of pavement required for these areas (and therefore the overall pavement cost).

General fill for other components of the Project (such as ATC tower/ARFFS facility) may be of a lower quality than that used for the aircraft movement areas; nevertheless, reasonable strength and homogeneity would reduce potential settlement issues and whole of life maintenance costs.

Table 3.2a: Preliminary fill volume estimates for the Project

Fill Type	Volume (m^3)	Density (t/m^3)	Mass (t)	Fill Requirement
Subgrade	1,100,000	1.7	1,870,000	Sand or high-quality engineered fill
Pavement	137,500	2.4	330,000	Engineered pavement fill

Figure 3.2a: Cross section of runway and taxiway showing the fill types required for the Project



A key criterion to consider in selecting the bulk fill for the Project is the time required for construction and surcharging prior to runway opening. It is anticipated that the earliest construction start date could be January 2016, subject to Queensland and Australian Government approvals processes progressing as planned. Meeting the 2020 opening date for the new runway would therefore depend on the construction start date. The construction methodology is detailed in Chapter A5 – Project Construction and a basic construction schedule is as follows:

- Civil Works: January 2016 to February 2017
- Dredging: March 2017 to November 2017
- Runway and taxiway pavements: January 2018 to October 2019
- Upgrade of Existing Terminal: July 2017 to August 2019
- Commissioning: October 2019 to January 2020.

Sand is the preferred type of fill for runway, apron and taxiway construction. Sand is less likely to have settlement issues, as it is a more homogenous material than crushed rock or other terrestrial fill types. The use of sand reduces the risk of future settlement, reduces the risk of pavement failure and lifetime maintenance costs and is a more time efficient material to work with on site (versus using rock that firsts needs to be processed to meet the engineering requirements).

3.2.2.2 Options considered

A number of bulk fill sources, both terrestrial and marine based, were considered for the Project. Four potential fill source and delivery options were considered for the Project, as follows:

Terrestrial sources

There are two potential bulk fill terrestrial sources:

1) Local quarries and delivered to site by truck (see **Section 3.2.2.3**).

2) One of two identified Key Resource Areas (KRA's) in the region (see **Section 3.2.2.3**).

Marine sources

1) Nearshore marine source - dredged from a source in the Maroochy River mouth or the Maroochy River coastal basin (see **Section 3.3.2.4**).

2) Moreton Bay marine source which would be transported to site in a dredge and from there hydraulically delivered to site (see **Section 3.3.2.4**).

3.2.2.3 Terrestrial bulk fill options

Local quarries

A number of potentially suitable terrestrial fill sources were considered for the Project, as shown in **Table 3.2b**. As most quarries have supply commitments, limits on maximum annual extractions, and logistical limitations on transport volumes, it is likely that two or more quarries would be required to supply the required fill quantities.

Key issues for each quarry are summarised in **Table 3.2b** and locations shown on **Figure 3.2b**.

Of the quarries considered, Moy Pocket is most likely to have suitable material types and quantities for the Project.

The haul route from Moy Pocket quarry is shown in **Figure 3.2c**. It is approximately 65 km from the quarry to the Project site (130 km round trip). An alternative route would be to follow Eumundi Noosa Road east to take the Sunshine Motorway south to David Low Way and Finland Road.

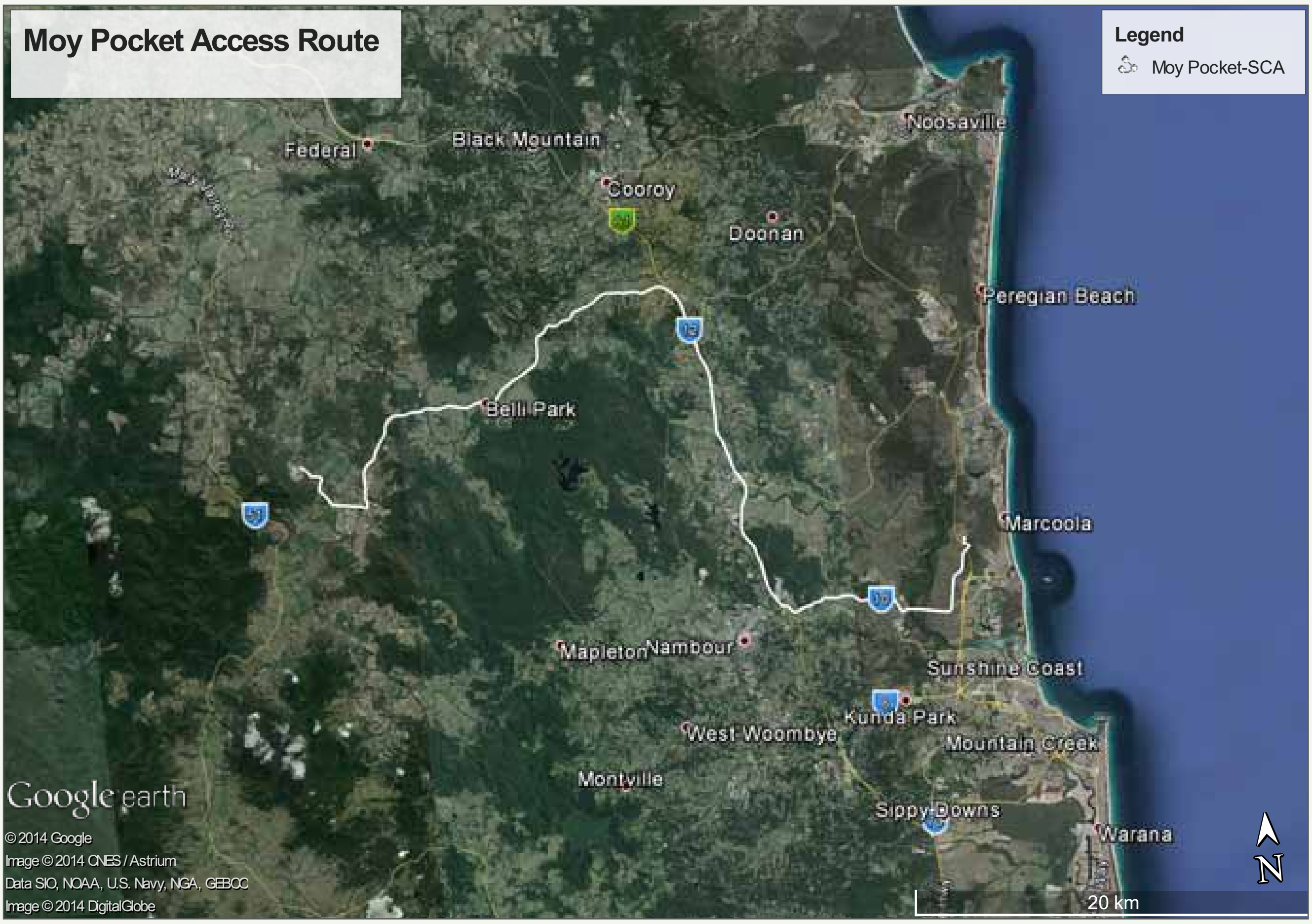
Table 3.2b: Quarries considered for terrestrial fill source

Quarry	Key Issues
Boral Narangba Quarry	The Narangba quarry is approximately 85 km from SCA. Narangba quarry produces a range of sealing, asphalt and concrete aggregates as well as road base.
Boral Petrie Quarry	The Petrie quarry is approximately 90 km from SCA. Petrie quarry produces slightly weathered to fresh greenstone which provides products suitable for use as concrete and asphalt aggregate, and as road base.
Boral Moy Pocket Quarry	**The Moy Pocket quarry is approximately 60 km from SCA.** **Moy Pocket quarry produces aggregates.**
SCC Image Flat Quarry	The Image Flat quarry is approximately 20 km from SCA. Image Flat quarry produces rhyolite rock and associated aggregates.
Holcim Nambour Quarry	The Nambour quarry is approximately 15 km from SCA. Nambour quarry produces aggregates.
SCC Dulong Quarry	The Dulong quarry is approximately 20 km from SCA. Dulong quarry produces road metal aggregates.

Of the quarries considered, Moy Pocket is most likely to have suitable material types and quantities for the Project.

Figure 3.2b: Terrestrial fill sources considered

Figure 3.2c: Haul route from Moy Pocket quarry to the Project site



Material would need to be delivered by road truck at a production rate of approximately 7,000 t/day. At this production rate, it would take approximately 12 months to import the material to site. This also represents some 350 truck movements per day (175 in each direction). In a 10-hour day, this would equate to one truck movement approximately every 1.7 minutes.

The haul route passes through Bli Bli and a number of other small towns. Potential amenity impacts associated with frequent truck movements for a prolonged period (12 months) would include noise, vibration and dust.

Key resource areas

Two terrestrial sand sources both identified as KRA's by the State Government were considered in this process:

Meridan Plains

While not an active site, a potential terrestrial source of fill is the Meridan Plains Extractive Resource Area. This site covers an area of 100 ha, is located 8 km to the north-west of Caloundra and borders the Mooloolah River. The haul route to SCA would be via the Bruce Highway and Sunshine Motorway with minimal local roads being required to be used except near the extractive area. This site has 18,0000 tonnes of sand suitable for processing to concrete and bituminous aggregates.

There is no approval for extraction at this site and as such is not a currently operating quarry source. For this reason the Meridan Plains KRA was not considered further.

KRA 150

KRA 150 has been identified as a Key Resource Area located in low-lying cane farmland (private land) west of the Sunshine Motorway at Pacific Paradise, south-west of the airport between the Motorway and the Maroochy River.

The fill source has been identified in two sections, one that is closer to the airport and comprises layered clean sand over coffee rock, the other section is located further south and comprises clean sand with no coffee rock to a depth of 2.6 m. The groundwater is near surface meaning any extraction would need to be by a dredge.

Fill would be hydraulically placed at the airport by pumping as a sand-water slurry mix, most likely via a 600 mm diameter pipeline. Due to the distances to the RWY 13/31 site, the pipeline would require a booster pump. Depending upon the booster pump design, more than one booster pump may be required. Extraction of the fill source would result in the creation of a lake.

This source was discounted for the following reasons:

- SCC would be required to maintain the residual lake that would be created following extraction (due to a high water table in this location) in perpetuity, with ongoing costs of maintenance for water quality for reasons of public health and safety
- It is understood that SCC has placed a moratorium on creating 'fill lakes' due to a legacy of poor environmental performance of such lakes on the Sunshine Coast. Developing support for this option through Council would therefore require special consideration
- The timeframe for land acquisition (the site is located on private land), environmental and design investigations, and regulatory approvals would negatively affect the Project's delivery program
- There is a potential for the lake to attract birds across airport flight approaches/departures. Although the lake can be designed to discourage birds to some extent, its attraction is unlikely to be eliminated. Deliberately locating such a waterbody close to the new runway would be counterintuitive to Project objectives
- The management of tailwater would be a major technical operational challenge of this option. The process would produce a lot of dirty water (sediments and acid sulphate 'slimes'). This would present significant environmental risk to receiving waters (i.e. Maroochy River).

3.2.2.4 Marine fill options

The following marine fill options have been considered for the Project:

- The Maroochy River
- A nearshore coastal source
- Moreton Bay – Spitfire Realignment Channel and Middle Banks.

These options are discussed below.

Maroochy River

Dredged sand from the Maroochy River was considered as a possible source of fill for the Project. The river has been used for sand extraction in the past, for example, at the Cable Ski Park near Bli Bli and at Twin Waters. It is likely that sand extraction from the River would be undertaken by continuous suction dredging via pipeline to a booster pump on the bank of the Maroochy River. From there, the dredged material would be pumped to the site through an approximately 5 km pipeline.

Tailwater would be captured in a sediment pond that would discharge into Marcoola drain which leads into the Maroochy River.

Key concerns that led to this fill source being discounted were:

- Material from the River is likely to be of variable and potentially unsuitable quality, as riverine flows are likely to deposit layers of silts and clays in the river bed. Relative to clean sand, the higher concentration of silt/clay material in river sand is likely to produce higher levels of turbidity in the tailwater being discharged to the Maroochy River. Lenses of silt/clay in the earthworks platform also has the potential to cause differential settlement beneath the runway pavements which is not desirable
- It is possible that material from the river would contain potential or actual acid sulphate soils (ASS). Disturbing ASS during dredging could release acidic material into the riverine environment or mobilise metal contaminants into the water column. Investigations would be required to determine the presence of ASS
- Timing of approvals for dredging in the river is highly uncertain, particularly in the context of the timing of the Project
- A booster pump station would be required on the bank of the Maroochy River. This would need to be in a navigable part of the river, and dredge vessel movements may present a risk to recreational and other watercraft.

Nearshore coastal sand

Dredging from a nearshore coastal sand source was also considered. This option would involve dredging sand from an as-yet-unidentified source offshore from Marcoola that would not detrimentally affect the beach (i.e. 1 km to 5 km from shore). Once full, the dredger would pump sand to shore from a temporary pump-out site near Marcoola, as for the Moreton Bay dredging options. Tailwater would be managed as for the Moreton Bay dredging options.

Key concerns that lead to this fill source being discounted were:

- There is not yet an identified nearshore source and considerable investigation work (including prospecting) would be required as part of the EIS to establish a suitable site that did not detrimentally affect the beach
- The timing of approvals for dredging a nearshore coastal sand source are highly uncertain, particularly in the context of the timing of the Project
- Community acceptance for dredging a nearshore coastal sand source is also highly uncertain.

Moreton Bay

The Moreton Bay Sand Extraction Study (MBSES) was initiated by the Queensland State Government and undertaken between 2002 and 2005. It involved a detailed investigation of the physical processes, water quality, ecological processes, indigenous cultural heritage and economic impacts associated with increasing sand extraction in Moreton Bay.

The MBSES also provided a comparative analysis of the availability and associated impacts of land-based sand extraction. Overall, the scientific reports that formed part of the MBSES found that impacts associated with sand extraction in Moreton Bay would be relatively minor, even for very large sand extraction scenarios, with marine-based sand extraction having significantly fewer environmental, social and economic impacts than land-based extraction.

As a result of the MBSES, the Queensland Government made a decision that over 20 years (to 2026) it will support:

- Extraction of up to 40 M m^3 of sand for development of Australia TradeCoast projects, including the expansion of the Brisbane Airport and the Port of Brisbane
- Extraction of up to 20 M m^3 of sand for use within the construction sector.

It is proposed that sand extraction for the Project would involve dredging using a Trailing Suction Hopper Dredge (TSHD), which then transports the sand to a temporary pump-out site offshore from Marcoola, and pumping sand to the site through a large pipeline.

Given that SCA were seeking a volume of sand in addition to that volume already approved by the MBSES, it was required that, as part of the Terms of Reference (TOR) process, SCA would undertake an additional assessment to consider the cumulative impact of taking an additional 1.1 M m^3 of sand over the existing 60 M m^3 approved allocation from Moreton Bay. The results of this cumulative sand assessment are presented in **Section 3.3**.

The Project considered marine sources of bulk fill for the Project from two locations assessed in the MBSES as potential sand extraction locations:

- The Spitfire Realignment Channel
- Middle Banks.

Both locations (see **Figure 3.2d**) have been dredged for various purposes by other proponents as discussed further here.

Middle Banks

Middle Banks is located in Moreton Bay approximately 20 km north-east of the mouth of the Brisbane River and 4 km due west of Tangalooma Point on Moreton Island. Middle Banks is located at the southern-most tip of the northern delta and is situated approximately 15 km to the south of Spitfire Banks.

In 2006, Brisbane Airport Commission (BAC) sought approval through the preparation of a combined EIS and Major Development Plan (MDP), for extraction of 18 M m^3 of sand from Middle Banks for its new runway Project. This proposal was approved in 2007 and BAC has completed an early sand dredging project in advance of the main extraction campaign, which commenced in June 2014. The construction industry also has permitted sand extraction areas within Middle Banks, situated to the west of the BAC extraction footprint.

Spitfire Realignment Channel

The Spitfire Realignment Channel is located within the northern delta sand banks of Moreton Bay between Spitfire Banks and Western Banks. The Channel is currently approved to be dredged by the Port of Brisbane Pty Ltd (PBPL) as part of a channel straightening and maintenance project. As such, the environmental impacts of dredging sand from this site have previously been considered in both the MBSES and through State approval processes undertaken by PBPL. This also included referral of the sand extraction under the EPBC Act and a determination that the proposed PBPL dredging was not a controlled action.

Were sand to be extracted from the Spitfire Realignment Channel, the volumes required by SCA would be in addition to the 15 M m^3 approved and allocated to PBPL and outside of the allocated amount in the MBSES.

Consultation with PBPL confirmed that they are not opposed to SCA dredging additional sand (up to the required volume of 1.1 M m^3) from the Spitfire Realignment Channel for the Project, assuming the volume of material is in addition to PBPL's approved allocation and that appropriate permits approvals are obtained.

In addition to PBPL, the construction industry also uses an area of the seabed adjacent to the Spitfire Realignment Channel for sand extraction. It was agreed with the State Government that approval for sand extraction for the Project would not be sought in the area approved for the construction industry.

Comparison of options

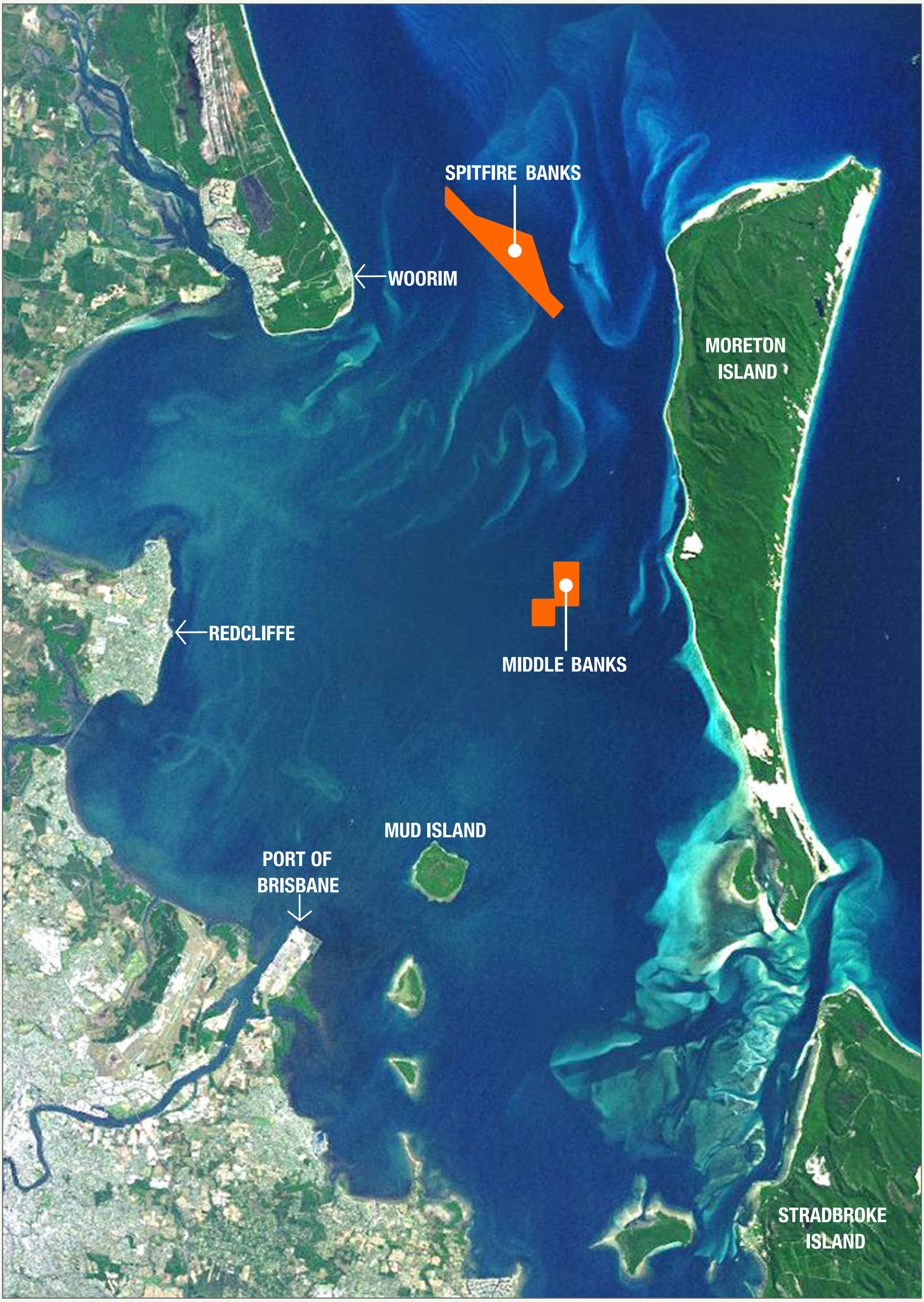
The following aspects were considered in identifying a preferred sand extraction location for the Project:

- Middle Banks is approximately 20 km steaming distance further from Marcoola than Spitfire Realignment Channel. Travelling an additional 40 km for each round trip would extend the duration of dredging and increase dredging costs
- Middle Banks has greater environmental values than Spitfire Channel, including seagrass, fishing uses and nearshore environments along Moreton Island
- Previous geotechnical investigations indicate that sand at both Middle Banks and Spitfire Realignment Channel is suitable for the construction of the Project
- Dredging at both sites would occur within areas previously assessed in the MBSES, although the overall dredging volume would be greater and require cumulative assessment
- Dredging of the Spitfire Realignment Channel is already approved as part of a capital works program for the Port of Brisbane.

Based on an assessment of both sites, the Spitfire Realignment Channel was preferred because:

- The area of dredging is co-located the footprint previously approved for PBPL, although the overall dredging extent would be deeper

Figure 3.2d: Moreton Bay sand extraction areas considered for the Project



- Benthic flora and fauna in the dredge footprint is characterised by sparse comunities with low diversity
- Benthic fauna is considered to be reasonably resilient to dredging related distances given large scale dredging has previously occured in the footprint
- The potential environmental impacts at the site are well understood and have been approved in the past
- Dredging along the Spitfire Realignment Channel has secondary benefits to maritime navigation and PBPL
- Spitfire Realignment Channel provides cost savings compared to dredging at Middle Banks as it is closer to the airport site and would reduce the overall duration of dredging.

3.2.2.5 Comparison of terrestrial and marine bulk fill options

The options analysis indicated that terrestrial fill brought to site by truck, and dredged sand from the Spitfire Realignment Channel were considered feasible for bulk fill supply for the Project.

Table 3.2c summarises the key aspects of each of these options.

A marine fill sourced from the Spitfire Realignment Channel is the preferred fill source as it provides a better quality fill material that can be quickly delivered to site with minimal environmental and social impacts at the dredge site and during delivery.

The environmental impacts associated with securing sand from the Spitfire Channel Realignment are assessed in Volume C. The environmental and social impacts associated with the delivery, placement and surcharging of sand on site is addressed in Volume B.

The cumulative sand assessment for the extraction of an additional 1.1 M m^3 of sand for the Project in the context of the MBSES is presented in **Section 3.3**.

Table 3.2c: Aspects considered in assessing terrestrial and marine fill sources

Aspect	Terrestrial Bulk Fill Source	Marine Bulk Fill Source
Quality	Stringent quality controls are required to ensure a homogeneous material is delivered and placed on site. This may include blending material on site from different quarries to meet the material specifications.	Available geotechnical information indicates that sand at Spitfire Realignment Channel is of good quality, meets quality controls and is consistent throughout the sand body.
Cost	Preliminary estimates indicate the cost to import terrestrial and marine fill to site is very similar at approximately $75 M.	
Fill Delivery	It is estimated that it would take approximately 12 months to deliver terrestrial fill to site.	It is estimated that it would take approximately 3 months to deliver marine fill to site.
Environmental and community impact	Terrestrial fill would be obtained from an approved, licensed quarry. Potential impacts would predominantly be associated with hauling of the fill and the increased construction traffic on the identified haul roads. Associated with the increase in construction traffic would be noise, vibration and dust for communities along the identified haul route. Noise and dust at the construction site would also be a potential impact of this option to neighbouring residents. Blending of transported fill material and preparing it to meet material specifications would require crushing of fill material at the Project site with potential for increased noise and dust generation. Runoff from the fill area would also have a relatively high sediment load (compared to clean sand).	SCA propose dredging in the Spitfire Realignment Channel which has an existing approval for PBPL to dredge for navigation purposes, the Project would seek to deepen the dredge area to obtain the fill. The cumulative impact assessment for the additional 1.1 M m^3 of sand fill from Spitfire Channel Realignment is presented in **Section 3.3** and shows that the additional allocation of sand associated with the Project is not considered to present any unacceptable cumulative impacts. Generally, the MBSES indicated that marine fill sources have less environment and social impacts than terrestrial fill. Impacts associated with this option are described in detail in Volume C. Potential impacts at the Project site include temporary disturbance from installation and decommissioning the dredged sand delivery pipeline, and temporary impacts from the discharge of tailwater.

3.2.3 Pavement fill requirements

Pavement fill makes up approximately 10 per cent of the total fill required for the Project. The pavement thickness, and consequently volume, for the runway depends on the underlying ground conditions after treatment and the proposed 'design case' aircraft operations.

The most significant element of the pavement fill is the Fine Crushed Rock (FCR). FCR forms the structural base of the pavement, and therefore it is a significant factor in the performance of the runway pavement. The FCR is required to have a specific gravity (SG) of greater than 2.5. An initial investigation into rock sources indicated that local quarries use a base parent rock which does not meet the SG requirements.

Two local quarries have advised that they can provide material with an SG greater than 2.5, including:

- Boral Moy Pocket Quarry (65 km from the Project site via Yandina Coolum Road and Sunshine Motorway)
- Boral Narangba Quarry (80 km from site via Bruce Highway and Sunshine Motorway).
- Three local quarries produce pavement gravels that may be used for roads and car parks, but is unlikely to be suitable for airfield pavement:
  - Holcim Bli Bli Quarry (15 km from site via Bli Bli Road – Sunshine Motorway)
  - Boral Coolum Quarry (16 km from site via Yandina Coolum Road – Sunshine Motorway)
  - SCC Image Flat Quarry (20 km from site via Image Flat Road – Bli Bli Road – Sunshine Motorway).

Any quarry considered for use for pavement fill will already have the necessary permits and approvals in place. The actual quarry or quarries to be used will be determined based on environmental and economic considerations when the runway is constructed.

3.3 CUMULATIVE SAND ASSESSMENT

3.3.1 Introduction

3.3.1.1 Scope

This section responds to the following aspects of the TOR for an EIS, 2012 for the Project:

Section 3.8.2 – Relevant plans

If Moreton Bay is being considered as a potential site for sourcing fill material for the runway, the EIS must discuss the relationship of the proposal with the Moreton Bay sand extraction study (Environmental Protection Agency 2005) in this section and address it in detail in the relevant sections of the TOR.

Section 5.3.3 – Sediment quality and dredging

If Moreton Bay is being investigated as an option for accessing sand for fill for the airport site, provide a cumulative impacts assessment based on the Moreton Bay sand extraction study which considers the cumulative environmental impacts and resource allocation issues of extracting an additional 3 M m^3 of sand (or greater amount if required) from Moreton Bay and specific justification for sand extraction from Middle Banks, Spitfire Channel or other site.

3.3.1.2 Sand allocation in Moreton Bay

Marine sand has been extracted from Moreton Bay over many years. From the period 1980 to 2000, the Queensland Government estimated that over 30 M m^3 was lawfully extracted. This was comprised of ~2 M m^3 by the construction industry, ~19 M m^3 by the Brisbane Airport to establish the existing airport site in the early 1980s and ~18 million m^3 by the Port of Brisbane as part of channel maintenance and capital works (DERM, 2005).

In 2000, the Moreton Bay Sand Extraction Study (MBSES) was initiated to examine the feasibility of using Bay sand to supply raw materials for several major infrastructure and development projects in the Australia TradeCoast area and for the construction sector. Based on the MBSES, the State Government decided on a 20 year approach for management of sand resources in northern Moreton Bay, in order to supplement diminishing land based sources of sand.

From a total available sand resource in Moreton Bay of approximately 3,770 M m^3, the Government made a decision in 2005 that over the next 20 years it would support:

- Extraction of up to 40 M m^3 (less than 1.1 per cent of the total sand resource) of sand for development of Australia TradeCoast projects including the expansion of Brisbane Airport, Trade Coast Central site and the Port of Brisbane
- Extraction of up to 1.1 M m^3 (less than 0.6 per cent of the total sand resource) of sand for use within the construction sector
- Restricting approved sand extraction to specified locations at Spitfire and Western Banks (within and adjacent to the Spitfire Realignment Channel area) and at Middle Banks within Northern Moreton Bay.

Strategic planning for expansion associated with Australia TradeCoast, Brisbane Airport and the then Port of Brisbane Authority were well advanced at the time of the MBSES and as such, these organisations along with the construction industry, partly funded and participated in the study.

Following consideration of the MBSES, the State Government's decision to support sand extraction from the Bay in 2005 did not provide an assurance that every sand extraction proposal would be approved and that each proposal would be subject to a detailed environmental assessment under relevant State and potentially Commonwealth legislation.

Accordingly, development applications and associated environmental assessments were prepared and lodged with relevant Government agencies over the period 2005 – 2007 by the following entities:

- Port of Brisbane Corporation for a channel realignment project for Spitfire Channel
- BAC for sand extraction at Middle Banks for their parallel runway project and domestic terminal apron projects
- The two major sand extraction operators in the Bay (Bowen Tug and Barge and Riverside Industrial Sands) as well as several construction companies for extraction in the approved construction permit areas.

Permits under relevant State legislation were granted for each of these applications, noting the BAC EIS/MDP was also subject to a Commonwealth EIS and controlled action approval under the EPBC Act.

The resultant approved sand extraction areas within the Bay are shown within the Moreton Bay Marine Park Zoning Plan (2008) as reproduced in **Figure 3.3a** (noting this figure shows the industry extraction permit areas at Spitfire and Middle Banks, as well as the Spitfire Realignment Channel area but does not show the BAC's approved footprint for dredging at Middle Banks which is situated adjacent to the East Channel).

3.3.1.3 Sand extraction and dredging undertaken since 2005

With relevant permissions secured, construction industry sand dredging has occurred at the approved permit area at Spitfire Banks, as well as the occasional use of extractive permit areas at Middle Banks during periods of inclement weather. Permits for these areas were issued for an initial period of two years after the MBSES and have been extended annually up to 2012. The permits allow the construction industry to take up to 1 M m^3 of material from the Bay annually, although it is understood that the industry has not needed to fully utilise this allocation in meeting the current demand. At the time of preparation of this EIS, an allocation tendering process was being examined by the Queensland Government that would allow longer term allocations of Bay sand to be extracted (up to six years) by the construction industry.

In addition to annual volumes extracted by the construction industry, several large scale sand dredging operations for infrastructure purposes have also been approved and undertaken since the MBSES.

The *Volvox Asia* - a medium-sized Trailing Suction Hopper Dredge (TSHD) - has undertaken three separate sand dredging campaigns over the period 2005 - 2012. These were two campaigns at the Spitfire Realignment Channel Area for the Port of Brisbane Corporation (now PBPL) and a single campaign from Middle Banks for BAC. In each case, sand was extracted from the approved offshore borrow site, brought to a designated pump out location in the Brisbane River, and then pumped as a sand and water slurry onto a designated reclamation site, similar to the methodology proposed for the Project.

3.3.1.4 Relevance of the allocation decision and MBSES to the Project

Based on the approved volumes and extraction rates to date, it is possible that not all of the 60 M m^3 allocated in 2005 will be fully utilised by 2025. However, local governments were generally not invited to participate or fund the MBSES, and marine sand was not made exclusively available for their capital projects as part of the Government's decision on Moreton Bay sand extraction in 2005.

In addition, planning for a new runway at the SCA was only at a very preliminary stage in 2000 (when the MBSES commenced) and the justification and need for the Project had not yet been established.

As a result, the Queensland Government has indicated to the proponent for the Project that marine fill proposed to be taken from Moreton Bay to support the project should be considered for approval:

1) As part of the EIS process
2) As an additional volume of material to the 'approved' 60 M m^3 allocated in association with the MBSES decision in 2005.

3.3.1.5 Fill requirements

As outlined in Chapter A4 – Project Description, the proposed Project site (the "site") needs to be filled to ensure a level runway, provide flood immunity, address soft soils that occur at the western end of the runway alignment, and to construct, and provide a solid foundation for, high strength airfield pavements.

Excluding pavement fill requirements, 1.1 M m^3 of select fill is required for the Project. This fill is to be used for the runway, taxiways and apron.

Due to the volumes of fill required for construction, a number of terrestrial and marine-based bulk fill sources were considered as part of the scoping phases of the Project (see **Section 3.2**). A marine based bulk fill source was identified as preferred.

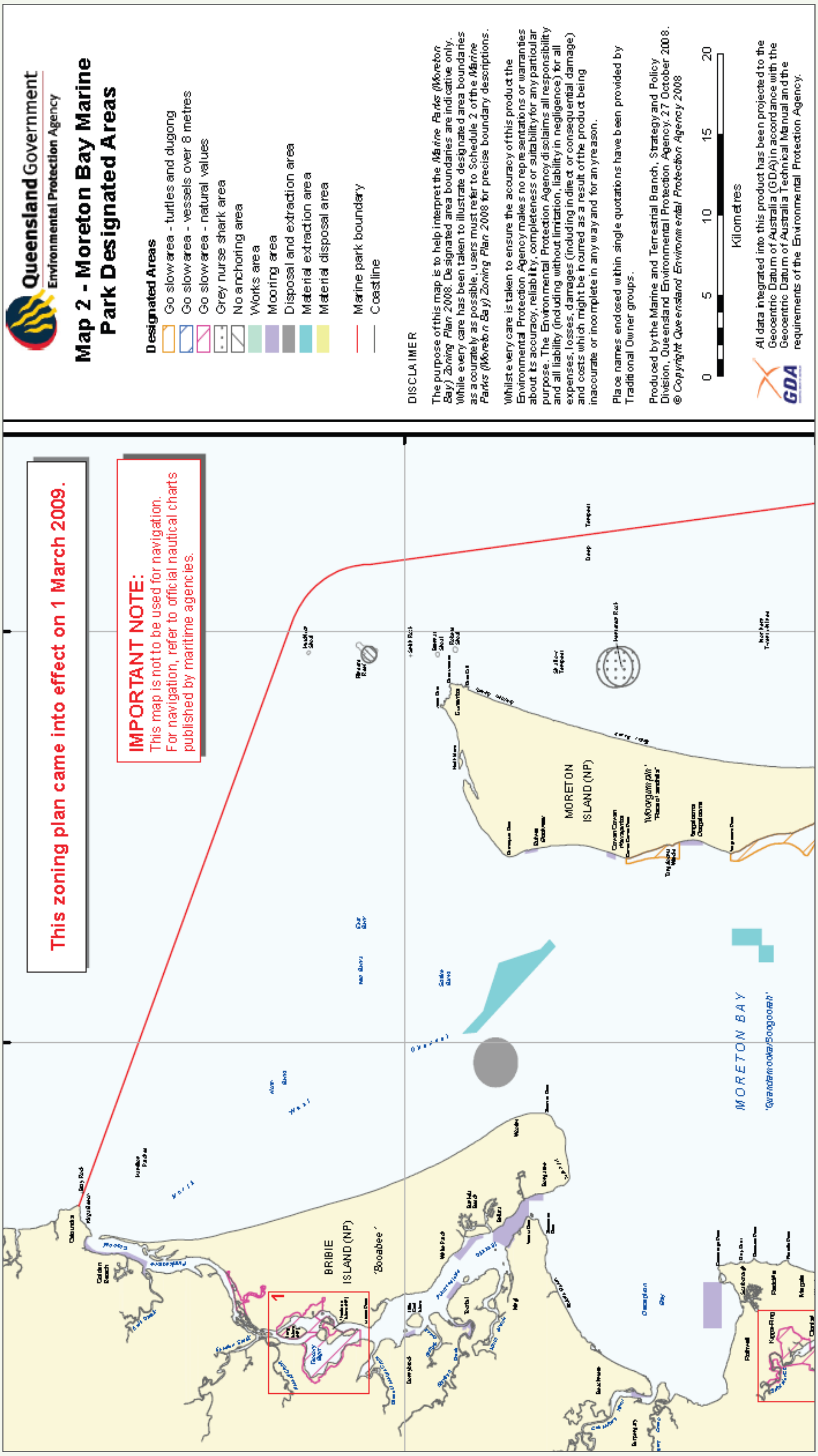
3.3.1.6 Marine sand extraction alternatives and preferred footprint

Following a decision to pursue marine sand extraction as the preferred fill source for the Project, an options analysis was undertaken of various marine sites, including:

- At Middle Banks (within or adjacent to approved sand extraction for Brisbane Airport)
- At the Spitfire Realignment Channel (within and adjacent to the approved sand extraction area for the Port of Brisbane)
- Directly offshore from the Sunshine Coast.

As described in **Section 3.2**, deepening of the proposed channel in the Spitfire Realignment Channel is the preferred option for the Project as it:

Figure 3.3a: Approved material extraction areas (shown in blue) within Moreton Bay (extract from Map #2: Moreton Bay Park Zoning Plan 2008)



- Deepens an existing approved sand extraction site that has been subjected to previous disturbance by sand dredging activities (as opposed to targeting a new greenfield area in the Bay or off the coast from the airport that has not been dredged in the past)
- Minimises conflicts with other Bay users and operators (as it is outside of the current shipping channel, outside of the adjacent 'triangular" permit area used by the construction industry and is not known to be an important area for commercial and recreational fisheries)
- Will produce navigational benefits through deepening of the proposed shipping channel and potentially reducing the frequency of future maintenance dredging
- Will have minimal environmental impacts as there are limited environmental receptors at the location and similar scale dredging has already been approved at this dredge site
- Compared to the Middle Banks option, it is geographically closer to the airport site so will reduce the overall duration of the dredging which has cost and environmental benefits.

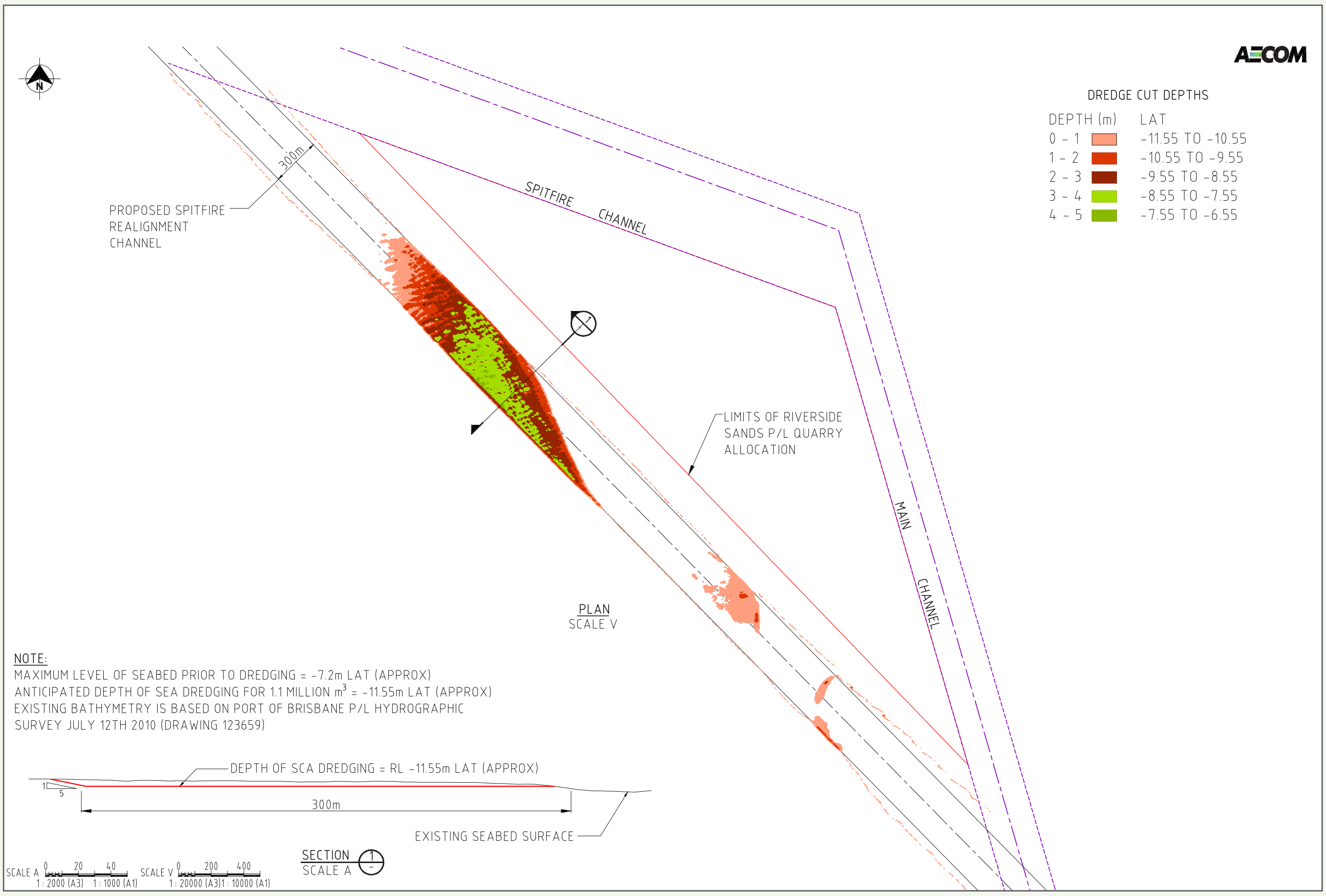
3.3.1.7 Dredge bathymetry in the Spitfire Realignment Channel

The Spitfire Realignment Channel is also an area of proposed dredging by PBPL, which once complete, will remove a dogleg from the existing shipping channels, resulting in a channel that will ultimately be 500 m wide and to a depth of -16.5 m Chart Datum (CD). PBPL has a 15 M m^3 allocation to dredge the realignment channel for use as fill and reclamation.

The triangular area enclosed by the existing Spitfire Channel and the Spitfire Realignment Channel is subject to a previously approved allocation for Riverside Sand Pty Ltd, as shown in **Figure 3.3a**. SCA has been in consultation with PBPL to identify opportunities for a combined sand extraction area at the Spitfire Realignment Channel for the Project and PBPL's current allocation.

PBPL has indicated a preference for a shared dredging footprint that would be extended deeper than PBPL's current approved dredging footprint, rather than wider. As dredging for the Project is likely to occur before PBPL undertakes any major dredging of the realignment, PBPL have indicated that it would be preferable for the SCA dredging to form a 'shallow' 300 m wide channel within the overall realignment channel footprint. This may then allow the realignment to be used for navigation by some vessels.

Figure 3.3b: Indicative dredge footprint based on 2010 seabed bathymetry: 300 m wide channel to depth of approximately -11.55 m CD



Based on bathymetry of the seabed surveyed in 2010, a 1.1 M m^3 allocation would provide a 300 m wide channel to an average depth of approximately −11.55 m CD as shown in **Figure 3.3b**. The final level will depend on any prior dredging undertaken by PBPL and the quality of sand within the footprint. To develop a combined extraction area of 16.1 M m^3 (i.e. PBPL's 15 M m^3 allocation and 1.1 M m^3 for the Project) the base of the realignment would need to extend to approximately -17.05 m CD as shown in **Figure 3.3c**.

3.3.2 Cumulative assessment for the additional volume sought

3.3.2.1 Introduction

In considering an additional allocation of 1.1 M m^3 of marine sand from the Spitfire Realignment Channel for the purposes of the Project, a review has been undertaken of the key findings of the MBSES as well as findings from recent dredging campaigns in the Bay. The objectives of the review are to assess:

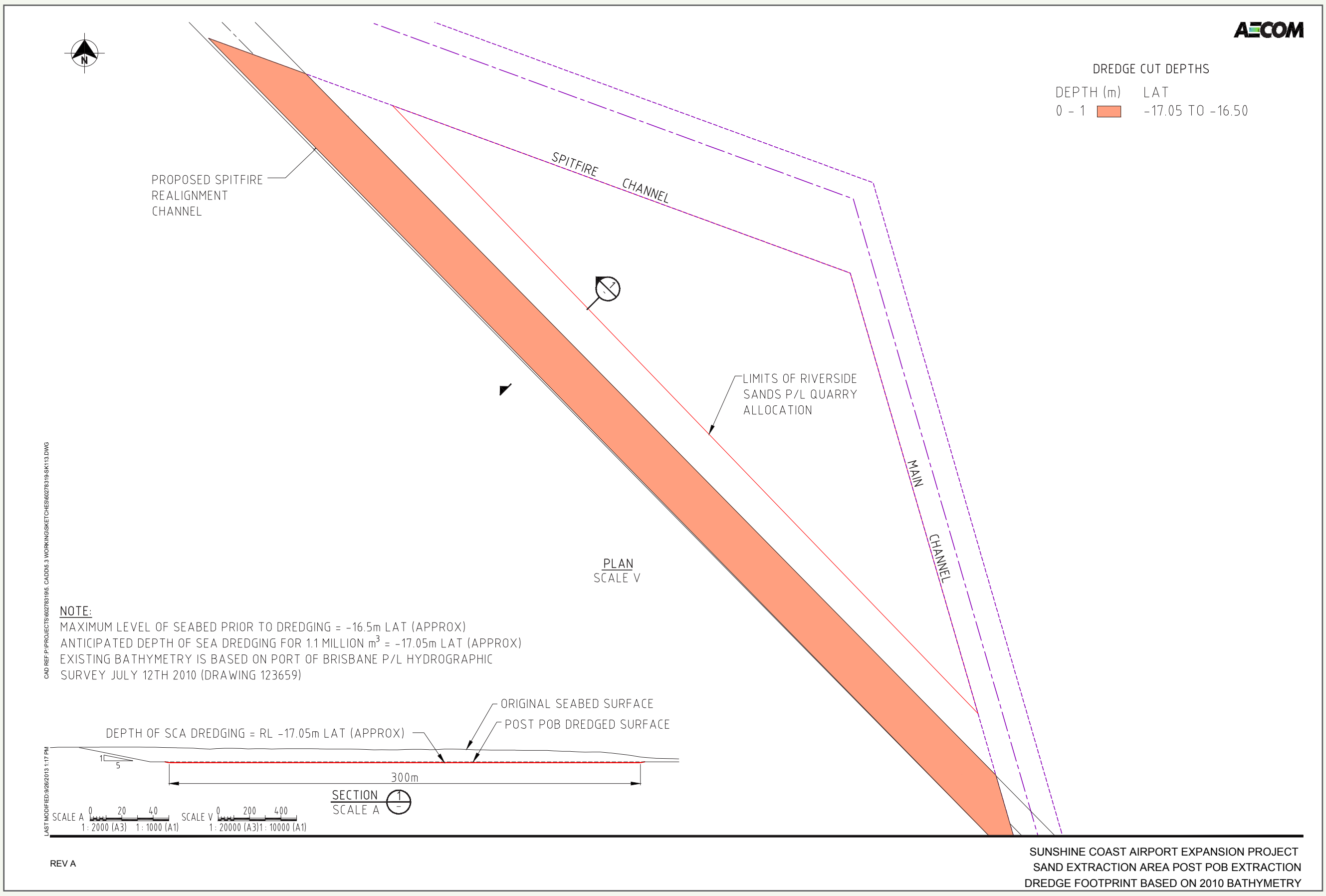
1. If the allocation of an additional 1.1 M m^3 of material would materially change the outcomes or key findings of each study
2. If there are other issues or matters that have arisen since 2005 that are relevant to consider in the context of the Project including, taking into account other large sand dredging campaigns that have been undertaken including within the proposed dredge footprint
3. Any cumulative impacts from allowing additional sand extraction over and above the 60 million m^3 over twenty (20) years set out in the Queensland Government's decision about sand extraction in Moreton Bay in 2005.

3.3.2.2 National Assessment Guidelines for dredging

Noting that the MBSES was undertaken over ten years ago, the assessment also considers the current requirements of Section 4.3.1 of the National Assessment Guidelines for Dredging (NAGD; DEWHA 2009) in terms of assessing potential dredging (including loading site) impacts. NAGD provides guidance on 'best practice' for the assessment of impacts at the dredging sites. There are four key elements to consider in identifying potential impacts:

1. Physical environment – including consideration of sediment type, bathymetry and proximity to sensitive or otherwise important environmental receptors
2. Biological environment – including impacts to listed or threatened species and migratory species, or their habitats

Figure 3.3c: Indicative dredge footprint for dredging undertaken after PBPL sand allocation extracted: 500 m wide channel to approximately 17.05 m CD



3. Other uses – including shipping and navigation, public use of the shoreline, fishing and aesthetic values
4. Economic and operational feasibility.

Each of these issues are considered in detail in the MBSES, and summarised in the following sections.

3.3.2.3 MBSES structure

Being composed of clean sand of marine origin, the northern tidal delta of Moreton Bay was selected for sand extraction investigations by the Queensland Government on the basis of the following environmental attributes:

- It has no permanent or dense seagrass beds or other turtle/dugong feeding areas
- It was not in close proximity to declared Ramsar Wetland sites
- It was not in close proximity to declared Fish Habitat Areas
- It was not in close proximity to beaches and shorelines
- It was mostly within the (then) General Use Zone of the Marine Park.

The MBSES consisted of a two phase study managed by the then Queensland Environmental Protection Agency (EPA). Phase 1 was a comprehensive review of environmental factors and gap analysis undertaken by BMT WBM in 2002.

The independent Scientific Expert Panel (SEP) of the Moreton Bay Healthy Waterways Partnership was presented with the Phase 1 report and recommended five separate specialist investigations be undertaken as part of Phase 2 of the study. These investigations were related to:

- Economic analysis of sand extraction from marine and land based sources
- Sediment geochemistry processes and accompanying impacts on water quality
- Benthic fauna and fisheries
- Indigenous cultural heritage
- Numerical modelling of wave penetration.

The key findings of the detailed (Phase 2) studies were documented in the MBSES Summary of Findings Document (Queensland Government, 2005) which was publicly released along with the individual technical reports listed above via the EPA's website.

The following sections provide a summary of findings for each of the key matters examined by the MBSES and a discussion of any implications on these findings as a result of a decision to allocate the removal of an additional 1.1 M m^3 from the Spitfire Realignment Channel Area for the Project.

The discussion includes, where relevant, observations and data from recent large scale sand extraction activities undertaken in Moreton Bay, including two dredging campaigns undertaken by the *Volvox Asia* (a medium-sized TSHD) in the Spitfire Realignment Channel since 2005.

3.3.2.4 Coastal processes

Key findings

The MBSES Summary of Key Findings (Queensland Government, 2005) reported the following with respect to coastal processes –

The complex field of banks and channels of the northern tidal delta provides an important control on the overall tidal characteristics of Moreton Bay and limits the penetration of wave energy propagating from the open ocean.

WBM (2002) and WBM (2003) reported on a hydrodynamic model study of potential changes in tidal conditions within the Bay as a result of sand extraction scenarios in the northern tidal delta. This assessment was made using an existing numerical model providing a two dimensional representation of the tidal hydrodynamics of Moreton Bay and indicated that extraction of large volumes of sand from the northern banks would:

- *Have no potential for change to the overall hydraulics of the Bay, therefore no changes in tidal flushing or tidal levels at surrounding shorelines are likely; and*
- *Have only localised effects on the prevailing tidal flows in adjacent areas.*

The modelling also demonstrated that, based on an assessment of peak tidal flows without the additional effects of wave action, sediment transport processes are constantly active throughout the entire northern banks area.

WBM (2004b) provided results of a study of potential changes to wave conditions in the vicinity of the Moreton Bay shoreline as a result of sand extraction scenarios. The study utilised the SWAN wave modelling system; a "third generation" spectral wave model implemented to represent all the important shallow water wave generation and transformation processes. Recorded wind and wave data for the region were examined to develop fifteen representative wave conditions. Potential impacts were assessed by comparing modelled wave fields before and after extraction scenarios for each site and for each wave condition. In total, 165 model runs were completed for the study.

The numerical wave modelling shows that wind-waves generated by winds over fetches within Moreton Bay are potentially equal to, or greater in height than swell waves propagating from the adjacent Pacific Ocean. Wind-waves however are typically of much shorter wavelength than swell and are therefore less affected by the seabed. Model results predict negligible changes to existing wind-wave conditions at shoreline locations within Moreton Bay.

Under swell-only conditions, the modelling did give indications of some potential change in wave height, generally along the north-western shoreline of Moreton Island. The largest reported changes at these shoreline points, ranging up to a 15 per cent increase, occurred for low inshore wave heights, typically less than 0.3 m. WBM (2004b) report that these swell-only wave height increases are partially a result of numerical "noise" within the model and may therefore be overstated. The modelling showed that for all cases examined, wave directions were generally unaffected.

The wave propagation modelling has indicated that there would be no significant changes in wave conditions at the southern end of Bribie Island and at Redcliffe from the proposed sand extraction scenarios.

Taken together, numerical modelling of both wave propagation and tidal flows showed that localised changes would occur as shallow sand banks are removed however only small changes to wave climates or tidal currents close to the shoreline would be expected. As a result of this study it may be inferred that the likely impacts on sediment supply and shoreline stability of adjacent coastal areas would be negligible.

Implications for additional allocation

The base case scenario examined as part of numerical modelling within the MBSES was a potential dredging project to straighten the main shipping channel in the vicinity of Spitfire Banks. This would result in removal of an area of approximately 800 ha including part of the northern end of Western Banks and require extraction of approximately 15 M m^3 of material to provide an ultimate depth of -16 m LAT. This scenario became the approximate size and volume of material allocated to the Port of Brisbane by the Queensland Government.

The MBSES also considered a further scenario at the Spitfire Realignment Channel, with additional extraction to increase the dredged depth by up to 5 m (to -21 m LAT) and a resultant increase in extraction volumes to 45 M m^3. This depth of cut and volume exceeds that which is sought as part of the Project from the proposed dredge footprint but provides a conservative and directly relevant basis for assessing broad scale impacts on coastal processes and sediment transport processes from the current proposal.

Modelling and assessment presented in WBM (2004b) concluded that for both scenarios, the following key findings were relevant:

- There no likely changes in tidal condition within the Bay as a result of large scale sand extraction at any of the sites investigated
- Greater water depths associated with dredging produces highly localised changes to hydrodynamics such as differing shoaling patterns, a reduction in wave focussing around the shoals, waves propagating past the dredge areas with slightly less loss and winds generating slightly higher waves across the dredge areas because of reduction in depth limiting factors
- Increasing the dredged depth at Spitfire Realignment Channel and other sites has less impact on wave conditions than increasing the dredged footprint to achieve greater sand extraction
- Generally there are only isolated local change in wave heights and mostly less than 5 per cent at the studied sites
- The modelling showed no significant changes in wave heights at the southern end of Bribie Island and at Redcliffe from the proposed dredging.

Based on the above findings, the additional allocation of sand associated with the SCA Project is not expected to pose any risks of increased impacts on coastal processes. To this end, more detailed analysis of potential changes to hydrodynamics and shoreline processes are presented in Chapter C3 – Coastal Processes and Water Quality.

3.3.2.5 Water quality

Key findings

The sand within the northern delta of Moreton Bay represents material that has been transported along the coast from northern New South Wales, as far south as the Clarence River. Consequently, the proportion of fine silt material in the sediments is very small, typically less than 2 per cent. As reported as part of the MBSES (Queensland Government, 2006), the sediments have low levels of trace metals/metalloids and other toxicants, although localised outcrops of coffee rock may occur within the deeper sand deposits.

Water clarity within the northern Bay is generally very high, although there is continuous re-suspension of the fine sand particles by the strong tidal currents and the influence of wave action. Median background turbidity levels in the northern delta in the proximity of the Spitfire Realignment Channel are generally less than 10 Nephelometric Turbidity Units (NTU) and mostly less than 5 NTU although they can rise to 10 – 20 NTU in response to large wind events (WBM 2006, Queensland Government 2005).

WBM (2002) within the MBSES, reported on past monitoring studies of suspended sediment plumes undertaken for typical extraction operations in Moreton Bay. Results of the monitoring showed that the direct disturbance of extraction operations can cause a localised, but short-lived increase in suspended sediment. Recorded turbidity plumes are limited in duration and extent (typically less than 200 m) from the disturbed site and the measured turbidity is moderate and well within the limits set by licence conditions. Visible plumes can extend for some distance however the suspended sediment concentrations are only slightly elevated above background levels.

More extensive water quality monitoring has since been undertaken during successive campaigns of the Volvox Asia at the Spitfire Realignment Channel in 2006 (as discussed in WBM 2006) and at Middle Banks when that vessel was commissioned to undertake sand extraction for BAC (BAC, Ben Garnett, pers comm). These monitoring studies have confirmed turbidity levels of approximately 10 - 20 NTU generated by the dredge at defined sampling distances of 50 – 200 m from the vessel, consistent with predicted plume generation and previous monitoring of similar vessels. These plumes have been observed in the field to dissipate rapidly, with a return to background conditions within hours of the cessation of the dredging activity (e.g. between dredge cycles).

Implications for additional allocation

Turbidity monitoring undertaken during recent large scale sand dredging campaigns by a similar TSHD have confirmed the likely plume characteristics as well as duration and magnitude of water quality impacts. Consistent with the predictions of the MBSES, none of these dredging campaigns have led to any detectable medium or long term impact on Bay water quality.

Subsequent to approval of sand extraction activities within the Spitfire Realignment Channel in 2005, the Moreton Bay Marine Park was re-zoned by the Queensland Government in 2008. Marine National Park Zone 03 'Northern Wedge' (a green zone) is now situated to the north of the proposed dredge footprint at Spitfire Banks. This zone is the nearest sensitive receptor to the Spitfire Realignment Channel and is also a High Ecological Value (HEV) Water under the *Environmental Protection (Water) Policy 2008*. As such, a specific assessment of water quality effects from the proposed sand extraction for the SCA Project in this area is discussed in Chapter C3 – Coastal Processes and Water Quality of the EIS.

3.3.2.6 Sediment geochemistry

Key findings

The MBSES Summary of Key Findings (Queensland Government, 2005) reported the following with respect to sediment geochemistry –

The bio-geochemical processes within the surficial sediments of Moreton Bay, such as denitrification and nitrogen fixation, provide an important function in nutrient cycling, water quality and overall ecological health. Sand extraction operations can potentially impact on the bio-geochemical processes by:

a) Long-term alteration of sediment bio-geochemical processes by the removal of shallow sand banks and creation of deeper areas

b) Short-term disruption to sediment bio-geochemical processes caused by artificial disturbance of the surface sediments and therefore altering the normal functioning of nutrient cycling processes.

In addition, the sediments contain dissolved organic and inorganic nutrients that can potentially have porewater concentrations several orders of magnitude greater than in the overlying water column. Disturbance of the sediment profile by sand extraction operations can cause release of porewater nutrients into the adjacent waters and could therefore lead to degradation of water quality.

As part of the MBSES, NIWA (2004) studied the key sediment geochemistry and water quality processes within the sand banks and indicated the following:

- *Denitrification rates in the surface sediments of the sand banks within the study area are higher in the deeper channels than they are on the top of the sand banks*
- *There is no detectable impact of dredging 30 days after it has occurred*
- *Nitrogen fixation rates in the surface sediments of the sand banks are very low both with and without dredging; hence it is unlikely that sand extraction would have a significant impact on these rates*
- *The nutrient content in the porewater of the northern tidal delta sand banks was relatively low and the nutrient released in the plume of a conventional sand extraction operation was unlikely to have a measurable impact on available nutrients, except in the immediate vicinity.*

Overall, the results of the NIWA study indicated that sand extraction in the northern tidal delta is unlikely to have a significant impact on the nutrient cycles in Moreton Bay, especially over the longer term. No evidence could be found for a serious disruption to the microbial processing (nitrogen fixation or denitrification) in the surface sediments with the only potential of large-scale sand extraction being to increase denitrification rates in the sediments of the northern delta by increasing the amount of deeper sandy habitat.

Implications for additional allocation

Based on the above findings, the additional allocation of sand associated with the Project does not pose any risks of increased impacts on sediment geochemistry.

3.3.2.7 Benthic ecology

Key findings

Fauna

In assessing the direct impacts of sand extraction on benthic environments, it should be noted that the surface layers of sand banks within the northern tidal delta are highly mobile under the influence of the prevailing tidal flows and wave action. Despite this dynamic environment, the sandy substrate provides habitats for a range of benthic (bottom dwelling) fauna such as worms and prawns. Some of these fauna are in turn prey species of fish and are therefore important for environmental and commercial reasons.

As the majority of organisms occur in the top 30 cm of the sediment, a typical sand extraction operation would be expected to completely remove all benthic fauna within a dredge site.

As outlined in WBM (2004a) and BAC (2006), recolonisation of benthic fauna to a dredged area may occur via several processes including: passive recolonisation (involving the passive settlement of entrained or otherwise resuspended organisms); larval settlement by planktonic organisms; and post-colonisation invasion of the dredged area by adult and juvenile fauna from neighbouring undisturbed areas

Once recovered from the initial disturbance, the resultant deeper water assemblages after dredging have shown in previous studies to exhibit a larger number of species and overall abundance of macrobenthos. This is consistent with a lower energy environment (less exposed to tidal currents, wave action and sediment transport) at greater depths.

Study results of small scale trials undertaken as part of the MBSES (as outlined in WBM 2004a) indicated rates of recolonisation by organisms from larval dispersal and active colonisation in sand banks from adjacent areas are very high (on the order of hours to days). This can be attributed to the adaptation of faunal species to their highly mobile sand bank habitat. However, the size of disturbance is also a relevant factor; noting that while recolonisation will occur in a short time frame, full 'recovery' of a large dredge footprint could be on the order of months and even possibly years.

More recent field-based benthic ecology studies undertaken at Middle Banks in 2005 as part of the Brisbane Airport parallel runway EIS MDP (BAC, 2006) confirmed that full benthic habitat recovery had been achieved at that location following the original dredging for the airport in 1982 (despite notable changes to the original bathymetry). Likewise, surveys undertaken as part of the current EIS study (see Chapter – C4 Marine Ecology) within the proposed dredge footprint at Spitfire Channel have observed intact benthic ecological communities are present, despite two instances of broad scale disturbance in the area since 2005.

Flora

Dense, permanent seagrass beds do not occur in the northern tidal delta of Moreton Bay owing to the highly mobile substrate present and prevailing tidal flows currents. As part of surveys undertaken for the Port of Brisbane in 2005, WBM observed sparsely distributed seagrass in low abundance (*Halophila ovalis*) on the Western Banks within the Spitfire Realignment Channel. Given its low abundance (located at approximately 15 per cent of the sites sampled, with <5 per cent cover at individual sites), ephemeral nature and marginal habitat value, this seagrass was permitted to be removed as part of the approval of the Project.

The Project will involve a further deepening of the Spitfire Realignment Channel below the current approved depth. This action is unlikely to have a further impact on local seagrass values on the basis that the dredging will result in seabed depths that are either at or beyond the light availability limits of seagrasses that occur in these environments.

Implications for additional allocation

At a regional scale (northern Moreton Bay), there are no specific adverse cumulative impacts to additional sand extraction from the Bay on benthic ecology as the extraction will not be impacting on important benthic flora habitat and the impacts on benthic fauna are temporary.

Site specific impacts on marine ecology from the dredging are discussed later in Chapter C4 – Marine Ecology and are not assessed as having significant residual impacts.

3.3.2.8 Fisheries

Key findings

The MBSES Summary of Key Findings (Queensland Government, 2005) reported the following with respect to fisheries –

The potential impacts on commercial and recreational fisheries are important considerations, as the deeper waters and surrounding estuaries of Moreton Bay contain benthic habitats (e.g. seagrass, mangrove, sand bars and mud flats) essential to many prawn and fish species that are economically important.

A major component of commercial fishing in Moreton Bay is the otter trawl fishery with approximately 200 prawn trawlers operating and taking 10 percent of the total Queensland trawl catch. Catch and effort data of the trawl fishery was extracted from the CHRIS database, administered by the Queensland Department of Primary Industries and Fisheries. Although these data are limited in spatial resolution, it can be concluded that the region encompassing the sand extraction scenario sites at Yule and Spitfire Banks is not a primary location for commercial trawling.

While there is some understanding of the fish, crustacean and mollusc community in Moreton Bay, detailed knowledge of the feeding and other habitat requirements is unavailable. Most of the economically important species would be expected to have broad diets utilising organisms found in the substrate and in the water column. Extractive operations are unlikely to result in detectable medium or long-term changes in the distribution or abundance of these species in Moreton Bay. Furthermore, major impacts to fishing operations are not expected. Any impacts are likely to be of a temporary nature.

Implications for additional allocation

Based on the above findings, the additional allocation of sand associated with the Project does not pose unacceptable, additional risks of impacts to fisheries resources. Additional discussion of the potential impact of the Project on commercial and recreational fishing is contained in Chapters C4 – Marine Ecology and C6 – Other Considerations.

3.3.2.9 Cultural heritage

Key findings

The MBSES Summary of Key Findings (Queensland Government, 2005) reported the following with respect to coastal processes –

Previous cultural heritage work in Moreton Bay has highlighted that the entire landscape and seascape are part of the Indigenous cultural heritage of the region.

Fesl and Davies (2004) completed a specific study of potential impacts of sand extraction in northern Moreton Bay on Indigenous cultural heritage for Phase 2 of the MBSES. A review of available information was undertaken, including the geological investigation by PPK (1997), and key findings were as follows:

- *The area proposed for sand extraction was, prior to the most recent sea level rise (the Holocene marine transgression), a terrestrial plain that was probably used and valued by the original inhabitants at the time.*
- *Much of this pre Holocene (e.g. Pleistocene) land surface is now overlain by sand deposits (typically between 5 and 10 metres thick). However, there is potential for dredging to disturb the ancient land surface and/or significant archaeological items.*
- *Although no specific places of Indigenous cultural significance were identified in the course of the study, it was determined that there is potential for finding Indigenous cultural sites and/or materials in the study area.*

Any sand extraction that impacts upon the prior land surface of the now submerged study area has the potential to impact upon not only Indigenous archaeological and cultural sites/ places that may have been present but also the cultural landscape which has continuing contemporary significance.

Implications for additional allocation

In recognition of these findings, care has been taken as part of the current study to ensure the dredge design does not extend into older pre-Holocene (e.g. Pleistocene) sedimentary layers that have potential cultural heritage significance.

Coffey (2004) undertook a geotechnical survey of six boreholes across the length of the dredge footprint at the Spitfire Realignment Channel as part of the original approval process for the Port of Brisbane. These boreholes all showed unconsolidated sands of Holocene origin to a depth at or below -20 m LAT. The additional extraction depth sought as part of the EIS for the SCA Project will not be below -18 m LAT, meaning older Pleistocene layers will not be disturbed by the Project.

Additional discussion of the potential impact of the Project on cultural heritage is contained in Chapter C6 – Other Considerations.

3.4 CONCLUSIONS AND CUMULATIVE IMPACTS

From a total available sand resource in Moreton Bay of approximately 3,770 M m^3, the Government made a decision in 2005 that over the next 20 years it would support extraction of up to 60 M m^3. In making a decision as part of this EIS to allocate an additional 1.1 M m^3 of sand to support the Project, this combined allocation of 61.1 M m^3 would result in less than 2 per cent of the total sand resource in the Bay.

Consistent with the findings of the MBSES, there are distinct economic, social and environmental benefits of sourcing the required large volume of fill from marine sources as opposed to land based sources. Adopting this approach will reduce the duration of the Project from years to months and is the best option to meet the strict geotechnical engineering requirements of the runway Project in terms of homogeneous fill.

In selecting a marine dredging location, the Spitfire Realignment Channel was chosen as the preferred footprint on the basis that large scale sand extraction is already approved by the Queensland Government in this location, it has a history of past disturbance, and it presents navigational and economic benefits over other alternative sites considered.

Various environmental assessments of offshore sand extraction were undertaken as part of the MBSES. Numerical modelling undertaken as part of the MBSES looked at the hydrodynamic implications of a deep cut at the Spitfire Realignment Channel (down to -21 m LAT) which is a greater depth than is proposed to be removed as part of the current Project.

The numerical modelling has shown that only limited, localised effects would be expected as a result of the proposed sand extraction scenarios. No significant changes in the wave conditions or prevailing tidal currents close to the shoreline would result from the proposed dredging therefore the foreshores of northern Moreton Bay would not experience significant changes in sand transport or shoreline position due to the proposed dredging. Site specific assessments of implications for coastal processes are contained later in this EIS in Chapter C3 – Coastal Processes and Water Quality.

The additional dredging at Spitfire Realignment Channel would have temporary water quality impacts from dredge overflow when operating but given the low fine content of the material (generally less than 2 per cent) will be highly localised and dissipate quickly. Site specific assessments of plume behaviour and dissipation rates are contained later in this EIS in Chapter C3 – Coastal Processes and Water Quality.

Benthic ecology will also be temporarily affected, but will recover through a range of recolonisation processes. In deeper areas, this may mean a more stable and biological diverse community develops, as it may be slightly more protected from wave action. Sparse seagrass detected in previous sampling on the Western Banks is unlikely to be present as a result of the previous approved dredging and deeper profile of the channel that would be created by the current proposal. Site specific assessments of benthic ecology are contained later in this EIS in Chapter C4 – Marine Ecology.

Additional, deeper dredging at the Spitfire Realignment Channel would not have further impacts on commercial and recreational fishing as the works are fully contained within the existing approved footprint. Potential indirect impacts on water quality and benthic fish habitats are assessed as indicated above.

Care has been taken in the selection of a dredge footprint to avoid pre-Holocene sediments that may have indigenous cultural heritage significance. Based on geotechnical data obtained from the Port of Brisbane, the proposed dredge footprint would avoid intersection of these layers.

In conclusion, based on the above findings, the additional allocation of sand associated with the Project is not determined to present any unacceptable cumulative impacts.

3.5 REFERENCES

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