

**Port of Gladstone
Gatcombe and Golding Cutting
Channel Duplication Project**

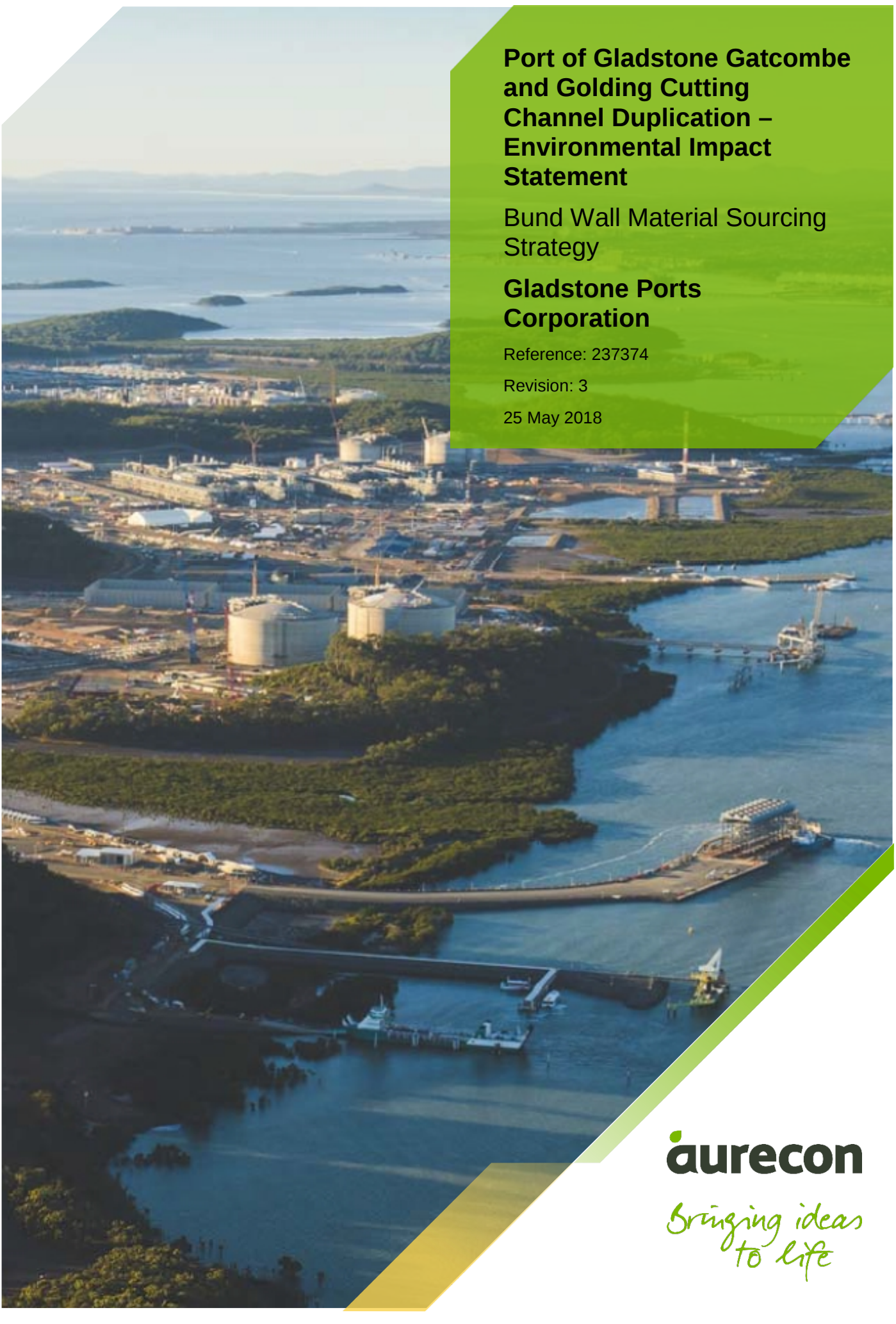
Environmental Impact Statement



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Appendix E7 Bund Wall Material Sourcing Strategy



Port of Gladstone Gatcombe and Golding Cutting Channel Duplication – Environmental Impact Statement

**Bund Wall Material Sourcing
Strategy**

**Gladstone Ports
Corporation**

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*Bringing ideas
to life*

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Acronyms and abbreviations

Abbreviation	Explanation
AS	Australian Standard
BWMSS	Bund Wall Material Sourcing Strategy
CG	Queensland Coordinator-General
CSD	cutter suction dredger
Cth	Commonwealth
DES	Department of Environment and Science
DMPOI	Dredged Material Placement Options Investigation Study
DMTL	Dredged material transfer location
DoEE	Commonwealth Department of the Environment and Energy
DSDIP	former Department of State Development, Infrastructure and Planning now the Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP)
EA	Environmental Authority
EIS	Environmental Impact Statement
EIS Guidelines	Guidelines for an EIS for the Port of Gladstone Gatcombe and Golding Cutting Channel Duplication Project
EP Act	<i>Environmental Protection Act 1994 (Qld)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>
ERA	Environmentally Relevant Activity
GBRMP	Great Barrier Reef Marine Park
GBRMP Reg	<i>Great Barrier Reef Marine Park Regulations 1993 (Cth)</i>
GBRWhA	Great Barrier Reef World Heritage Area
GPC	Gladstone Ports Corporation Ltd
GRC	Gladstone Regional Council
GSDA	Gladstone State Development Area
kg	kilogram
KRA	Key Resource Area
LAT	lowest astronomical tide
m	metres
m ³	cubic metres
Mm ³	million cubic metres
OUV	outstanding universal value
Ports Act	<i>Sustainable Ports Development Act 2015 (Qld)</i>
Project	Port of Gladstone Gatcombe and Golding Cutting Channel Duplication Project
QER	Queensland Energy Resources
Qld	Queensland
Reef 2050	Reef 2050 Long-Term Sustainability Plan
SDPWO Act	<i>State Development and Public Works Organisation Act 1971 (Qld)</i>
t	tonne
ToR	Port of Gladstone Gatcombe and Golding Cutting Channel Duplication Project Terms of Reference for an EIS
TSHD	trailing suction hopper dredger

Abbreviation	Explanation
WBDDP	Western Basin Dredging and Disposal Project
WBE reclamation area	Western Basin Expansion reclamation area

EXPLANATORY NOTE

March 2019

This Bund Wall Material Sourcing Strategy was finalised in May 2018 to support the Port of Gladstone Gatcombe and Golding Cutting Channel Duplication Project Environmental Impact Statement (EIS).

This report presents the Project dredging methodology that was relevant and in effect at that time.

Between July 2018 and December 2018, the Project dredging methodology was amended to comply with the Sustainable Ports Development Act 2015 (Qld), however there was no change to the preferred dredged material placement area that was included in this report.

In this regard, this report has been provided in the Gatcombe and Golding Cutting Channel Duplication Project EIS as an assessment of the potential feasible borrow sources and associated transport route options for the material needed to construct the outer bund walls for the Western Basin Expansion reclamation area and barge unloading facility. The preferred borrow source scenario defined in this report has been used in the detailed impact assessment within the Project EIS.

1 Introduction

1.1 Project background

1.1.1 Overview

Gladstone Ports Corporation Limited (GPC) proposes to undertake the Gatcombe and Golding Cutting Channel Duplication Project (the Project), which involves the deepening of the existing Gatcombe and Golding Cutting bypass shipping channels, and the construction and operation of associated port infrastructure within the Port of Gladstone. The Project is required to improve Port of Gladstone operational and economical efficiencies, and improve the existing and future safe passage of vessels within the Port as throughput and associated vessel numbers increase, and the portion of predicted Capesize vessels also increases.

The key components of the Project include:

- Construction of the Western Basin Expansion (WBE) reclamation area bund walls prior to dredging commencing
- Initial dredging works by a cutter suction dredger (CSD) of approximately 1.52 million cubic metres (Mm³) of seabed material (including dredging tolerance) to establish a dredger access channel and dredged material transfer location (DMTL) to allow a dredger to transport dredged material from the Gatcombe and Golding Cutting shipping channels. The initial dredging works material will be placed directly within the existing Western Basin reclamation area and/or the WBE reclamation area.
- Dredging by a trailing suction hopper dredger (TSHD) of approximately 12.6Mm³ of seabed material (including dredging tolerance) to permanently duplicate the Gatcombe and Golding Cutting shipping channels
- A dredging methodology involving up to two dredgers (i.e. CSD and TSHD) to transport dredged material from the Gatcombe and Golding Cutting bypass shipping channels for placement and beneficial reuse within the WBE reclamation area
- Dredged material dewatering management within the WBE reclamation area
- Removal, relocation and installation of new navigational aids
- Maintenance activities on the WBE reclamation area.

Construction of the WBE reclamation area is expected to commence in 2020 or later. The dredging for the Project is expected to commence in 2023, however the timing of the commencement could be after this time subject to actual and predicted Port throughput and associated vessel movements over the next 5 to 10 years.

The initial dredging works involves dredging the dredger access channel within the existing Targinie channel to a design depth of -11.0 metres (m) lowest astronomical tide (LAT), and the DMTL to a design depth of -18.0m LAT. The initial dredging works will take approximately 2 months.

Dredging of the Gatcombe and Golding Cutting shipping channels will occur in either a single stage, dredging to the final depth of -16.1m LAT over approximately 17 months, or over two stages. Stage 1 would involve dredging approximately 7.25Mm³ of material to -13.5m LAT over a period of 10 months. Stage 2 involves dredging of approximately 5.35Mm³ of material to the depth of -16.1m LAT over approximately 7 months. The area to be dredged for the Project has been designed to best accommodate the existing and future users of the Port, minimise the potential environmental impact associated with dredging and minimise the dredged material volumes associated with both capital and maintenance dredging requirements.

1.1.2 Project status

The Project was declared a 'coordinated project' by the Queensland Coordinator-General (CG) under the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act) on 25 September 2012. The Project was also determined to be a 'controlled action' requiring an Environmental Impact Statement (EIS) by the Commonwealth Minister for the Environment under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) on 23 October 2012.

GPC is currently proceeding with the EIS phase of the Project. The EIS will be submitted for parallel assessment to both the CG under the SDPWO Act and the Commonwealth Environment Minister (Department of the Environment and Energy (DoEE)) under the EPBC Act.

1.1.3 Dredged material placement options

Aurecon, together with GPC, has undertaken a Dredged Material Placement Options Investigation (DMPOI) study primarily to identify a potential dredged material placement site for the 14.12Mm³ of dredged material for the Project. Notwithstanding this primary objective, the DMPOI has also sought to support a strategic approach to planning the long term dredging needs of the Port of Gladstone by considering whether any of the identified placement sites would be more appropriately/efficiently used if prioritised for other future Port dredging requirements.

Whilst the main portion of the original DMPOI study was completed in 2013-2014, significant changes in government policy and environmental regulation occurred in 2015. These changes required the preparation of a Supplementary DMPOI to ensure legislative compliance could be achieved. These key changes included:

- Reef 2050 Long-Term Sustainability Plan (Reef 2050)
 - Released by the Australian and Queensland Governments in March 2015, Reef 2050 presents actions to protect the Outstanding Universal Value (OUV) of the Great Barrier Reef World Heritage Area (GBRWhA), whilst supporting ecologically sustainable development. The Reef 2050 included a port-related action to undertake port master mapping for the priority ports of Gladstone, Abbot Point, Townsville and Hay Point/Mackay, and committed to limiting port-related capital dredging in the GBRWhA to the four priority ports and supporting the prohibition of sea-based placement of capital dredged material in the restricted area.
- Sustainable Ports Development Act 2015 (Qld) (Ports Act)
 - The Ports Act provides a legislative framework for the protection of the GBRWhA through managing port-related development in and adjacent to the area. The Ports Act gives legislative effect to the Queensland Government's key port-related commitments in Reef 2050. As a result of its enactment, the Ports Act:
 - Restricts new port development in and adjoining the GBRWhA to within current port limits and outside both the Commonwealth Great Barrier Reef Marine Park (GBRMP) and State Great Barrier Reef Coast Marine Park
 - Prohibits capital dredging for the development of new, or the expansion of, existing port facilities within the GBRWhA outside the four identified priority ports of Gladstone, Abbot Point, Townsville and Hay Point/Mackay
 - Prohibits the sea-based placement of port-related capital dredged material within the restricted area (which includes any area within the GBRWhA, including within port limits but outside the GBRMP) unless the material is beneficially reused
- Great Barrier Reef Marine Park Regulations 1983 (Cth) (GBRMP Reg)
 - The GBRMP Reg prescribes limitations on the granting of permission for 'prohibited dumping', which prohibit the sea-based placement of an amount of capital dredged material that prior to its excavation was, in situ, greater than 15,000 cubic metres (m³) in volume.

At the conclusion of the Supplementary DMPOI study, the WBE reclamation area was identified as the preferred site for dredged material placement.

1.1.4 Additional investigations

In addition to identifying the WBE reclamation area as the preferred location for dredged material placement, the DMPOI study also highlighted the need to undertake additional investigations to support further assessment of the dredged material placement location in accordance with DoEE's 'Guidelines for an EIS for the Port of Gladstone Gatcombe and Golding Cutting Channel Duplication Project' (EIS Guidelines) and the CG's 'Port of Gladstone Gatcombe and Golding Cutting Channel Duplication Project Terms of Reference for an EIS' (ToR). These included:

- Development of a preliminary concept design, including:
 - Site configuration and scale
 - The location and nature of tail water discharge points
 - Existing levels and proposed final levels
 - Design options for protection from the impacts of coastal processes
- Development of a preliminary construction methodology
- Development of a Bund Wall Material Sourcing Strategy (BWMSS) to identify:
 - Material types, quantities and sourcing options to support construction of the outer bund wall
 - Timeframe estimates of construction commencement, completion and rates of progress.

1.2 Purpose

This report presents the methodology and findings of the BWMSS completed to support the EIS project definition phase for the Project. Specifically, this BWMSS has been undertaken to support the identification of a feasible borrow source(s) and associated transport route (borrow source scenario) for the material needed to construct the outer bund walls for the WBE reclamation area. The preferred borrow source scenario will then inform the detailed impact assessment to be undertaken in the EIS.

1.3 Scope

The BWMSS progresses those key additional investigation recommendations from the DMPOI which are necessary to support identification of a preferred borrow source scenario for the WBE reclamation area, in turn supporting a detailed impact assessment to be undertaken in the EIS. The scope of the BWMSS comprises:

- Development of a preliminary concept design and schedule of material requirements (i.e. types, quantities and specifications) for the WBE reclamation area
- Identification of potential borrow sources within the Gladstone region where material could be won/commercially supplied (considering existing operational quarries, as well as brownfield and greenfield sites)
- Sourcing of information to assess the feasibility of each potential borrow source, including resource types, quantities, quality and availability of supply
- Consideration of transport and logistic needs for each borrow source (i.e. haul routes by land and any associated temporary infrastructure)
- Identification of a preferred borrow source/transport logistic scenario for the WBE reclamation area, together with recommendations regarding any additional outstanding information or actions required.

1.4 Methodology

This BWMSS has been completed in four stages, with the details of each stage and the key tasks and outputs summarised in Table 1.1.

Table 1.1 Bund wall material sourcing strategy methodology

Stage	Report section	Methodology	
		Tasks	Output
Stage one Preliminary concept design and material requirements	Section 2	■ Undertake a review of all existing available site information for the WBE reclamation area, including geotechnical data obtained to date, to support the preparation of a preliminary concept design ■ Identify the material types, specifications and approximate quantities required for each of the following key material components: – Primary armour – Secondary armour – Core material	■ Preliminary concept design – General arrangement – Typical cross section of the outer bund wall ■ Material specification for the outer bund wall
Stage two Identification of potential borrow source options	Section 3	■ Investigate potential borrow source sites within the Gladstone region which could be used to fulfil the outer bund wall material requirements, with consideration given to existing commercial quarries, including the GPC Ticor Quarry (utilised for the Western Basin Dredging and Disposal Project), as well as potential greenfield and brownfield sites ■ Undertake a desktop geological and topographical review to determine indicative greenfield resource potential within the Gladstone region, focussing primarily on hard rock ■ Undertake a desktop review of existing Key Resource Areas (KRAs) within the Gladstone region, and their known material characteristics to investigate existing commercial quarries and brownfield sites ■ Engage with key agencies and industry to determine potential sources and material availability, including: – Gladstone Regional Council (local government area opportunities) – Former Department of State Development (now the Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP) (Gladstone State Development Area (GSDA) opportunities) – Existing quarry operators	■ Identification of the most feasible borrow source options to assess in further detail in Stage three.
Stage three Assessment of borrow source options and transport scenarios	Section 4	■ Confirmation of material availability, type and quality associated with obtaining material from each potential borrow source ■ Identification of feasible transport and logistics scenarios for each potential borrow source, including: – Identification of the most likely transportation routes ■ Consider transport and logistics for each of the five borrow site options, including: – Identification of the most likely transportation routes from each borrow source to the WBE reclamation area (considering by road and/or rail) – Identification of any temporary infrastructure which may be required to facilitate transport and construction (i.e. haul roads, marine infrastructure and laydown areas) ■ Consideration of other potential material options	■ For each borrow source: – Summary of material availability, quantity and quality – Potential transport and logistics scenario/s – Potential opportunities, constraints and risks – Regulatory requirements

Stage	Report section	Methodology	
		Tasks	Output
Stage four Preferred scenario and recommendations	Section 5	■ Undertake a comparative options assessment of the five borrow site options and provide a recommendation regarding the preferred borrow source to be considered as part of the EIS process, having regard to the potential opportunities and constraints associated with: – Material availability – Transport and logistics – Potential planning and environmental development issues (regulatory requirements) – Project delivery risks	■ Identification of a preferred borrow source scenario

1.5 Assumptions

In preparing this BW MSS, the following assumptions have been made:

- Reclamation construction methodology and material placement:
 - Due to its location, material can be most effectively supplied to the WBE reclamation area by land (direct truck delivery). Material transported from the borrow source via road direct to the bund construction area is tipped/unloaded where required, without the need for stockpiling or re-handling.
- Logistics and haulage:
 - Logistics scenarios have been developed based on the assumption of a construction period of no more than two years for each WBE reclamation area (i.e. southern area and northern area)
 - Calculation of the number of trips required in developing a transport scenario for each borrow source option has assumed the following:
 - Transport via public road is by B-Double¹ with a 40 tonne (t) payload
 - Transport via private haul road is by Moxy² with a 40t payload
 - Transport via rail is by 50 wagon train, with each wagon having a capacity of 80t, resulting in a total payload of 4,000t per train
 - The use of rail as a logistics option assumes the use of the existing Fisherman's Landing Rail Loop
 - For comparative purposes, a single indicative delivery site has been nominated for all borrow source logistics options.

1.6 Limitations

The limitations and assumptions relevant to this strategy are:

- In preparing the BW MSS, Aurecon has relied upon the preliminary concept design prepared and provided by GPC for the WBE reclamation area (refer Appendix A). Given its preliminary design phase status, the design, along with associated material types and quantities (upon which this BW MSS is based) are subject to change as the Project progresses.
- Investigations have been limited to desktop assessment only (with the exception of undertaking stakeholder consultation in 2015), and is therefore reliant upon the accuracy and availability of government database mapping and information. No field investigations or geotechnical testing has been undertaken by Aurecon.
- The BW MSS has undertaken a comparative assessment of quarry options with preference given to the identification of a single preferred quarry source option to support the EIS Project definition phase. Notwithstanding this, multiple quarry options may be considered if required, in the future.
- Information regarding material type, quality and availability presented in this report is based on information provided by each commercial quarry operator. Whilst copies of testing certificates have been obtained, no validation investigations or independent testing has been undertaken.
- Whilst this strategy has considered the use of rail as a logistics option, the scope has excluded consideration and detailed assessment of rail network availability and access.
- Final transport trip numbers are indicative only based on the current concept design and are subject to revision and finalisation as part of detailed design

¹ B-Double refers to a heavy vehicle consisting of a prime mover towing two semi-trailers

² Moxy truck refers to an articulated hauler (dump truck) specifically designed for off-road use

- The majority of investigations undertaken as part of this BWMSS were undertaken in 2015, as a result it is recommended that further bund wall material sourcing investigations be undertaken during the WBE reclamation area detailed design phase to confirm the source(s) of the bund wall material.

2 Stage one – preliminary concept design and material requirements

2.1 Preliminary concept design

As part of Stage one, preliminary concept designs for the WBE reclamation area were developed by GPC for input into the BWMSS. These include:

- Development of a preliminary outer bund wall layout (general arrangement) and calculation of total dredged material storage capacity
- Typical bund cross sections for the outer bund wall.

Refer to the general arrangement and typical bund wall cross section drawings contained in Appendix A.

2.2 Material specifications

Following completion of the preliminary concept designs, calculations of the material types, specifications/grading and quantity estimates were undertaken by GPC.

2.2.1 Material type

Given that the Project involves reclamation within the coastal environment, and with consideration to the design and material specifications required, the material type sourced must satisfy several key requirements (i.e. including strength, durability and size). The material types required for the Project fall generally within the following categories:

- Armour – hard, durable rock, of a size suitable for use in the marine environment, particularly for the purposes of forming the outer layer of the bund wall as revetment/armouring to withstand the coastal processes of the location
- Core – hard, durable rock also suitable for use in the marine environment, but typically of a smaller size to the armour, for it to be used as the key material forming the inner portion ('core') of the bund wall.

2.2.2 Specifications/gradings and quantities

Table 2.1 summarises the rock type, specifications/gradings and estimated design quantities developed by GPC for the WBE reclamation area outer bund wall.

Table 2.1 Material type and volume requirements for the WBE reclamation area outer bund wall

Type	Weight range (kg)	Southern area approximate quantity (m ³)	Northern area approximate quantity (m ³)	Total approximate quantity (m ³)
Armour	200 to 300	60,000	113,000	173,000
Core	10 to 100	387,568	567,730	955,298
Total rock volumes (m³)	-	447,568	680,730	1,128,298

Table notes:

Rock density 2.6 m³/t

Quantity volumes are based on a 1.3 allowance for sinkage and contingency

Core material will contain fines (approximately 5% to 10%) to assist in the sealing of the outer bund wall

3 Stage two – identification of potential borrow source options

3.1 Overview

Stage two of the BWMS involved undertaking a review of available regional information to identify potential borrow source options (sites) with the Gladstone region. This assessment included:

- Review of existing operational commercial quarries and KRAs (i.e. known proven extractive resources)
- Stakeholder discussions with State and local government representatives to identify other potential opportunities (i.e. known proven or unproven extractive resources)
- Completion of a desktop geological investigation to assess geological formations in relation to existing proven resources and potential new sites (i.e. unproven greenfield extractive resources).

3.2 Review of existing Key Resource Areas and commercial quarries

Within the Gladstone region there are a number of existing operational quarries that produce hard rock suitable for use in the construction of the WBE reclamation area. A number of these operational quarries are also identified as KRAs. KRAs are extractive resource areas that are of State or regional significance. KRAs are identified and are afforded protection against incompatible land uses through the State Planning Policy. KRAs are identified based on one or more of the following criteria:

- Size – the size of the extractive resource is equal to or greater than the annual demand for the commodity type in its region or sub-region
- Production – the extractive resource is capable of producing 5% of annual demand for the commodity type in its region or sub-region
- Market – the extractive resource can supply more than one significant part of the region or sub-region
- Scarcity – the extractive resource has particular physical properties that are scarce in the region or sub-region
- Specialised – the extractive resource is a specialised resource needed for strategic infrastructure.

Each KRA consists of a:

- Resource/processing area – the extent of the extractive resource and any operational areas associated with extraction and processing
- Separation area – the area surrounding the resource/processing areas required to maintain separation from sensitive receptors
- Transport route – the route used to transport extracted resource to market, comprising a road or rail link from the boundary of the resource/processing area to the nearest major road or railway line
- Transport route separation area – the area surrounding the transport route needed to maintain separation from sensitive receptors.

Table 3.1 summarises the location, type and current operators of existing commercial quarry operations within the Gladstone region, together with the associated KRA description, where applicable.

Table 3.1 Existing KRAs and commercial quarries within the Gladstone region

Key resource area		Quarry operator	Location	Extractive resource type	Project suitability
Number	Name				
19	Targoola	Sibelco Australia	Charters Crossing Road, Targoola	Quarry rock	Armour rock core material
20	Yarwun	Earth Commodities Gladstone Pty Ltd	Quarry Road, Yarwun	Quarry rock	Armour rock
117	Iveragh	-	Tannum Sands Road, Tannum Sands	Sand	Not suitable
118	Tannum	-	Tannum Sands Road/Bruce Highway, Tannum Sands	Sand and gravel	Not suitable
119	Targinnie	Butlers Yarwun Quarries³	Gladstone-Mt Larcom Road, Targinnie	Quarry rock	Armour rock core material
136	Calliope River	-	Carrara Road/Bruce Highway, north of the Calliope River	Sand	Not suitable
157	Wooderson	D&D Quarries	Dawson Highway, Wooderson	Quarry rock	Armour rock core material
N/A	N/A	Capricorn Quarries	Power Station Road, Stanwell	Quarry rock – all types	Armour rock core material
N/A	N/A	GPC Ticor Quarry	Guerassimoff Road, Yarwun	Quarry rock – all types	Armour rock core material

Upon review of the KRAs within the Gladstone region, KRA 117 (Iveragh), KRA 118 (Tannum) and KRA 136 (Calliope River) were identified as extractive resources for sand/gravel. Given that these quarries could not meet the Project requirement for hard rock, they were not considered further in the BWMSS.

For the purposes of this report, each hard rock commercial quarry is referred to by its respective quarry operator name as identified in Table 3.1.

3.3 Stakeholder discussions

3.3.1 Input sought

Stakeholder input was sought from State and local government representatives to identify other potential borrow source locations or opportunities where suitable material might be available. This included consideration of potential greenfield and brownfield sites, with either proven or unproven extractive resource potential.

In addition, input was also sought regarding the existence of any large sites or areas of land which may be subject to future planned development, or which had been identified for future strategic development needs, and for which may benefit from a substantial amount of extraction/excavation.

³ Prior to mid-2016, the quarry was owned and operated by Yarwun Commercial Quarries

3.3.2 Summary of feedback

Gladstone Regional Council

Gladstone Regional Council (GRC) advised that whilst they were not aware of any additional hard rock sources (proven or unproven), an existing borrow source was being utilised on an ongoing basis by GRC to supply material for their civil works.

Located on Goodman Road (off Narrow Road), north east of Mt Larcom, and identified as Lot 5 on RP615603, the resource was described by GRC as granite type material. GRC advised that material can be extracted via dozer operation, without the need for blasting.

Further desktop investigations following the discussion with GRC identified that Lot 5 on RP615603 formed one of several continuous land parcels in the area owned by Esso Australia Resources Ltd (property ownership information sourced through CoreLogic), and subject to a granted oil shale Mineral Development Licence (MDL 179). The extent of land holding, including Lot 5 on RP615603 (shaded blue) is illustrated in Figure 3.1.



Figure 3.1 Esso Australia Resources Ltd land holdings

State government

The former Department of State Development, Infrastructure and Planning (DSDIP) now DSDMIP were also contacted regarding potential borrow source opportunities within the GSDA however no potential additional locations with suitable hard rock were identified.

3.4 Desktop geological investigation

A desktop geological investigation was undertaken to determine the location and extent of regional geological formations in relation to existing proven resources (existing commercial quarries), together with potential new unproven resources (greenfield sites).

3.4.1 Proven resources

A review of the Rockhampton and Monto geological maps (sheets SF 56-13 and SG 56-1 from the Geological Survey of Queensland 1:250,000 series) show that existing quarries are generally extracting material from individual hard rock beds. These beds are typically found within geological formations consisting of layered sequences of mixed rock types. The mixed rock types contain Targinnie Adamellite, a high quality granitic rock that appears to be extracted by quarry operators, including Earth Commodities, Yarwun Commercial Quarries and the GPC Ticor Quarry.

There are also numerous small limestone deposits throughout the Gladstone region. Limestone is a potentially suitable source rock and has been quarried successfully by Sibelco Australia but the deposits in the region tend to occur as narrow discontinuous deposits and it may be difficult to obtain sufficient reserves in any one deposit.

3.4.2 Unproven resources

The regional geology of the Gladstone area is complex, and given that existing proven operations are generally extracting material from individual hard rock beds or small localised deposits, the task of predicting the occurrence of comparable deposits (to identify new greenfield sites) within the same geological formation is a significant challenge which carries commercial risks.

It is anticipated that a targeted exploration program would be required to identify and quantify the size of any potential greenfield quarry sources, such as the land owned by Esso Australia Resources Ltd. Although possible, it is unlikely to be economical when compared to the number and size of existing 'proven' established quarry operations within the region.

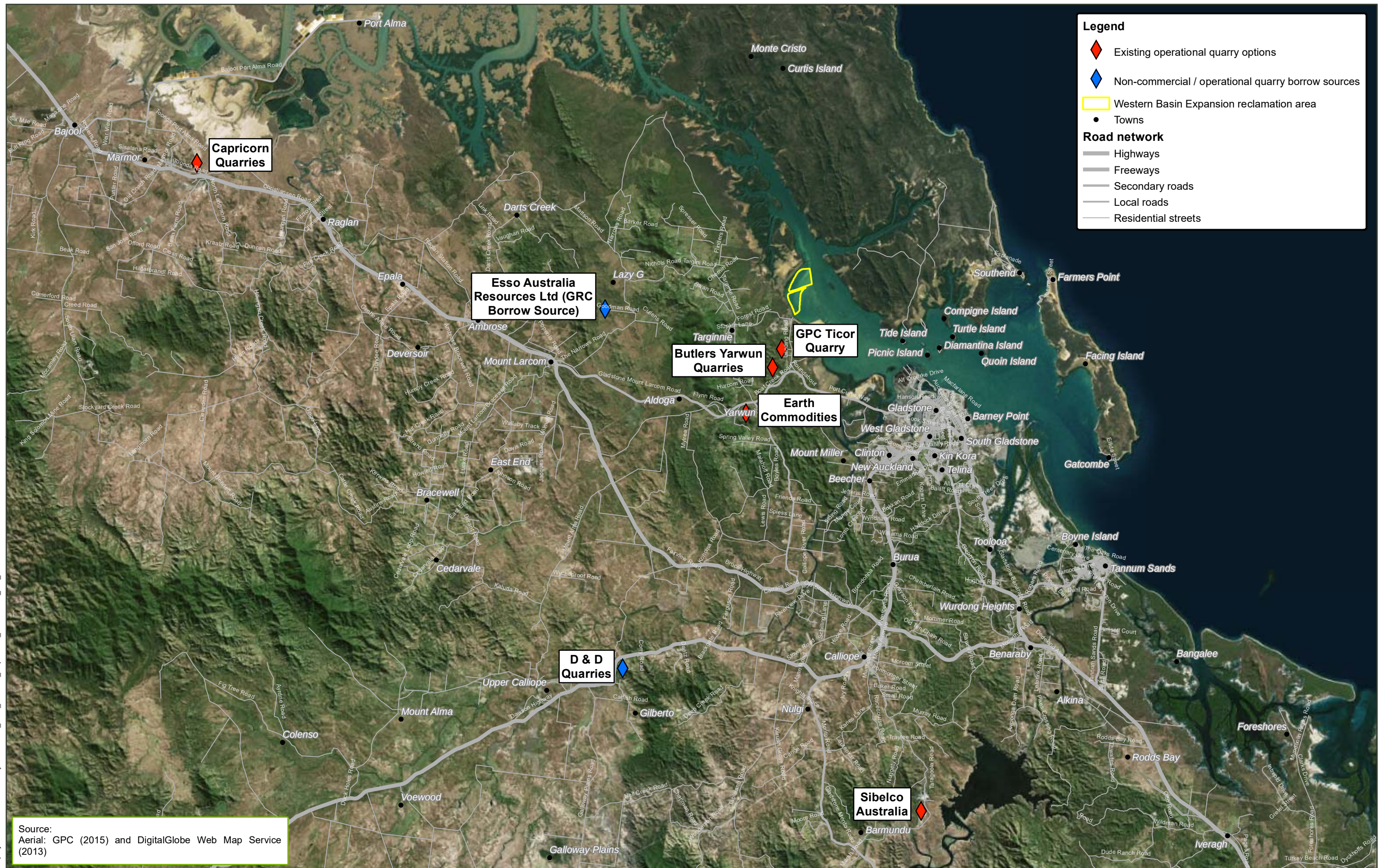
3.5 Progression of options

Having regard to the number of existing proven and operational hard rock quarries within the Gladstone region, and the comparative unproven extractive resources potential of the Esso Australia Resources Ltd site, it was decided that the Esso site, as a greenfield option would not be progressed further in the BWMSS.

Following the desktop site background and geological investigations, together with stakeholder discussions to identify and review each of the potential borrow source options, the following sites (borrow source options) were chosen to progress to the Stage three feasibility assessment:

- Sibelco Australia
- Earth Commodities Gladstone
- Butlers Yarwun Quarries
- D&D Quarries
- Capricorn Quarries
- GPC Ticor Quarry.

The location of each of these borrow source options are shown in Figure 3.2.



Gatcombe and Golding Cutting Channel Duplication Project

Figure 3.2: Potential borrow source options

4 Stage three – assessment of borrow source options and transport scenarios

4.1 Overview

4.1.1 Scope of assessment

Stage three of the BWSS involved undertaking an assessment of the shortlisted borrow source options, identifying:

- Material quality, quantity and availability at each borrow source option
- Potential transport and logistics scenarios associated with transporting material from each borrow source to the WBE reclamation area, and assessing the feasibility of these scenarios
- Potential opportunities, constraints and risks, together with regulatory requirements associated with each borrow source option (covering extraction and haulage activities).

4.1.2 Preferred borrow source options

Utilising the Project's material specification requirements developed in stage one, each of the commercial quarry operators were approached to advise on their ability to supply the type and quantity of material needed for the WBE reclamation area outer bund wall. Each of the commercial quarries agreed to provide the preliminary information requested with the exception of Sibelco Australia. Sibelco Australia opted not to provide a quotation citing constraints in the specification and given the preliminary nature of the study. As a result, the Sibelco Australia site was not progressed further in the BWSS.

In addition to the commercial quarry operators, information was also requested from GPC regarding their GPC Ticor Quarry, which was utilised for the Western Basin Dredging and Disposal Project (WBDDP).

4.1.3 Material supply

Each quarry was requested to provide an indication of their ability to satisfy the following requirements:

- Provide a hard, durable product suitable for use as a revetment rock in a marine environment
- Produce a product capable of meeting the size and weight specifications defined by the Project
- Supply the product in the quantities defined by the Project.

Given the current stage of the Project, no proof of resource size or supply capability was requested of the quarry operators. However, confirmation of the material strength and durability (in the form of laboratory testing certificates) was requested and subsequently supplied by all quarry operators with the exception of Earth Commodities.

4.1.4 Transport logistics

In parallel with requesting the required material supply information from each quarry, a review of potential transport route and logistic options was undertaken from each borrow source option to the WBE reclamation area. This review included:

- Identification of the most likely transportation routes, considering road (public roads and private haul roads) and rail modes

- Identification of any temporary infrastructure which may be required to facilitate transport and construction (i.e. haul roads and rail infrastructure).

4.2 Option one – Butlers Yarwun Quarries

4.2.1 Locality

Butlers Yarwun Quarries is a well-established hard rock quarry, located on Guerassimoff Road (on the northern side of Gladstone Mount Larcom Road), approximately 3 kilometres (km) southwest of Fisherman's Landing within the GSDA and approximately 5km from the WBE reclamation area.

4.2.2 Material quality and availability

Butlers Yarwun Quarries (formerly Yarwun Commercial Quarries) has a long-standing history of supplying quarry rock to the Gladstone region, including for the purposes of revetment works. The deposit at the Butlers Yarwun Quarries site most likely consists of sedimentary and igneous rocks that have undergone varying degrees of metamorphism over time.

A petrographic report supplied by Butlers Yarwun Quarries classifies the tested rock as 'hard, strong and durable' and suitable for use as 'rip rap' and 'marine armour rock and dimension stone, provided blocks of sufficient size can be quarried'. Results of laboratory point load strength testing (on samples soaked for 48 hours) show the tested rock to be of 'high to very high strength' in accordance with Australian Standard (AS) 1726: *Geotechnical site investigations*.

The quarry (at the time owned and operated by Yarwun Commercial Quarries) provided confirmation they could supply all materials in accordance with the Project specifications (type and quantity) for the outer bund wall, noting however that some additional sorting and processing of materials may be required as not all material types within the Project specification fell within the standard trommel processing size.

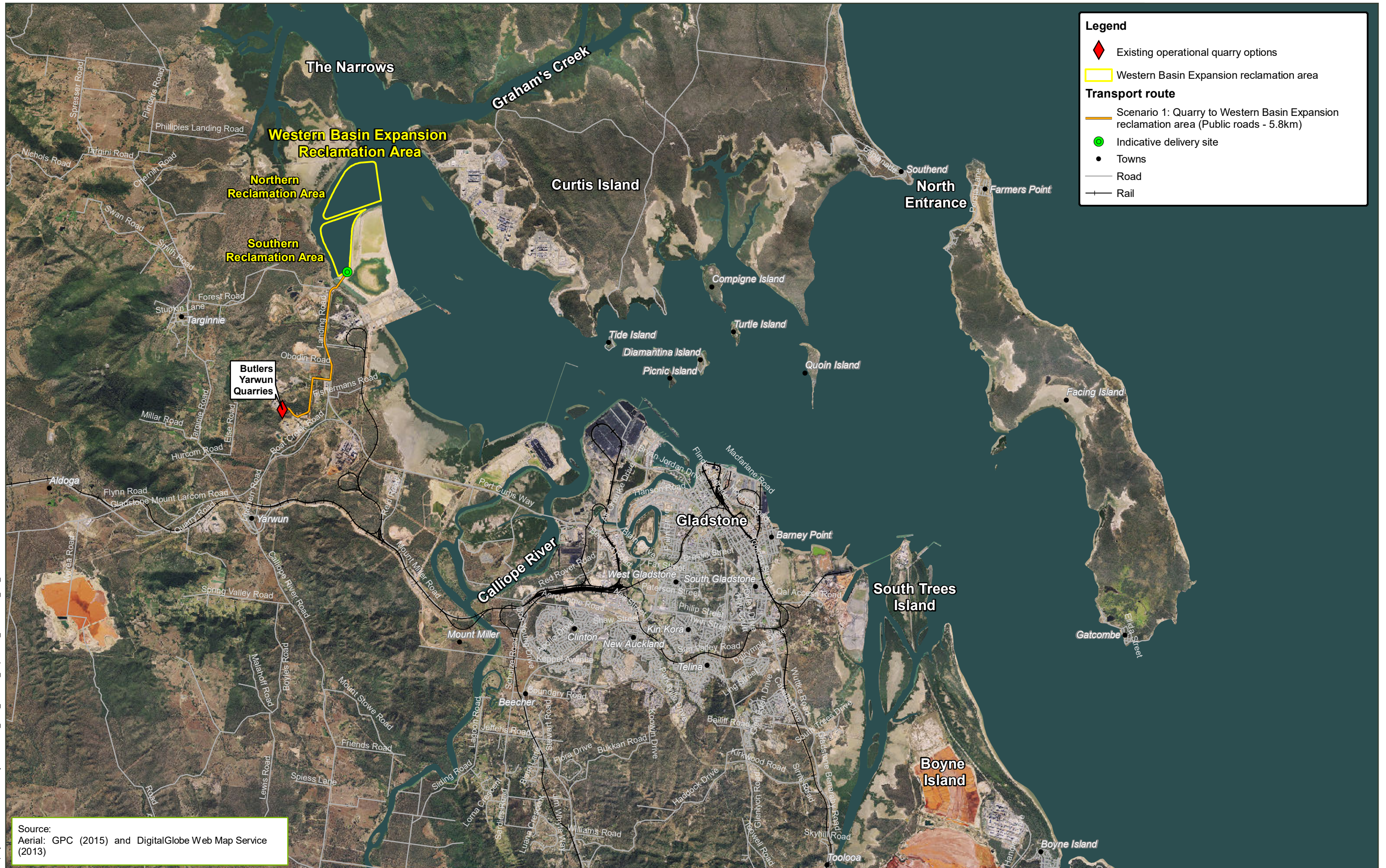
4.2.3 Assumptions, risks and opportunities

At the time of response, the quarry had identified a potential opportunity to reduce effort (and therefore potential future cost) of supply by revising the material specification to match standard trommel sizes.

4.2.4 Transport and logistics options

The potential transport and logistics options below have been considered from the Butlers Yarwun Quarries site to the WBE reclamation area and where identified as feasible have been illustrated on Figure 4.1.

- **Public roads** – the existing public roads of Guerassimoff Road and Landing Road could be utilised, which would comprise a route length of approximately 5.8km. A total of 73,340 (one way) trips would be required (assuming B-Doubles with 40t payload). It is however noted that GRC is likely to impose infrastructure charges for the use of GRC's local government roads (e.g. Guerassimoff Road), increasing the total cost of this option.
- **Haul road** – if a haul road were to be established from the Butlers Yarwun Quarries to the WBE reclamation area it would likely require the haul road route to pass through the GPC Ticor Quarry site. The practicalities of such an option are however unlikely to be feasible given the physical and operational obstacles that are anticipated to be encountered associated with designing, constructing and operating a haul road in a manner that avoids impacts to quarry infrastructure and operational areas within the GPC Ticor Quarry site. It is however noted that the usage of a haul road would result in the Project avoiding infrastructure charges to GRC associated with the use of public roads.



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Gatcombe and Golding Cutting Channel Duplication Project

Figure 4.1: Transport scenario options - Butler's Yarwun Quarries

- **Rail** – owing to the proximity of the Butlers Yarwun Quarries site in relation to the WBE reclamation area and the existing Fisherman's Landing Rail Line, there are no logistically or economically feasible rail transport options for this borrow source.

Transport scenario summary

Table 4.1 summarises the feasible transport scenario (Scenario 1) from Butlers Yarwun Quarries to the WBE reclamation area. The scenario is also illustrated on Figure 4.1.

Table 4.1 Butlers Yarwun Quarries transport scenario

Transport scenario	Mode and distance	Number of trips required (one way)		
		Public road	Haul road	Rail
Scenario 1	Public roads via Guerassimoff Road and Landing Road (approximately 5.8km)	73,340	-	-

4.2.5 Regulatory requirements

The following regulatory requirements are anticipated in the instance that Butlers Yarwun Quarries is utilised to supply material for the Project:

- Butlers Yarwun Quarries would, as an existing commercial quarry operator, be responsible for any approvals required to undertake extraction activities (and any associated crushing, grinding, milling or screening as required) within the operational site and haulage to the WBE reclamation area on public roads. However, it is assumed that the necessary regulatory requirements would already be held.

Searches of permit and operator databases maintained by the Department of Environment and Science (DES) have identified that Butlers Yarwun Quarries currently holds:

- An existing Environmental Authority (EA) under the *Environmental Protection Act 1994* (Qld) (EP Act) (EA No. EPPR00510113) authorising the undertaking of Environmentally Relevant Activity (ERA) 16 – Extractive Activities, which include extractive and screening activities greater than 1,000,000 tonnes (t)/year
- Suitable Operator Registration (Ref. RSO000601) under the EP Act.

4.3 Option two – Earth Commodities Gladstone

4.3.1 Locality

Earth Commodities Gladstone is a well-established hard rock quarry located on Quarry Road, accessed via Mount Larcom-Yarwun Road (off Gladstone Mount Larcom Road), Yarwun, approximately 1km west of the township of Yarwun and approximately 11km from the WBE reclamation area. The Earth Commodities Gladstone site is located adjacent to the North Coast Rail Line.

4.3.2 Material quality and availability

The deposit at the Earth Commodities Gladstone quarry site is located at the contact between the sedimentary Berserker Bed and intrusive Targinnie Adamellite. The process of intrusion has resulted in metamorphism of the Berserker Bed along the contact margin, resulting in a mix of metamorphic and igneous rock throughout the quarry site. Quarried rock typically consists of hornfels, granite and volcanoclastic rocks. The resource is primarily used to produce road base, rail ballast and gabion rock, and is typically not used to produce larger revetment rock.

At the time of enquiry, Earth Commodities Gladstone estimated the size of their reserve to be in the order of 15 million tonnes, however due to the nature of the deposit and their current operational setup, Earth Commodities Gladstone would only be able to supply the core material component of the Project specification. Earth Commodities Gladstone were asked to provide an expression of interest regarding production of the larger size armour material however the offer was declined.

Earth Commodities Gladstone confirmed that whilst they could not provide the armour rock component of the material specification, they could provide the core material.

4.3.3 Assumptions, risks and opportunities

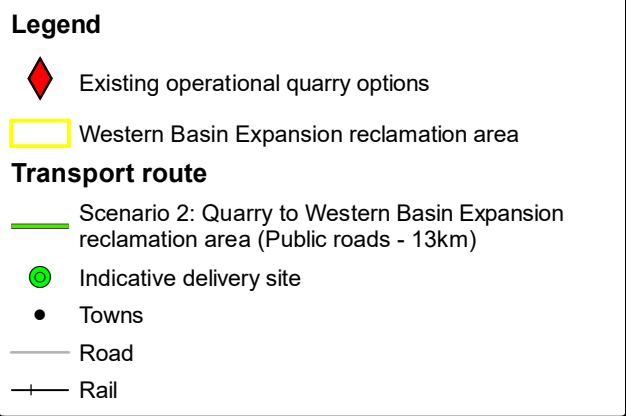
Although Earth Commodities Gladstone is not capable of supplying larger sized armour rock, there is an opportunity to use the quarry to supplement supply of the large volume of smaller core rock required by the Project. The quarry could also be used as a supplementary source of smaller core rock to reduce the risk of supply issues (i.e. shortages, etc) throughout the duration of the Project.

It should be noted that the density of supplied material (1.35t/m³) has been assumed by the quarry operator, however this is lower than what could typically be expected from a loose core run material.

4.3.4 Transport and logistics

The potential transport and logistics options below have been considered from the Earth Commodities Gladstone site to the WBE reclamation area.

- **Public road** – use of public roads including Quarry Road, Mount Larcom-Yarwun Road, Gladstone Mount Larcom Road and Landing Road, which would comprise a route length of approximately 13km. Figure 4.2 illustrates the transport route. A total of 62,095 trips (one way) would be required (assuming B-Double with 40t payload) to supply the core material (given the armour rock cannot be supplied). It is however noted that GRC is likely to impose infrastructure charges for the use of GRC's local government roads, increasing the total cost of this option.
- **Haul road** – not considered feasible owing to their being no direct off-road haul route from the Earth Commodities site



Source:
Aerial: GPC (2015) and DigitalGlobe Web Map Service (2013)

- **Rail** – the North Coast Rail Line runs adjacent to the Earth Commodities Gladstone site and could potentially be utilised to transport material to the WBE reclamation area via the Fisherman's Landing Rail Loop. However, given the relatively close distance between the quarry and the WBE reclamation area, together with the need to develop rail sidings, loading and unloading infrastructure, it is unlikely that rail transport would prove economical compared to the use of public roads.

4.3.5 Transport scenario summary

Table 4.2 summarises the transport scenario (Scenario 2) from Earth Commodities Gladstone to the WBE reclamation area. The scenario is also illustrated on Figure 4.2.

Table 4.2 Earth Commodities Gladstone transport scenario

Transport scenario	Mode and distance	Number of trips required (one way)		
		Public road	Haul road	Rail
Scenario 2	Public roads via Quarry Road, Mount Larcom-Yarwun Road, Gladstone Mount Larcom Road and Landing Road (approximately 13km)	62,095*	-	-

Table note:

* Supply of core material only

4.3.6 Regulatory requirements

The following regulatory requirements are anticipated in the instance that Earth Commodities Gladstone is utilised to supply material for the Project:

- Earth Commodities Gladstone would, as an existing commercial quarry operator, be responsible for any approvals required to undertake extraction activities (and any associated crushing, grinding, milling or screening as required) within the operational site and haulage to the WBE reclamation area on public roads. However, it is assumed that the necessary regulatory requirements would already be held.

Searches of permit and operator databases maintained by DES have identified that Earth Commodities Gladstone currently holds:

- An existing EA under the EP Act (EA No. EPPR00325413) authorising the undertaking of ERA 16 – Extractive Activities, which include extractive and screening activities greater than 1,000,000t/year
- Suitable Operator Registration (Ref. 622082) under the EP Act.

4.4 Option three – GPC Ticor Quarry

4.4.1 Locality

The GPC Ticor Quarry is a hard rock quarry identified as Lot 71 RP801113, located at 47 Guerassimoff Road, Yarwun, approximately 6km from the WBE reclamation area. Prior to GPC commencing their quarrying operations on the site in 2010-2011, the site had been the subject to historical quarrying activities by the previous owner, with pits, benches and other quarrying infrastructure already established on site.

The GPC Ticor Quarry was originally established as source of rock material for use in GPC development projects within the Port of Gladstone, including armour rock for infrastructure projects, including slope stabilisation works, bund stabilisation and new bund works, and rock and overburden material as fill for land-shaping projects.

4.4.2 Material quality and availability

Early studies completed for GPC by GHD in 2009 to support the establishment of the GPC Ticor Quarry operations identified that the site typically consists of deposits that have undergone varying degrees of metamorphism. Four main rock types were identified, from highest to lowest metamorphic grade, as lithic meta-sandstone, pelite, rhyodacite and trachyandesite.

Field borehole logs and laboratory test certificates indicated the rock to be of generally high to very high strength, with all rock of resource value categorised as bluestone, suitable for rock armour revetment within the marine environment.

At the time of GPC's commencement of quarrying operations on site, the quarry was estimated to have an operational life of approximately 40 years, with the potential for this to be extended subject to GPC's future needs for the resource. Design of the quarry supports quarrying in three stages, with a total of 8,192,062 bank cubic metres (BCM) (volume of insitu rock before extraction) of bluestone from a total of 15,012,082 BMC of total material (bluestone and overburden) estimated as being able to be won across the three stages.

Initial extraction rates identified in 2009 were based on the need for the GPC Ticor Quarry to provide rock material for the WBDDP and Fisherman's Landing Northern Expansion Project. As such, extraction rates across the 40 year life of the quarry were estimated to be:

- Up to 1,800,000m³ (4,500,000t) of hard rock in the first year to support the WBDDP and Fisherman's Landing Northern Expansion Project
- Up to 200,000m³ (380,000t) per year in the years following.

Whilst quarrying activities across the three stages are yet to be completed, GPC is currently undertaking investigations to support development of a final land form plan for the quarry, which includes consideration of the potential opportunity for further extraction on the site.

4.4.3 Assumptions, risks and opportunities

To date, the GPC Ticor Quarry has been operated by GPC and used to supply bluestone rock material to support various GPC projects, including 1.6Mm³ of rock for the WBDDP and Fisherman's Landing Northern Expansion Project as well as smaller volumes of rock and rock/fill material for other GPC works within the Port of Gladstone.

The site operates on either a low extraction rate or high extraction rate arrangement, depending on the resource demand at the time. Therefore, during times where a low extraction rate is occurring, on-site infrastructure is restricted to essential infrastructure only, with a proportion of plant and infrastructure being stored off-site. When higher extraction rates are required, additional plant and infrastructure is remobilised to site. In this regard, there are anticipated to be minimal re-mobilisation costs associated with the GPC Ticor Quarry reverting to its high extract rate arrangement for the Project.

A dedicated haul road running from the GPC Ticor Quarry to Fisherman's Landing was previously established to deliver hard rock materials from the GPC Ticor Quarry to the WBDDP. Sections of this haul road were decommissioned after completion of the WBDDP (e.g. temporary creek crossings were removed and rehabilitation undertaken), and therefore would require the undertaking of reinstatement works to facilitate future use.

The previously used haul road is located on private land, with no public access, and could therefore be used to transport material in large off-road mining dump trucks (e.g. Moxy). Whilst the route consists of the same previous alignment used for the WBDDP, it is noted that there is the potential for the haul road to impact private land should any expansion of the existing Queensland Energy Resources (QER) plant occur.

There are a number of opportunities that arise from utilising the GPC Ticor Quarry over other established commercial quarries, including:

- Greater control over quarry operations – allows GPC to maintain control over quarry development and operational procedures which may assist in optimising material supply rates and costs
- Haul via dedicated private route – haulage via private haul road enables larger off-road mining equipment (e.g. Moxy) to be used, reducing the number of haulage trips, increasing the rate of material supply resulting in potential time and cost savings to the Project.

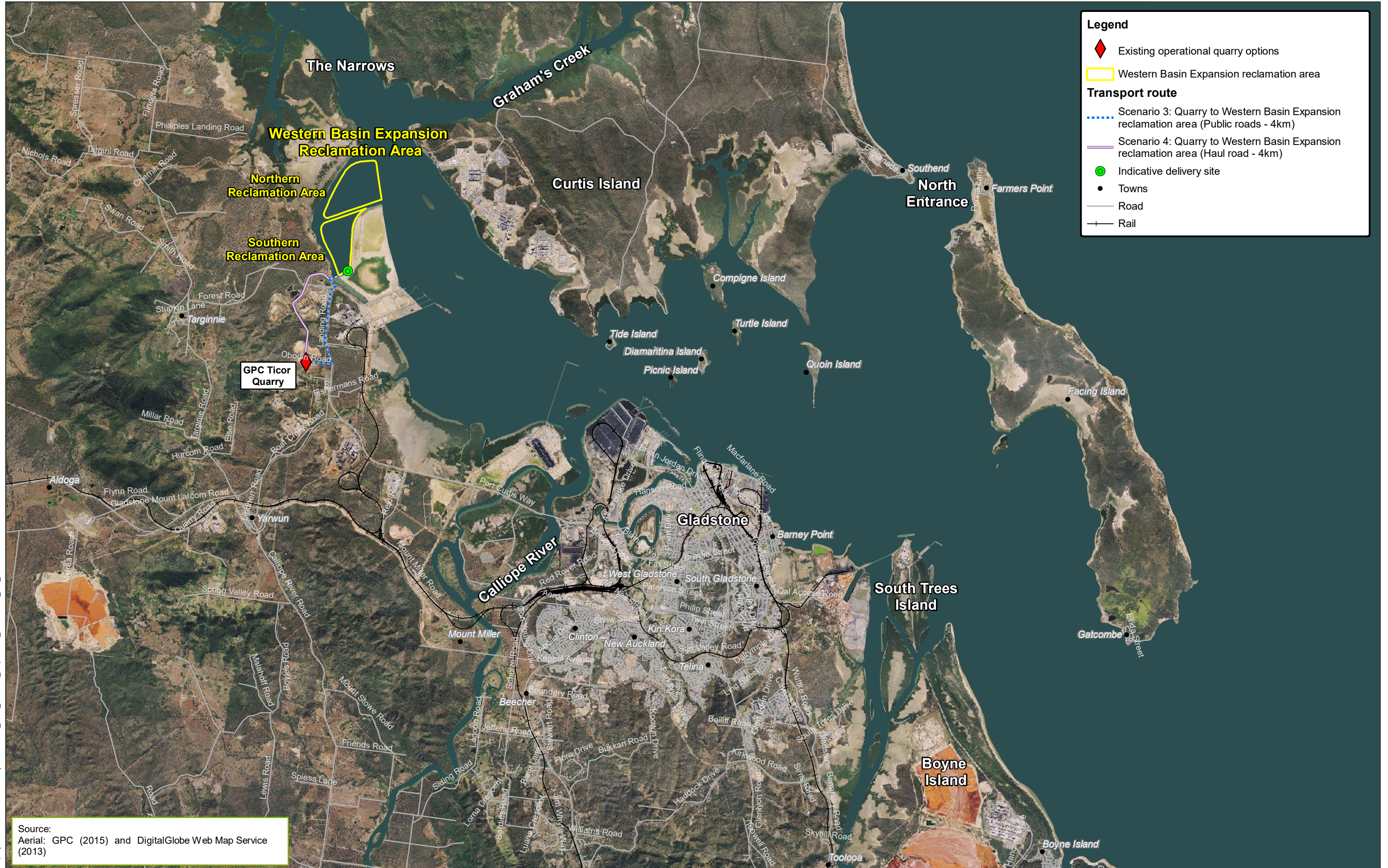
4.4.4 Transport and logistics

The potential transport and logistics options below have been considered from the GPC Ticor Quarry site to the WBE reclamation area.

- **Public road** – the existing public roads of Guerassimoff Road and Landing Road could be utilised, which would comprise a route length of approximately 4km. A total of 73,340 trips (one way) would be required (assuming B-Double with 40t payload). It is however noted that GRC is likely to impose infrastructure charges for the use of GRC's local government roads, increasing the total cost of this option.
- **Haul road** – the GPC haul road to Fisherman's Landing is approximately 4km and could be re-established. A total of 73,340 trips (one way) would be required (assuming Moxy with 40t payload). The usage of a haul road would result in the Project avoiding infrastructure charges to GRC associated with the use of local council roads.
- **Rail** – owing to the proximity of the GPC Ticor Quarry in relation to the WBE reclamation area together with the location of the existing railway line, there are not considered to be any logistically or economically feasible rail transport options that could be utilised for the GPC Ticor Quarry.

4.4.5 Transport scenario summary

Table 4.3 summarises the transport scenarios (Scenarios 3 and 4) from the GPC Ticor Quarry to the WBE reclamation area. Both scenarios are illustrated in Figure 4.3.



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Table 4.3 GPC Ticor Quarry transport scenarios

Transport scenario	Mode and distance	Number of trips required (one way)		
		Public road	Haul road	Rail
Scenario 3	Public roads via Guerassimoff Road and Landing Road (approximately 4km)	73,340	-	-
Scenario 4	Haul road (approximately 4km)	-	73,340	-

4.4.6 Regulatory requirements

The following regulatory requirements are anticipated in the instance that the GPC Ticor Quarry is utilised to supply material for the Project:

- GPC (or an appointed quarry operator) would be responsible for any approvals required to undertake extraction activities (and any associated crushing, grinding, milling or screening as required) within the operational site and haulage to the WBE reclamation area.

A review of GPC's existing permit and operator registration has confirmed that GPC currently holds:

- An existing EA under the EP Act (EA No. EPPR00473013) authorising the undertaking of ERA 16 – Extractive Activities, which include extractive and screening activities of more than 1,000,000t/year from the Ticor Quarry, Yarwun, subject to conditions. The authorised activity includes the undertaking of blasting.
- Suitable Operator Registration (Ref. 704915) under the EP Act.

In addition, GPC also holds an existing Material Change of Use (MCU) Approval (Extractive Industry) under the SDPWO Act authorising the establishment and operation of a hard rock quarry within the Targinnie Precinct of the GSDA, subject to conditions. The GSDA MCU approval authorises:

- Extractive activities to be undertaken generally in accordance with the approved plans of development, which includes quarrying across three stages together with the establishment and operation of associated site infrastructure within the quarry boundary site
- A maximum haulage of 110,000 tonnes per annum on State-controlled roads (Gladstone-Mt Larcom Road and the Gladstone Port Access Road).

GPC is currently progressing a review of the existing GPC Ticor Quarry approvals, which includes consideration for GPC's intent to develop a final land form plan for the quarry. It is noted that additional approvals or amendments to existing approvals would be required in the instance that the final land form plan is considered to be substantially different from what has already been approved.

Where the Project preference is to utilise a private haul route instead of public roads, GPC would be required to secure the necessary approvals to enable the previously used haul route to be re-established. These are likely to include:

- Material change of use associated with re-establishing the past use
- Vegetation clearing (subject to final alignment and completion of ecological field survey)
- Compliance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (effective July 3, 2017 or later version) or obtaining a Development Permit (where compliance cannot be achieved) in the instance that new haul road crossings are required to be constructed across mapped waterways.

4.5 Option four – Capricorn Quarries

4.5.1 Locality

Capricorn Quarries is an established hard rock quarry located at Marmor, approximately 65km west of Gladstone. The quarry is located approximately 56km west of the WBE reclamation area.

4.5.2 Material quality and availability

Capricorn Quarries is located within the Mount Holly Beds which typically consist of tuff as well as volcanic arenite, siltstone, mudstone, conglomerate and limestone.

Three petrographic reports were supplied by Capricorn Quarries which describe the material as a regionally metamorphosed sedimentary rock. The samples were classified as meta-pelite interbedded with fine meta-greywacke layers, meta-volcaniclastic greywacke and meta-volcano lithic arenite. Each of the samples was reported to be moderately durable to durable, moderately hard to hard and apparently strong and generally suitable for use as a source of road base and rail ballast. No recommendation was made with respect to the suitability of the material for use as revetment rock.

Results from a single test report a total weight loss of 0.2% and a Los Angeles value of 15%. Rock densities were provided for three samples and ranged between 2.767t/m³ and 2.868t/m³.

Capricorn Quarries confirmed they could supply all materials in accordance with the Project's material specification and quantity requirements.

4.5.3 Assumptions, risks and opportunities

The location and petrographic nature of the quarry product means there are some risks associated with the Capricorn Quarries option, including:

- The haulage distance of approximately 56km to the WBE reclamation area increases the risk of delay in delivery due to events outside the quarry's control (i.e. road works, road closures or heavy traffic)
- Existing, available laboratory testing indicates the quarry product is moderately durable to durable and moderately hard to hard and apparently strong. The material is described as suitable for use in road base and rail ballast however it is envisaged that additional testing would need to be undertaken to specifically confirm the suitability of the product as armour rock in a marine environment.
- The size of the Project (volume of material required) is large and the quarry's ability to reliably supply in these volumes would need to be confirmed.

At the time of their original advice, Capricorn Quarries identified a potential opportunity to install an additional large crushing plant on their site to increase the rate of production.

4.5.4 Transport and logistics

The potential transport and logistics options below have been considered for the Capricorn Quarries site to the WBE reclamation area.

- **Public road** – the existing public roads of the Bruce Highway, Gladstone Mount Larcom Road and Landing Road could be utilised, which would comprise a route length of approximately 56km. A total of 73,340 trips (one way) would be required (assuming B-Double with 40t payload). It is however noted that GRC is likely to impose infrastructure charges for the use of GRC's local government roads, increasing the total cost of this option.

- **Haul road** – there is no existing off-road haul route from the Capricorn Quarries, and given the distance to the WBE reclamation area, is not considered to be a feasible option to develop
- **Rail** – there is an existing freight line running near Capricorn Quarries that could potentially be utilised, if the required rail sidings, loading and unloading infrastructure was constructed. The approximate distance from Capricorn Quarries to the WBE reclamation area would be 58km. A total of 220 rail trips (one way) would be required.

Transport scenario summary

Table 4.4 summarises the transport scenarios (Scenarios 5 and 6) from the Capricorn Quarries site to the WBE reclamation area. These scenarios are also illustrated on Figure 4.4.

Table 4.4 Capricorn Quarries transport scenarios

Transport scenario	Mode and distance	Number of trips required (one way)		
		Public road	Haul road	Rail
Scenario 5	Public roads via the Bruce Highway, Gladstone Mount Larcom Road and Landing Road (approximately 56km)	73,340	-	-
Scenario 6	Rail (approximately 58km)	-	-	220

4.5.5 Regulatory requirements

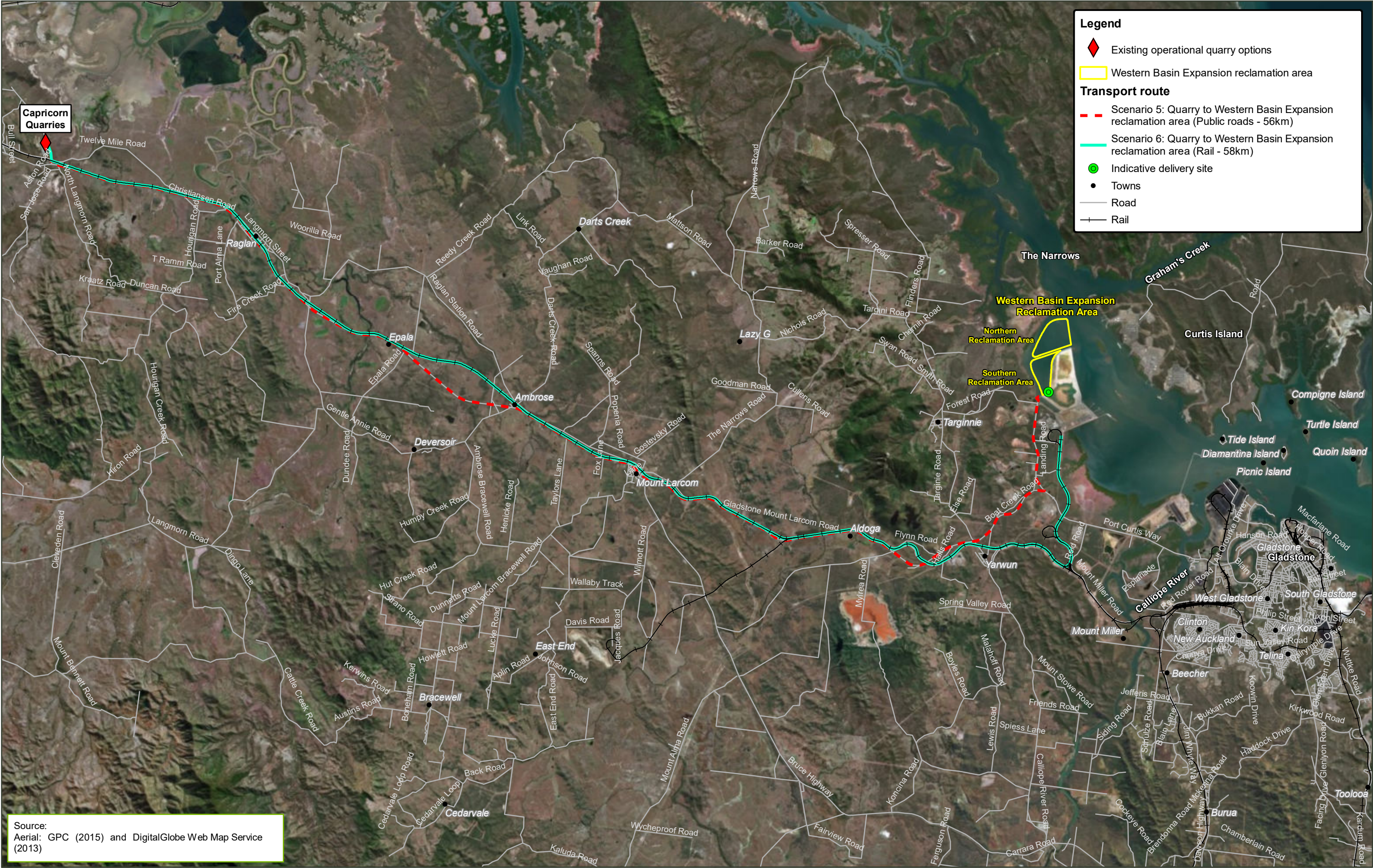
The following regulatory requirements are anticipated in the instance that Capricorn Quarries is utilised to supply material for the Project:

- Capricorn Quarries would, as an existing commercial quarry operator, be responsible for any approvals required to undertake extraction activities (and any associated crushing, grinding, milling or screening as required) within the operational site and haulage to the WBE reclamation area on public roads. However, it is assumed that the necessary regulatory requirements would already be held.

Searches of permit and operator databases maintained by the DES have identified that Capricorn Quarries currently holds:

- An existing EA under the EP Act (EA No. EPPR00237013) authorising the undertaking of former ERA 20 (Extracting) and 22 (Screening) now ERA 16 (Extractive activities) which include extractive and screening activities greater than 100,000 t/year
- Suitable Operator Registration (Ref. 593949) under the EP Act.

The Project will be required to secure the necessary approvals to establish and operate any associated rail infrastructure should the rail option be selected.



4.6 Option five – D&D Quarries

4.6.1 Locality

D&D Quarries is located on the Dawson Highway at Wooderson, approximately 18km west of the township of Calliope. The location has previously been used as a hard rock quarry, operating under KRA 157. The quarry is located approximately 54km from the WBE reclamation area. The D&D Quarries site is not currently operational.

4.6.2 Material quality and availability

D&D Quarries is located within the Mount Holly Beds which typically consist of tuff as well as volcanic arenite, siltstone, mudstone, conglomerate and limestone. The extractive resources descriptions for KRA 157 describes the deposit as meta-volcaniclastic rocks of mainly volcanolithic pebbly sandstone and volcanolithic pebbly breccia suitable for use as rail ballast, road base, concrete aggregate, surface cover aggregate and revetment material.

Two petrographic reports were supplied by D&D Quarries and describe the material as a volcanolithic pebbly arenite which has been indurated by diagenetic and incipient metamorphic processes. Both samples were reported to be durable, hard and strong and generally suitable for use as a source of rail ballast. No recommendation was made within the reports with respect to the materials suitability for use as revetment rock.

D&D Quarries confirmed they could supply all materials in accordance with the Project's material specification and quantity requirements.

4.6.3 Assumptions, risks and opportunities

The location of the quarry means there are some risks associated with D&D Quarries, including:

- The haulage distance of approximately 54km to the WBE reclamation area increases the risk of delay in delivery due to events outside the quarry's control (i.e. road works, road closures or heavy traffic)
- Existing, available laboratory testing indicates the quarry product is durable, hard and strong however the material has not been specifically assessed for suitability as a source of armour rock in a marine environment. Although the material is likely to be suitable for use as armour rock, testing will need to be undertaken to confirm this.
- The size of the Project is significant and D&D Quarries' ability to supply this volume out of Wooderson would need to be confirmed.

At the timing of initial enquiry, D&D Quarries advised that a potential opportunity existed to optimise the rate of supply through an existing commercial arrangement between D&D Quarries and Aurizon for the construction and integration of a rail siding at the Wooderson Quarry site. It was identified that the Project could potentially benefit from this arrangement through haulage of materials by rail to the WBE reclamation area which D&D Quarries have advised would reduce haulage rates.

Whilst D&D Quarries have previously held an EA under the EP Act (granted in 2014), current publicly available records indicate this EA has been suspended (refer Section 4.6.5 for details). Given the time associated with obtaining an EA, selection of the D&D Quarries site may result in additional Project delivery risk.

4.6.4 Transport and logistics

The potential transport and logistics options below have been considered for the D&D Quarries site to the WBE reclamation area.

- **Public road** – the existing public roads of the Dawson Highway, Calliope River Road, Boat Creek Road, Gladstone Mount Larcom Road and Landing Road could be utilised, which would comprise a route length of approximately 54km. A total of 73,340 trips (one way) would be required (assuming B-Double with 40t payload). It is however noted that GRC is likely to impose infrastructure charges for the use of GRC's local government roads, increasing the total cost of this option.
- **Haul road** – there is no existing off-road haul route from D&D Quarries, and given the distance to the WBE reclamation area (54km), the establishment of a haul road is not considered to be a feasible option to develop
- **Rail** – There is an existing freight line running near the D&D Quarries site that could potentially be utilised if the required rail sidings, loading and unloading infrastructure could be installed. Rail transport to the WBE reclamation area may therefore be feasible. The rail route from D&D Quarries to the WBE reclamation area is approximately 58km. A total of 220 trips (one way) would be required.

Transport scenario summary

Table 4.5 summarises the transport scenarios (Scenarios 5 and 6) from the Capricorn Quarries site to the WBE reclamation area. Both scenarios are illustrated on Figure 4.5.

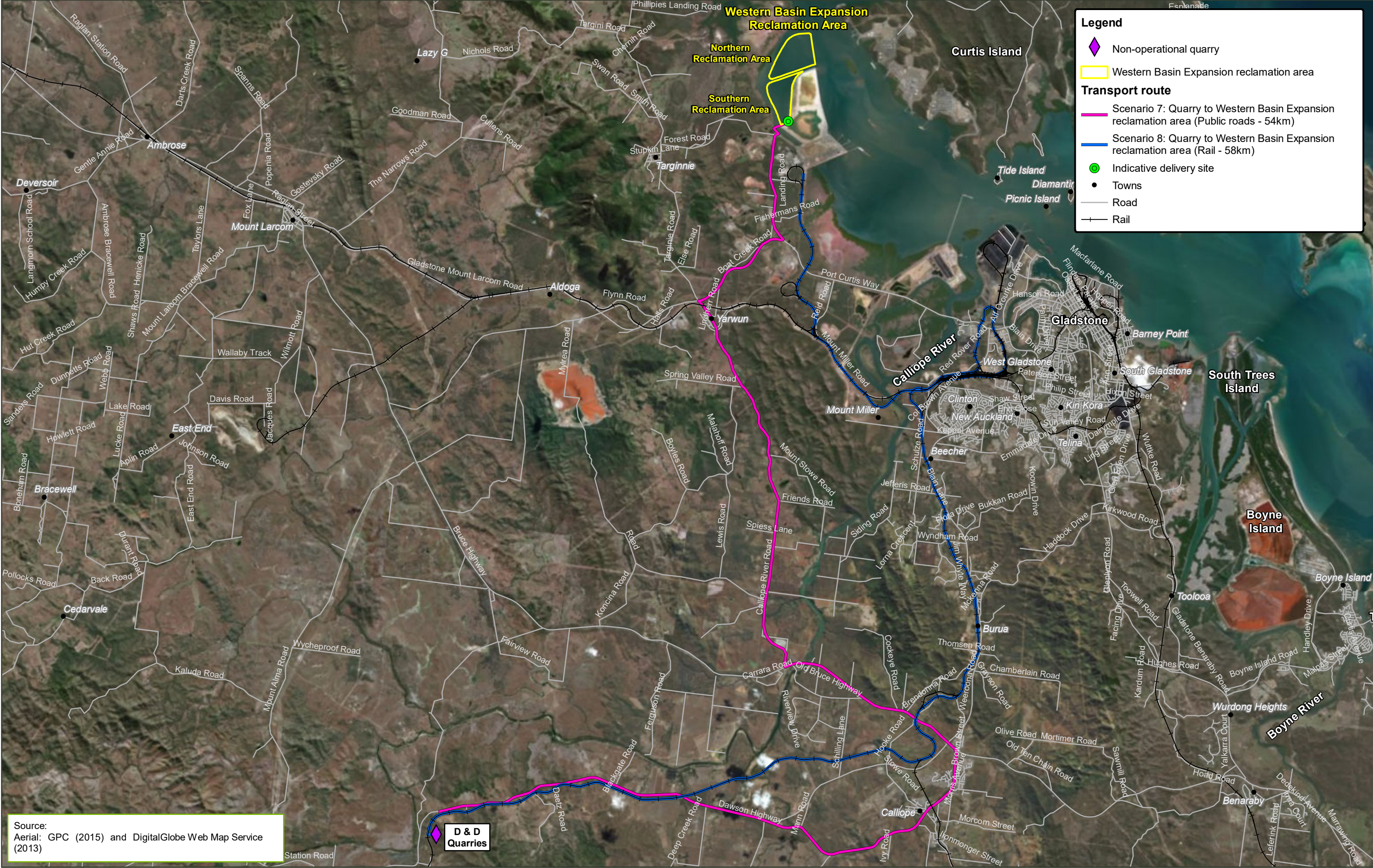
Table 4.5 D&D Quarries transport scenarios

Transport scenario	Mode and distance	Number of trips required (one way)		
		Public road	Haul road	Rail
Scenario 7	Public roads via the Dawson Highway, Calliope River Road, Boat Creek Road, Gladstone-Mt Larcom Road and Landing Road (approximately 54km)	73,340	-	-
Scenario 8	Rail (approximately 58km)	-	-	220

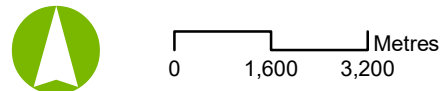
4.6.5 Regulatory requirements

The following regulatory requirements are anticipated in the instance that D&D Quarries is utilised to supply material for the Project:

- D&D Quarries, in their capacity as a commercial quarry operator, would be responsible for any approvals required to undertake extraction activities (and any associated crushing, grinding, milling or screening as required) within the operational site and haulage to the WBE reclamation area on public roads. Searches of permit and operator databases maintained by the DES have identified that D&D Quarries:
 - Have previously held an EA under the EP Act (granted on 23 July 2014) (EA No. EPPR02363014) authorising the undertaking of ERA 16 – Extractive activities including extractive and screening activities of greater than 100,000 t/year but less than 1,000,000t/year. The EA is currently listed in the DES public register as being suspended. A new EA would therefore be required to be sought to enable the quarry to lawfully operate.
 - Have current Suitable Operator Registration (Ref. 709961) under the EP Act.



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Gatcombe and Golding Cutting Channel Duplication Project

Figure 4.5: Transport scenario options - D & D Quarries

4.7 Summary of borrow source scenarios

At the completion of Stage three, seven borrow source scenarios had been identified for further consideration in Stage four. These scenarios are summarised in Table 4.6.

Table 4.6 Summary of borrow source scenarios

Scenario	Borrow source	Transport scenario	Number of trips required (one way)		
			Public road	Haul road	Rail
Scenario 1	Butlers Yarwun Quarries	Public roads via Guerassimoff Road and Landing Road (approximately 5.8km)	73,340	-	-
Scenario 2	Earth Commodities	Public roads via Quarry Road, Mount Larcom-Yarwun Road, Gladstone Mount Larcom Road and Landing Road (approximately 13km)	73,340	-	-
Scenario 3	GPC Ticor Quarry	Public roads via Guerassimoff Road and Landing Road (approximately 4km)	73,340	-	-
Scenario 4		Haul road (approximately 4km)	-	73,340	-
Scenario 5	Capricorn Quarries	Public roads via the Bruce Highway, Gladstone Mount Larcom Road and Landing Road (approximately 56km)	62,095*	-	-
Scenario 6		Rail (approximately 58km)	-	-	220
Scenario 7	D&D Quarries	Public roads via the Dawson Highway, Calliope River Road, Boat Creek Road, Gladstone-Mt Larcom Road and Landing Road (approximately 54km)	73,340	-	-
Scenario 8		Rail (approximately 58km)	-	-	220

Table note:

* Supply of core material only.

5 Stage four – preferred scenario and recommendations

5.1 Progression of options

Following completion of the assessment of borrow source options and associated transport scenarios in Stage three, the conclusions were drawn from the findings of the review to inform progression of the options to a shortlist for final consideration, including:

- A review of the material quality and availability information supplied for Earth Commodities Gladstone (Scenario 2) identified that the operator would only be able to provide the core material component specified, and not the larger armour material. As a result, any further consideration of Earth Commodities Gladstone as the borrow source would require consideration of a second quarry to meet the Project's full material specification. Given the existence of other well-established, operational and similarly located alternative quarries that could supply the full material specification (i.e. Butlers Yarwun Quarries and the GPC Ticor Quarry), together with the Project's preference to source material from a single source, the Earth Commodities option was not considered to be a preferred option to progress, however it could be considered in the future if Project options and requirements change.
- Whilst Capricorn Quarries and D&D Quarries offered the potential opportunity for transport via rail (Scenario 6 and Scenario 8, respectively), in both instances it was identified that rail siding infrastructure would need to be established both at the quarry location and Fisherman's Landing to enable either option to be feasible. Whilst both options would result in a significant reduction in the number of total trips and road trips required, additional road transport would still be required between the Fisherman's Landing Rail Loop and the WBE reclamation area. As a result of this, and given the significant distance between both these options and the WBE reclamation area, as well as the existence of other quarries in closer proximity to the WBE reclamation area, both these options were considered unlikely to be economically feasible.
- Whilst D&D Quarries also offered a public road delivery option (Scenario 7), it is considered that D&D Quarries' current operational approvals position (no current EA under the EP Act) and the relatively unproven nature of capacity to supply material in the quantities specified results in this site not being a preferred option to progress
- It is acknowledged that whilst Butler Yarwun Quarries confirmed their capacity to supply all materials in accordance with the Project specifications by public road (Scenario 1), a potential risk of increased costs exists given these specifications do not match standard production sizes
- Minimal re-establishment costs associated with utilising the GPC Ticor Quarry (Scenarios 3 and 4) is considered an advantage of this option. However the re-establishment costs associated with the private haul road option (Scenario 4) would be significant and may not be possible given GPC does not own the haul road land.
- Where the use of a public road is required, the preference is to use those options with the shortest transport distance to minimise potential impacts on the public road network, existing road users and surrounds.

5.2 Final preferred borrow source option

Based on the conclusions outlined in Section 5.1, Table 5.1 summarises the final shortlisted borrow source scenarios (in order of preference).

Table 5.1 Shortlisted scenarios for final consideration

Scenario	Borrow source	Transport scenario	Number of trips required (one way)		
			Public road	Haul road	Rail
Scenario 3	GPC Ticor Quarry	Public roads via Guerassimoff Road and Landing Road (approximately 4km)	73,340		
Scenario 1	Butlers Yarwun Quarries	Public roads via Guerassimoff Road and Landing Road (approximately 5.8km)	73,340	-	-
Scenario 4	GPC Ticor Quarry	Haul road (approximately 4km)	-	73,340	-

For the purposes of the Project EIS the GPC Ticor Quarry and the Butlers Yarwun Quarries (i.e. collectively referred to as the Targinnie/Yarwun quarry area) has been identified as the preferred borrow source(s) option for the Project given the relative close proximity of the quarry area to the WBE reclamation area, enabling the shortest haulage distances to be achieved out of all of the borrow source scenarios.

6 Conclusion

This report presents the methodology and findings of the BWMSS undertaken to support the identification of a preferred borrow source scenario(s) for the WBE reclamation area.

In seeking to achieve this objective, the BWMSS has sought to:

- Facilitate development of a preliminary concept design and material specification (material type and volume requirements) for the WBE reclamation area outer bund wall
- Identify potential borrow sources within the Gladstone region where material could be won/commercially supplied, having regard to existing operational quarries, as well as brownfield and greenfield sites
- Source information to assess the feasibility of each potential borrow source, including resource types, material quality, quantity and availability, and any key permitting considerations
- Identify feasible transport and logistical options for each borrow source, the number of trips required as well as the need for any support infrastructure
- Identify preferred borrow source option(s) and transport scenario, together with any key recommendations required.

In summary, the Targinnie/Yarwun quarry area has been identified as the preferred borrow source area, with bund wall material transported to the WBE reclamation area via Guerassimoff Road and Landing Road.

A large green parallelogram with a yellow triangle at the bottom left corner.

A

Preliminary
concept design

Appendix A

Preliminary concept designs

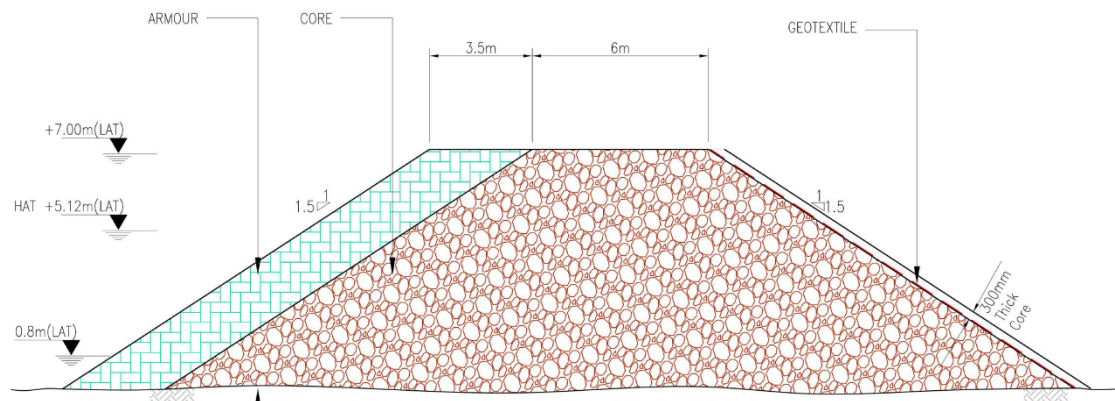


Figure A1 Western Basin Expansion typical section of bund wall armour, core and geotextile (bund wall type B1)

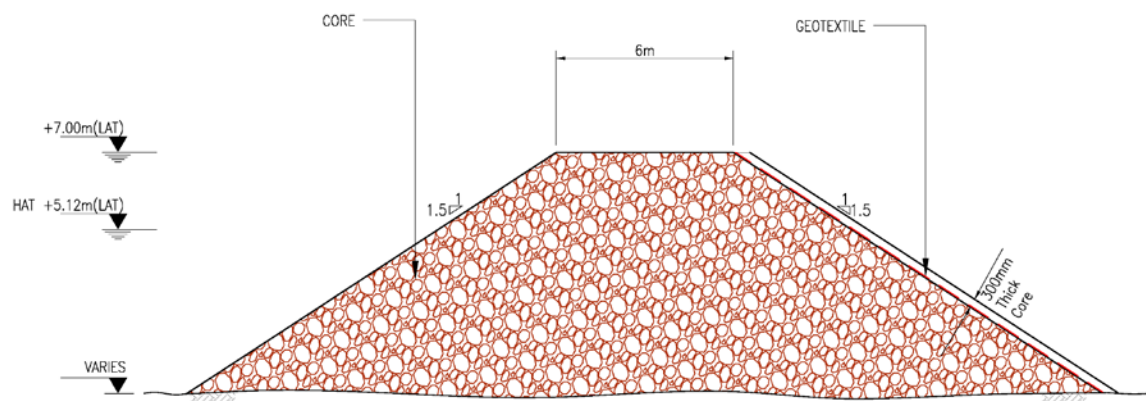


Figure A2 Western Basin Expansion typical section of bund wall core material and geotextile (bund wall type B2)



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Map by RB



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