BORAL LAND AND PROPERTY GROUP
Build something great ™

Response to Submissions
Stockton Sand Quarry Dredging Project
Volume 1

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1 Introduction

This Response to Submissions (RtS) report sets out responses to the 24 submissions received following the Department of Planning, Industry and Environment's exhibition of the State Significant Development, Development Application (SSD9690) proposing the establishment of a dredging operation at Boral's existing Stockton Sand Quarry site.

This report, Response to Submissions (Volume 1), responds to matters raised by submitters grouped under the following key theme areas:

- Social impact assessment;
- Biodiversity;
- Traffic and transport;
- Amenity (noise and air quality);
- Socio-economics;
- Coastal processes and climate change;
- General planning matters; and
- Strategic planning and policy matters.

All matters relating to and extenuating from groundwater and surface water have been withheld from response in this report and will be addressed in a further and separate response to submissions referred to as the Response to Submissions (Volume 2). The theme areas and responses provided in this report will include:

- Groundwater dependant ecosystems;
- Groundwater quality and contamination including poly-fluoroalkyl substances (PFAS);
- Impact on other water users; and
- The availability of water allocations.

1.1 Overview

In early 2020, Boral lodged an application to the Department of Planning, Industry and Environment (DPIE) for a new quarrying operation located on the inland vegetated dunes at Boral's established quarry, on Coxs Lane Fullerton Cove.

The project seeks to access an approximate 9 million tonne reserve of sand over a period of 25 years for use in the production of construction materials. As Boral currently operates from behind the windblown sand dunes, located adjacent to Stockton Beach, a site wide transport limit of 750,000 tonnes per annum (tpa) is sought until 2028, following this time the transport limit will reduce to 500,000 tpa.

The proposed quarrying project will use a mix of dry and wet extraction methods, to progressively extract sand over six stages. Wet extraction will involve the use of a suction dredge to remove sand to a depth of 15 metres below the ground water table (i.e. RL – 15 metres).

To access the sand resource, existing vegetation is required to be removed. The majority of this vegetation is rehabilitation vegetation planted and managed by Boral following the cessation of an earlier quarrying project in the same area in 2008. The removal of rehabilitation vegetation is considered to have a reduced impact on biodiversity values as this area has not matured to reflect the structural complexity of remnant vegetation areas thereby reducing the direct and indirect impacts on biodiversity.

Detailed assessment of the project demonstrates that the development will have no adverse amenity impacts associated with traffic, noise or air quality.

1.2 Public exhibition and submissions

Between 13 March 2020 and 9 April 2020, the Development Application was publicly exhibited by notices placed in the locally circulating paper and by direct mail out to residents. The application was also referred to government agencies and departments for comment.

A total of 24 submissions were received during the exhibition period. 13 from government agencies and 11 from the public and local/community organisations and interest groups.

1.3 Project justification and benefits

Boral is a leading producer and supplier of building and construction materials in the country. Accordingly, a significant amount of development in New South Wales (NSW), including many of NSW's best known structures, are underpinned by Boral-supplied concrete, cement, asphalt and construction materials such as natural sand.

The leading suppliers of natural sand are under pressure to meet increased demand from approved infrastructure projects in Sydney, Newcastle and other parts of NSW as natural sand has unique structural characteristics to manufactured sand and is essential to meet design specifications on wide range of development projects, including specialised infrastructure projects.

The project is an appropriate and suitable land use for the site allowing for the continued operation of an established quarry and access to a high quality, regionally significant resource.

The project design has adopted a low impact approach, adopting best practice methods to ensure environmental impacts are minimised through focusing activities in an area of previous

disturbance reducing the amount of remanent vegetation removed from the site. The project site benefits from extensive setbacks from adjoining receivers and consequently the project will not impact on amenity of nearby residents by way of noise, dust or visual impacts.

While it is acknowledged that there are no current dredging operations actively underway in the area. Dredging is a viable and industry accepted method of sand extraction and is actively used in other areas of the State. Diminishing natural sand reserves means that sand dredging projects are likely to increase as easily accessible reserves become exhausted or would require the removal of extensive areas of remanent vegetation.

The project will result in the following benefits:

- access and supply of up to 9 million tonnes of sand resource over a 25 year period;
- support the continuation of sand extraction at a long standing quarry in an environmentally, socially and economically sustainable and ethical manner;
- ensure the continued supply of essential natural sand to construction materials produces that supply local, regional and state significant development projects;
- facilitate economic benefits to the local community through the purchase of goods and services and local expenditure both directly and indirectly through employee wages with economic benefits to the nation, State and local community, estimated to include net benefits of $41 million (M) and $17 M to NSW.

1.4 Purpose of this report

This response to submissions (RtS) has been prepared in accordance with the Draft Environmental Impact Assessment Guidance Series Responding to Submissions (June 2017; DPIE). The purpose of the document is to consider and respond to agency and public submissions made in response to the exhibition of the Environmental Impact Statement (EIS).

The RtS has been split into two key phases, the first (the subject document, herein referred to as RtS, Volume 1) is the substantiative response that addresses the majority of matters raised through the exhibition and submission period, including:

- Biodiversity;
- Socio-economics;
- Traffic and Transport;
- Amenity (acoustic and air quality);
- Coastal processes and climate change; and
- General planning and policy matters.

All matters relating to and extenuating from surface water and groundwater have been withheld from Volume 1 of the RtS and will be provided in a further a separate report (RtS, Volume 2) to be submitted at a later date.

1.5 Report structure

This report has been structured as follows:

- **Section 1** provides a high level summary of the project, process and the subject report;
- **Section 2** provides a summary of the project as exhibited and any changes that have been made in response to the exhibition and submission process;
- **Section 3** provides a summary and analysis of the submissions received, identifying key themes and areas of concern;
- **Section 4** contains details of further information provided in the response to submission and clarifications to the project scope in response to matters raised or highlighted through the exhibition and submission process;
- **Section 5** response to State and Local government agencies;
- **Section 6** response to public and community group submissions. Submissions have been grouped according to key themes or areas of concern. A spreadsheet provided in **Appendix A** provides the detail of how submission comments have been grouped; and
- **Section 7** conclusion

2 Project overview

The project involves the extraction of sand from the former inland extraction area from the existing ground level to a depth of -15 m AHD. As extraction will intercept the groundwater table (at 1-2 m AHD) the primary method of sand extraction will involve dredging.
There is an estimated 9 million tonnes (Mt) of sand resource in the project site. The project seeks permission for a site wide increase on the dispatch limit to 750,000 tpa (i.e. the windblown sand extraction area and the project operations combined) up to 2028, after which the site wide limit will reduce to no more than 500,000 tpa.

The increase in the site wide dispatch limit is sought to permit maximum flexibility across the two sand extraction areas (on the same quarry site).

To account for fluctuations in demand, Boral is seeking consent to operate the project for 25 years.

Additionally, **Figures 1** and **2**, replicated from the EIS, depict the project layout and staging combined with the existing and proposed site infrastructure. The figure should be read in conjunction with **Table 1**.

Table 1 Project summary

Aspect	Exhibited application
Land use	Extractive industry
Hours of operation (standard operations)	▪ **Monday to Friday:** 6:15 am to 5:00 pm; ▪ **Saturday:** 6:15 am to 12 noon; and ▪ **Sunday and Public Holidays:** Closed.
Hours of operation (major supply contracts)	▪ **Monday to Friday:** 6:15 am to 6:00 pm; ▪ **Saturday:** 6:15 am to 3.00 pm; and ▪ **Sunday and Public Holidays:** Closed.
Consent period	25 years from commencement.
Production and transport limits	Up to 750,000 tonnes per annum
Extraction method	Stage 1 – dry extraction using front end loaders; and Stages 2 – 6 (inclusive) dredge.
Site infrastructure and plant	Dredge, bunded diesel generator, wash plant and telescopic radial stacker
Product transport	Truck via established road external network.
Waste management	Augmented waste management practices on site to meet an increased demand. A project specific waste management will be developed that compliments the existing site practices as necessary.

Material importation	70,000 Virgin Excavated Natural Material (VENM)
Employment	Six full time employees and three part time employees.
Rehabilitation and final landform	Open water body

Figure 1: Project area and layout

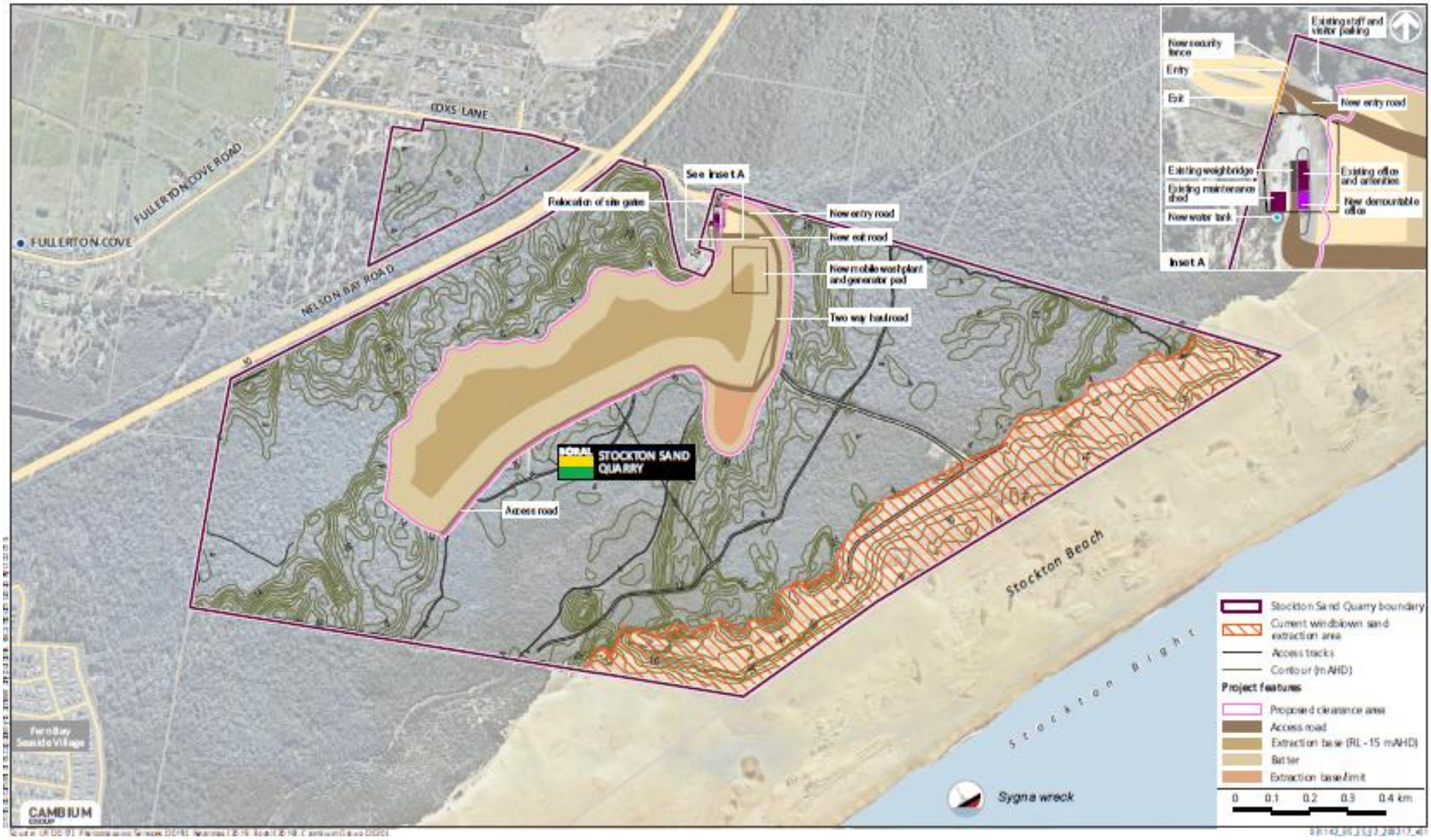
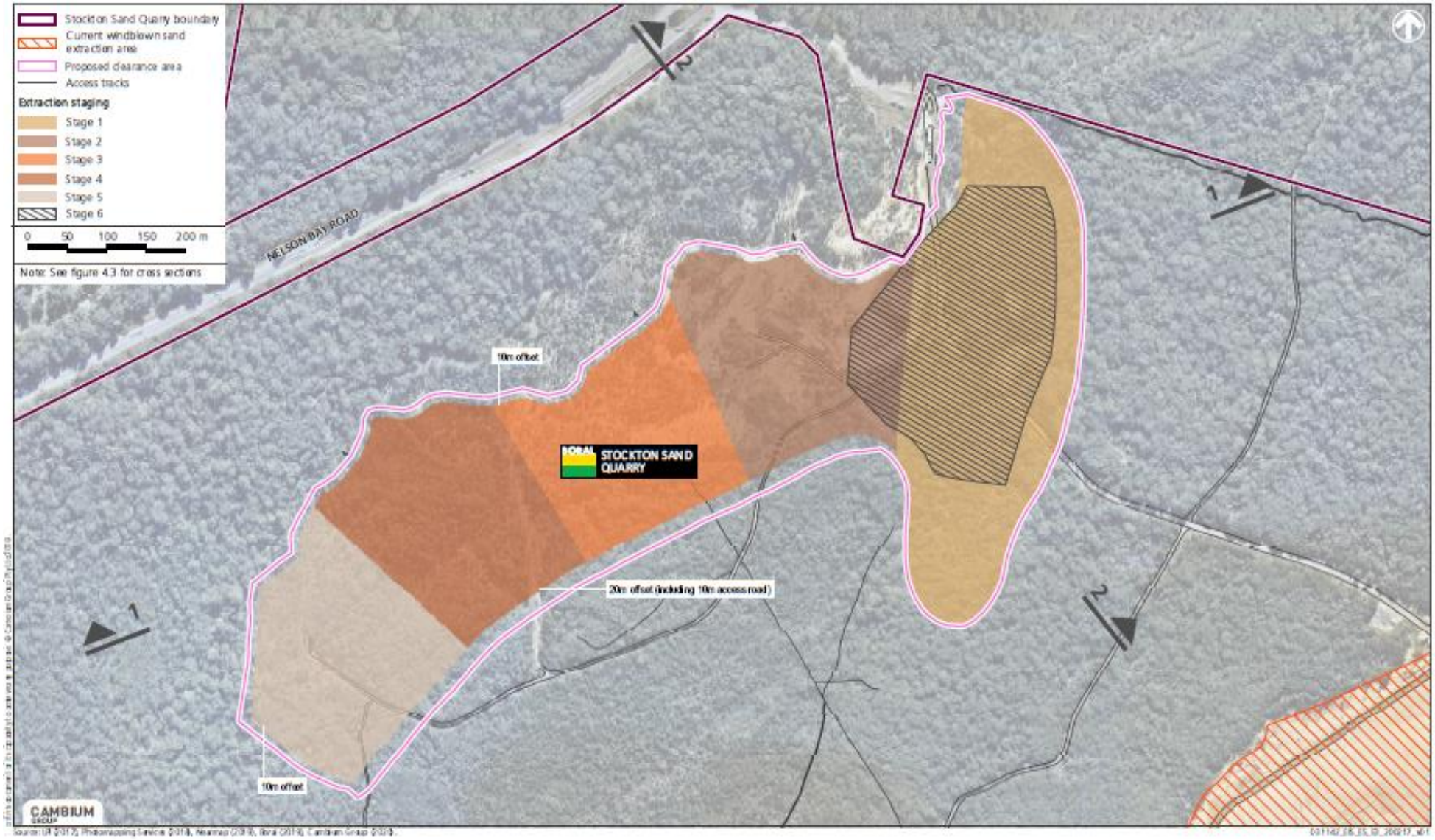


Figure 2: Project stages



3 Analysis of submissions

The application was exhibited and referred to government agencies by the DPIE for a period of 28 days between 13 March 2020 and 9 April 2020.

A total of 24 submissions were made in response to exhibition of the application. A high level summary of the submissions received is provided in **Table 2.**

Table 2: Summary of submissions

Position	Community - Individuals	Community - Organisation	Agency	Total	Percentage of all submissions
Comment	0	0	12	12	50
Objection	6	5	0	11	46
Support	0	0	1	1	4
Total	**6**	**5**	**13**	**24**	**100**

3.1 Source of submissions

Government agency responses made up the majority of submissions received, however within this group four (4) submissions made “no comment”, removing these from consideration reduces this respondent group to nine submissions, or 36 per cent of all submissions made.

Eleven community submissions were received from interest groups and individual community members. Of those submissions made by individuals, there was an even split made by those living within the immediate locality (i.e. Fern Bay and Fullerton Cove) of the project and those withholding their details or located regionally.

Interest Group submissions were made by made by regional community groups based in adjacent suburbs or the broader Hunter region.

3.2 Submissions themes

The 24 submissions made in response to the exhibition have been analysed to determine the distribution of concerns. A detailed analysis of all submissions was undertaken and identified 15 common themes across all submissions (refer to **Table 3**).
Extracting the theme area of “no comment” made by four submitters, results in 14 key areas requiring consideration and response. Five areas of concern were raised by two submission or less.

The primary areas of concern generally related to groundwater, biodiversity, traffic and transport, quarrying methods and rehabilitation.

Due to the small number of submissions received community interest groups and individuals have been grouped together for the purposes of analysis. The common themes and the prevalence are set out in **Table 3** and **Figure 3**.

Table 3: Summary of key themes – Community and Government

Area of Concern	Community – Individuals & organisation	Government	Total	% of submissions raising key
Groundwater	7	4	11	46
Biodiversity	5	3	8	33
Rehabilitation	2	2	4	17
Traffic and Transport	7	2	9	37.5
Quarrying method	4	1	5	21
Archaeology and Heritage	0	1	1	4
Planning & policy	2	1	3	12
Environmental Impact Statement	2	2	4	17
Socio-Economic	4	2	6	25
Water (general)	1	1	2	8
Amenity	2	0	2	8
Greenhouse gas emissions & climate change	2	0	2	8
Coastal Processes	2	0	1	8
Post consent conditions	0	6	6	25
No comment	0	4	4	17

The detailed submissions matrix is provided in **Appendix A.**

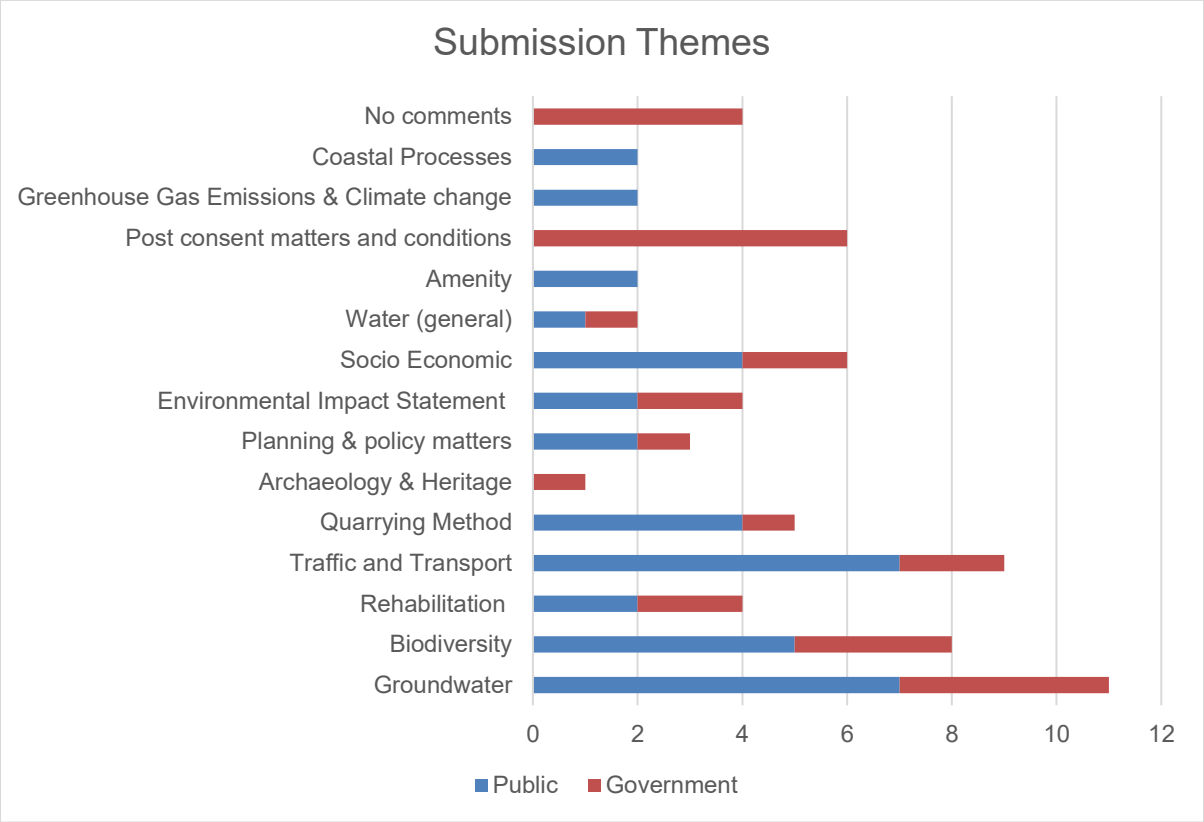
3.3 Referencing submissions

Submissions made by Government and Agencies have been addressed directly in **section 5**.

Owing to the small number of community submissions received, individual community submissions have been referred to more generally, as some members elected to withhold their details.

Where relevant and appropriate community groups have been identified in relation to particular and specialised responses. However, for the most part submissions have been addressed generally. Theme areas have been used across the RtS and the submission matrix (**Appendix A**) allowing submitters to identify their submission and cross reference how their comments/concerns have been addressed.

Figure 3: Distribution of key themes



4 Further information

The following sections set out project clarification points or provide an overview of additional and further information obtained in response to matters raised through the exhibition and submission process.

4.1 Clarifications

As a result of the submissions received, no substantial changes have been necessary for the proposal to address specific comments, requests or concerns. Notwithstanding this, the following section does provide clarification of certain elements of the proposal.

4.1.1 Existing consent and proposed development: relationship

The project is intended as a standalone consent and as such will be supported by management plans prepared specifically in response to any future consent. Despite comments made within the EIS, the project will not be included within the established management plans adopted for the concurrent, yet separate, windblown sand consent.

4.1.2 Worimi Conservation Lands – correction of ownership

Boral would like to correct an error and/or misdescription in the ownership of the adjacent land to acknowledge that conservation lands to the north of the project site and east extending along the Stockton Bight Beach form the Worimi Conservation Lands, Aboriginal owned and jointly managed with NPWS by the Worimi Conservation Lands Board of Management.

4.2 Updated technical reports

In response to comments received from key agencies the following additional work has been completed:

- Additional flora and fauna surveys were undertaken including one month camera trapping and recordings, six nights of spotlighting, call play backs, hollow bearing tree surveys, targeted orchid and amphibian surveys.

For the purposes of informing this response to submissions report the following reports have been updated:

- Social Impact Assessment (SIA) prepared by Element Environment; and
- Biodiversity Development Assessment Report (BDAR) prepared by Niche Environment.

As set out in **section 1.4** the RtS (volume 1) will be addressing all matters raised through the exhibition and submissions with the exception of those relating to an extenuating from groundwater and surface water.

4.2.1 Social impact assessment

The Social Impact Assessment, prepared by Element Environment, has been reviewed in response to comments received from DPIE's social impact assessment team. The amended report is included in **Appendix B.**

4.2.2 Biodiversity Development Assessment Report

An updated Biodiversity Development Assessment Report has been prepared by Niche Environment (September 2020) and is attached at **Appendix C**.

The updated assessment has been revised to cover those matters raised in the exhibition and submission period. In particular, the updates take into account the outcome of additional flora and fauna surveys conducted over May to August 2020.

The updated BDAR does not alter the assessment of outcome undertaken by other technical specialists for the purposes of informing the complete and holistic assessment of the project. Notwithstanding this, it is noted that the additional survey work identified several matters requiring further consideration, including:

- Evidence of foraging by the Gang-Gang Cockatoo on the site and habitat, such as suitably size tree hollows, identified within the project area. As such, further survey will be undertaken during the relevant breeding season to determine the presence of breeding habitat; and
- Pale headed Snake.

As the necessary surveys could not be undertaken prior to the submission of the RtS, the BDAR has assumed that potential habitat for each species is present in lieu of the site survey and assigned a species polygon for each.

Taking into account the above, together with the outcome of the surveys completed over May to August 2020 the offset liability and credit calculator have also been updated/amended. The offset strategy remains to pay into the biodiversity conservation fund. However, under the revised BDAR the liability has been staged to align with the progressive extraction staging.

The amended BDAR replaces the previously submitted assessment (9 December 2019) as part of the exhibited EIS.

4.3 Additional information

In addition to the above, the following documents are provided in response to specific matters raised by government agencies or members of the community:

- Coastal geomorphology report prepared in support of the exhibited EIS in relation to coastal process. The report is provided at **Appendix D**.

5 Response to State government agencies and Council

A total of 13 agency and Council submissions were received, of these four provided comments of “no comment”, two provided comments of “no objection” and sought conditions to be imposed. Seven agencies sought clarification or further details of the proposed development.

All responses from agencies and Council are addressed individually. In some instances, matters raised were closely related and the relevant responses are identical to those offered for other authority requests, where this is the case, a cross reference is provided to the first response.

5.1 Department of Planning, Industry and Environment: Resource Assessment

The following section details those matters raised by the lead assessors within the DPIE Resource Assessment Team. Where relevant and appropriate, matters have been cross referenced to the lead agency responsible for making the initial request. Where matters are unique to the DPIE Resource Assessment Team they are addressed in full in the section below.

5.1.1 Clarifications

DPIE has raised several points requiring clarification in relation to the Environmental Impact Statement (EIS).

Capital Investment Value

DPIE has sought an explanation/review of the disconnect between the discussion of capital costs in the Economic Assessment (EA) and the Capital Investment Value (CIV) identified in that calculated for the purpose of Planning Circular (PS 10-008) *New definition of capital investment value* (NSW Planning, 2010).

The EA report prepared by Gillespie does not make reference to the CIV planning circular issued by the DPIE, it makes reference to Development/Capital Costs generally that include business costs not captured by the definition of CIV adopted under the *Environmental Planning and Assessment Act 1979* (EP&A Act 1979).

The CIV report contains all facets of the project that are considered and defined as “capital costs” for the purposes of the EP&A Act 1979.

Hollow Bearing Trees

A hollow bearing tree (HBT) survey was conducted by Niche Environment. A total of 153 HBTs were recorded across the project area. A summary of the size of and number of hollows is provided below in **Table 2.** The distribution is shown in **Figure 3.**

Table 2: summary of recorded hollows

Hollow Size Category (cm)	Total number
< 5	16
5 - 10	38
10 – 15	40
15 – 20	29
20 – 30	15
30 – 40	9
40 +	6

Truck movements – Cabbage Tree Road, Nelson Bay Road and Lavis Lane

A detailed traffic impact assessment (TIA) was undertaken by Transport and Urban Planning Pty Ltd and was provided at Appendix H and discussed in section 12 of the exhibited EIS. The TIA included an assessment of the operation of the intersection as part of the major northern transport route (refer to page 15 of Appendix H) and is also identified as forming part of the network assessed in Figure 5.

Existing traffic counts were established by a road traffic count, and data is summarised in Figures 8 and 9. Section 4.8 of the TIA includes details of all the approved quarries, including Cabbage Tree Road Quarry (the most recent quarry approval noting that Bob's Farm is yet to submit their Response to Submissions). A cumulative assessment was undertaken and determined that the road network would not be adversely impacted. This assessment outcome has been verified by both Port Stephens Council and Transport for NSW who have raised no concerns with the quality or the outcome of the assessment.

Use of evaporation barriers

As set out in **section 1.4**, these matters will be addressed through a further and separate Response to Submissions report.

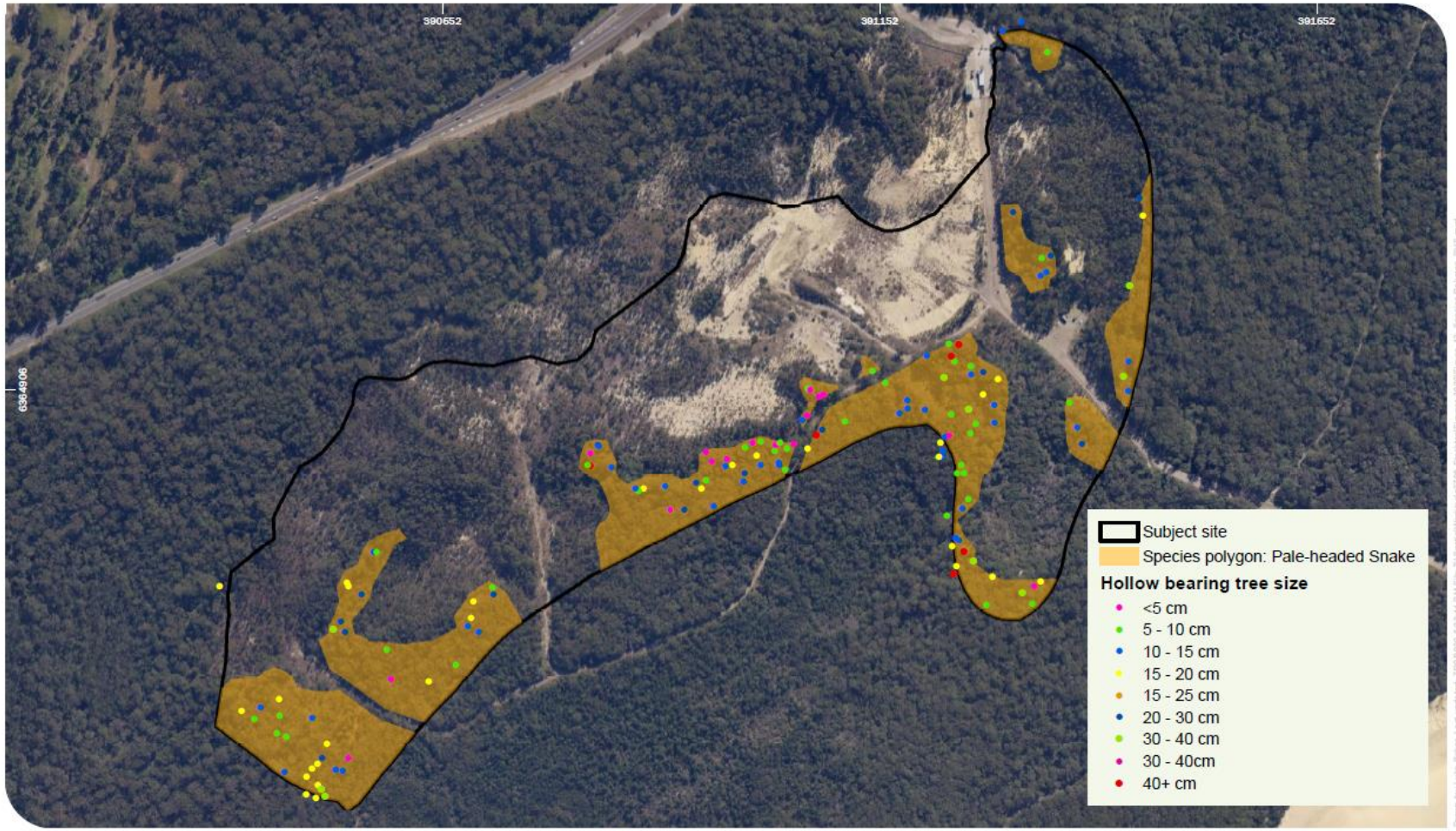
Connection to mains power

Mains power to the site does not extend beyond the depot at the entrance to the site. The potential to extend mains power into the site was investigated and proven to be cost prohibitive.

Crown access road

Boral has an existing lease over the adjacent Crown Land for the purpose of access. The proposed development does not alter this arrangement. Boral is liaising directly with Crown Lands in relation to the access road. However, these matters are not relevant to the proposed development.

Figure 3: Distribution of Hollow Bearing Trees (source: Niche, August 2020)



Consistency with strategic directions

These matters are addressed in **section 6.6** of this response to submissions report.

Correction to EIS

Boral acknowledges and apologises for the error in description of the Worimi Lands as "Crown Land". In this regard we correct the statement made in section 2.8 as follows:
Environmental conservation to the north of the site and extending along the Stockton Bight beach and dune system comprise lands gazetted under the NSW National Parks and Wildlife Act 1874 as the Worimi Regional Park, State Conservation Area and National Park. Collectively these reserves are known as the Worimi Conservation Lands and are Aboriginal owned and jointly managed with NPWS by the Worimi Conservation Lands Board of Management.

5.1.2 Planning matters

The DPIE assessment team have raised several matters relating to planning matters. Each is addressed in the following section.

Conditions of consent

The only point of commonality between the established quarry located behind the windblown dunes (and referred to as a windblown project) and the proposed dredging project is the transportation limit. These matters are addressed below.

Regulation of production

The existing project approval is not subject to a "production" or "extraction limit" and instead is regulated by a transportation limit that relates to the "site". The "site" for the purposes of the consent is all of Boral's landholdings, which includes land legally described as Lot 1 and DP1006399 and Lot 3 DP664552. As the proposed dredging operation occupies or relies on use of this land, it is arguably on the same "site" and subject to the same limit.

All product leaving the site is weighed and ticketed. This process will continue under any future consent, and drivers and site staff will be responsible for registering from which quarry pit product has been removed.

It is feasible that a minor administrative modification could be lodged for the windblown project to recognise the increased transportation limit given that the application has assessed the worst case scenario this application would be administrative in nature. This would remove any anomaly or inconsistency concerns.

Integration of management Plans

As set out in **section 4.1.1**, the two operations will be managed independently of one another, each with their own management plans. Where there is commonality between the projects the management plans may complement one another and share common resources. However, for the purposes of compliance such as the regulation of air quality, noise and rehabilitation measures the two project will stand alone and be managed independent of the other.
Boral has implemented a similar approach on the past, such as Dunmore Sand & Soil, when the two separate consents for Stage 1 and Stages 2 – 4 overlapped for a short period of time.

5.1.3 Biodiversity

The Resource Assessment team note the outcome of the assessment by the Biodiversity Conservation Division (BCD) and Port Stephens Council together with the public submission of the Hunter Bird Observers Club and have directed Boral to provide responses.

Additional survey work has been undertaken to inform the preparation of an amended Biodiversity Development Assessment Report (**Appendix C**). Consideration and responses to matters raised through the submission process are provided in the following sections;

- Port Stephens Council refer to **section 5.4**;
- Biodiversity Conservation Division refer to **section 5.5**;
- Community and interest groups refer to **section 6.2**.

As noted in **section 1.4** of this RtS, any matter relating to the groundwater or surface water will be addressed by an addendum/further report to be submitted in due course. As such, matters relating to groundwater dependant ecosystems are not addressed in this report.

5.1.4 Aboriginal and cultural heritage

Boral confirms that any artefacts encountered at depth would trigger an unexpected finds protocol ensuring operations would cease, the appropriate stakeholders contacted and where suitable artefacts documented, collected and preserved.

Despite the established and industry accepted means of addressing potential unexpected finds, Boral has considered the comments of DPIE and believes that the protocols could be enhanced through additional measures to include specific training of site staff by a suitably qualified archaeologist or where possible a member the Worimi in relation to the identification of artefacts. Any items found in the course of dredging and captured through screening processes will be inspected/reviewed by a member of the Worimi. These measures will be detailed in an Aboriginal Heritage and Culture Management Plan, prepared and approved by the relevant stakeholders prior to the commencement of operations associated with the dredging operation.

5.1.5 Water

DPIE have requested that Boral respond to the following matters raised by agencies and the community:

- DPIE Water/NRAR, in particular matters relating to water quality, “incidental” water take and how these may influence groundwater dependant ecosystems;
- Hunter Water Corporation, including matters relating to the final landform and requests to reduce the size of the final wetland (i.e. open lake) and how dredging operations will ensure the protection of the water source;
- Biodiversity Conservation Division (BCD) request to further consider the final landform and rehabilitation strategy; and
- Response to community submissions relating to PFAS contamination risk.

As set in **section 1.4**, modelling work is underway to further inform the response to key water matters. Accordingly, all responses to water related matters will form a further and separate response to submission report addressing all surface, ground water and related matters. This will be referred to as RtS (volume 2).

5.1.6 Social impacts

The matters raised by the DPIE social impact specialist are addressed in detail in **section 5.2**.

5.2 Department of Planning, Industry and Environment (DPIE): Social Impact Assessment

DPIE’s social impact specialist reviewed the exhibited SIA and made 14 recommendations. The recommendations centred around six key areas including engagement, methods, social baseline, distributive equity, assessment of social impacts, and mitigation, project scenarios, and monitoring.

A meeting was held with DPIE including the lead assessment officers and the SIA expert on 17 June 2020. Based on the outcome of these discussions and Boral’s consideration of the formal written comments received in relation to the exhibition from DPIE, the SIA has been amended (refer to **Appendix B**). The following section provides a summary and response to the comments received.

5.2.1 Engagement

The DPIE assessment of the submitted SIA raised concern that the methods used were not participatory. This led DPIE to question whether engagement with the community and/or groups within the community enabled stakeholders to genuinely articulate their views and influence decision making.

Recommendation 1: Review engagement methods

Boral has owned and operated Stockton Quarry since 1992. Over this period Boral has built up a relationship with the surrounding residents, particularly those located in the neighbouring streets of Fullerton Cove (west of the site and beyond Nelson Bay Road). More recently as Fern Bay has developed, Boral's engagement activities have expanded to include these residents, with particular attention paid to those living in Norfolk Street (the eastern most street, nearest to Boral's boundary).

Over the 28 years Boral has operated the quarry, there has been a perpetually low engagement response from the local community with many unaware of or unconcerned by Boral's operation.

Boral commenced engagement in relation to the proposed dredging project in early 2018 to inform the preparation of the SIA scoping report. This along with the Preliminary Environmental Assessment and request for Secretary's Environmental Assessment Requirements (SEARs) were submitted to DPIE in August 2018.

At the time of receiving the SEARs, Boral queried the need to establish a Community Consultative Committee (CCC) providing the following request to DPIE:

> *Boral questions the relevance of a CCC to be established during EIS phase and is not rather a condition of consent (ie undertake during operations)?*
>
> *Despite a significant effort to engage with the local community (as discussed in the PEA), preliminary consultation during the SIA scoping phase has had very little response or interest from the community.*
>
> *The merit of holding a CCC during the preparation of the EIS is considered limited, given CCCs generally only meet twice per year. It is also likely that by the time the CCC is established (in accordance with the guidelines), the EIS and the associated technical reports will be significantly commenced and potentially nearing completion.*

The DPIE Resource Assessment Team responded with ***Noted, CCC requirement removed.***

The exhibited SIA report submitted to DPIE as part of the EIS contains evidence of engagement (i.e. Figure 3 contains photographs taken at the community sessions). Summaries of resident consultations were also provided in Table 8 and Appendix D of the exhibited SIA, these records substantially demonstrate the conversations held. Given participants were not advised or their consent sought for the release of records taken through the course of these interviews the information is not considered appropriate for public release.

The methods used are considered to be both suitable and adequate having regard to the scale of the project and the potential for social impacts (positive and negative) to arise. Engagement

activities undertaken through the preparation of the EIS and up to lodgement reflect genuine attempts to identify and engage with a wide range of people.

Although all activities were designed and implemented to be open to all potential participants regardless of socio-economic status, we note that some (specifically the in-person 'doorknock' exercises) enabled access to a completely random sample of affected stakeholders and therefore are very likely to have encapsulated all relevant demographics within the Area of Social Influence (ASI).

Notwithstanding the above, a review of the methods has been undertaken and amendments to the SIA report have been made to better articulate their suitability in terms of enabling participation. These are set out in **Section 3.2.6** of the amended SIA.

Recommendation 2: Social media posts and responses

DPIE has requested that all responses to a social media post made on 12 February 2019 be included in the SIA and whether these comments are a reasonable reflection of the community's sentiment.

The original post and all comments are now provided as Appendix B of the amended SIA (**Appendix B**).

The post made by Boral, was general in nature and contained no detailed information relating to the project scope or methodology. The post was the subject of 12 comments in total, attracted eight shares, 34 "likes", one "love", and one "angry" emoticon responses. Overall the engagement level received in relation to the post is relatively high and positive.

Of those comments made, seven are considered to be either positive or neutral, including five comments related to product types, availability and development (including two from the public, two replies from Boral and one name tag) and a further comment related to the potential for discount product to be made available to local government. One comment was positive of the existing operation.

Of the remaining five comments, three could be construed as conveying negative sentiment towards other sand operations (Kurnell) or sand extraction on the beachfront; another comment could not be clearly discerned for its purpose or intent, and the final comment expressed a negative view of Boral.

Boral responded where and as appropriate, in line with the adopted corporate social media policy. Engagement with all commenters is generally not feasible or necessary, and in this instance engagement with those leaving negative responses was not considered suitable as none were specifically in relation to the project itself. To respond in these instances would not elicit a proactive discussion. In this regard, the comments are acknowledged but played no part in informing the direction of the project as they were largely unrelated to the project design and scope.

5.2.2 Methods

DPIE's social impact specialist has raised concern that the engagement methods and approach adopted to inform the SIA was too heavily focused on methods described as "informing" and "consulting". Accordingly, Boral has been requested to either justify the approach and methods adopted or undertake further "participatory" engagement.

Recommendation 3: post-scoping and follow up interviews

The assessment seeks justification as to why no post-scoping interviews or follow up interviews were undertaken. Boral acknowledges that DPIE's basis for the request arises from an observation that stakeholder responses were focused on Boral's established operation. Records of the transcript used to inform semi-structured interviews have been provided in the SIA. These demonstrate that stakeholder engagement was conducted with the express purpose of seeking feedback in relation to the *proposed project*. It could be construed from the responses received that stakeholder perceptions, concerns and aspirations of the project are influenced and informed by their understanding of how Boral currently operates the established site. In this regard, we note that the majority of those who participated in the randomised interviews either expressed positive views of the operation or only raised concern regarding other operators.

The application has since been exhibited. Exhibition took in an extensive area including the whole of Fern Bay and large areas of Fullerton Cove, well beyond the area of influence defined in the SIA. In the lead up to the formal exhibition undertaken by the Government, Boral also letterboxed the exhibition area to advise members of the community of the project and the forthcoming request for submissions. This letterbox drop took in some 800 properties across Fullerton Cove and Fern Bay. No responses or enquires were received.

As set out in **section 3** of this response to submissions the exhibition of the application elicited 11 community submissions. Six from individuals, of which only 50 percent live in the area of social influence (ASI) defined by the SIA.

In this regard, the exhibition response is considered consistent with the community response to Boral's ongoing engagement attempts, which are characterised by low levels of response. Taking into account all of the above, it is considered unnecessary to undertake post-scoping interviews, as the responses collected from the initial interviews raised no areas of particular concern that altered the project scope, neither did the process of exhibition. In this regard, it is considered unlikely that constructive feedback would be received or that the process would contribute meaningfully to the SIA.

Recommendation 4: venue location for consultation

The assessor raised that the choice of venue, a McDonald's café, may exclude some demographic groups and enquired if a more appropriate public venue could have been identified for use.

The choice of venue was considered at length by Boral through the design of the SIA engagement approach. McDonald's was eventually selected as the most appropriate venue on the basis of the following;

- there is no community building or infrastructure in Fullerton Cove (the immediately adjacent community to the project) available to appropriately stage a community information session.
- the Williamtown McDonalds is a local 'landmark' well-known to those familiar with the area. It is positioned prominently on the region's main road, is minimal distance from the primary community (Fullerton Cove) affected by the project and is highly accessible to the majority of stakeholders (ie easy parking and at grade entry).
- the McDonalds was able to cater to the spread of hours deliberately chosen to ensure the fullest participation of interested stakeholders - morning hours primarily aimed at older residents and parents of young and school aged children, afternoon/evening hours for employed, business people, and regional commuters.

In circumstances where there are limited to no options for publicly owned venues within the ASI, the selected venue is considered to be appropriate.

5.2.3 Social baseline

DPIE considers the information provided to define the social baseline appropriate but limited by its reliance on secondary, quantitative data. The nature of the data means that qualitative elements of the social baseline, including what community members may value about a locality and how they may be affected by the proposed quarry operation may have been overlooked.

Recommendation 5: Revise the social baseline in accordance with guideline.

Boral's social baseline has drawn extensively on reliable secondary data sources including the Australian Bureau Statistics (ABS) and Port Stephen's Council strategic planning documents to define key social parameters, including community values and aspirations. While Boral acknowledges that there is an absence of primary data collection in relation to this aspect of the SIA, this has arisen out of the low level engagement of the community itself. Boral has actively sought to engage with those located with the ASI since March 2018 and received minimal feedback in response to all forms of engagement.

In this instance reliance on secondary data sources to define a social profile and gain a deeper understanding of community values was the only option due to the limited response Boral received from the ongoing and numerous attempts to engage with the communities living within the ASI.

Primary data collection occurred in preparation of key technical reports including, economic impact, air quality, noise environments, traffic, biodiversity, and water (ground and surface). Moreover, Boral has worked within the Fullerton Cove community for around 28 years. Over the past 10 years ongoing and adaptive community techniques have experienced low levels of response from community members. Notably due to the separation of Boral's activities from residential and commercial premises many people in the community are either unaware of Boral's operation or unaffected.

It is important to note that the size and scale of the project is relatively minor in nature. The operation while important and valuable in contributing to the key supply chain for the production of construction materials, is not so significant that it would change or shape the local community with respect to its demographic profile, the amenity of the area or the experience of residents or visitors.

In this regard, the SIA is considered to meet the requirements of the guideline in that it was and is *"tailored to the specific project context"* having included only information that is relevant and of value to the project.

5.2.4 Distributive equity

DPIE has requested that distributive equity of the project be considered further due to the potential for resource projects to create “winners” and “losers”. DPIE recommended that further work be done to identify vulnerable and marginalised groups and how the experience of the project for persons within these groups may differ from others.

Recommendation 6: reassess how/whether impacts may be experienced unevenly

Detailed environmental assessment has been undertaken that demonstrate amenity impacts are minimal and within regulatory guidelines ensuring that receivers located within the ASI are not burdened unreasonably or inequitably by loss of air quality, intrusive noise or excessive vehicle movements.

The ASI for the project is relatively small when considered against a typical resource project that can take in several local government areas. The size of the ASI directly informs the potential for vulnerable communities to exist.

The SIA report has been amended with commentary about distributive equity. The amendments highlight three possible communities including:

- Indigenous peoples;
- under or unemployed persons; and
- aged persons.

The SIA report has also been amended to better articulate how these groups were catered for in the SIA methodology (refer to **section 3.2.6** of the amended SIA, **Appendix B).** These details are set out in **Table 3**, extracted from the SIA.

Table 3 – Engagement methods designed for under-represented or potentially marginalised groups

Population group	Engagement method	Participation considerations
Older people	Community information sessions	Session held in morning hours Venue selected with accessible parking and at-grade entry for mobility impaired Venue selected on main transport route with access to public transport Use of plain-English in invitations delivered in hard-copy across the ASI for those with information technology difficulties
	Doorknock	Visiting properties to cater for those unable to travel to

Population group	Engagement method	Participation considerations
		community information sessions due to mobility or other impairment Use of plain-English in invitations delivered in hard-copy across the ASI for those with information technology difficulties
Indigenous people	Consultation with members of the Local Aboriginal Land Council (LALC)	Providing engagement decision-making opportunity in relation to stakeholders nominated for consultation by the CEO
Unemployed people or people with lower incomes	Doorknock	Visiting properties to cater for those unable to afford travel to community information sessions or internet access Delivery of hard-copy communications to cater for those unable to afford access to communication collateral and/or printing
	Community information sessions	Venue selected on main transport route with access to public transport (catering to those unable to afford private transport options)

The SIA specifies a particular group within the ASI, the Worimi. As traditional owners of the land surrounding the project and custodians of the Worimi Conservation Lands adjacent the quarry, the Worimi people are the prominent group. The Worimi LALC was identified in scoping for engagement (see section 4.2.1 of the exhibited SIA report) and was consulted by Boral at various stages throughout the planning process. Boral's National Indigenous Relations Manager has regular meetings with the Worimi LALC members where matters relevant to Boral's operation and the Worimi are actively discussed.

5.2.5 Assessment of social impacts (including positive impacts)

DPIE acknowledges that section 6 of the exhibited SIA is particularly strong in reporting the outcome of the social research activities. However, DPIE raised concern that the low level of participation and response received from the community, which directly influenced the availability and use of qualitative data, has left "gaps" in the assessment.

Recommendation 7: Reassess impact categories following a methodological review

DPIE queried the reliability of the assessments made in relation to the identified social impact areas.

All impact categories were reviewed in light of the comments provided by DPIE and the subsequent review of the engagement approach and methods to inform the social baseline and identification of impact categorise. Through the review process Boral concluded that the methodology adopted was suitable in the circumstance. Consequently, no changes are considered necessary.

Recommendation 8: Assess social impacts considering the standard dimensions of, likelihood, extent duration, severity and sensitivity

DPIE raised concern that the exhibited SIA did not specifically make reference to the social risk matrix in the assessment of social impacts.

The proponent has taken these comments on board and amended the SIA to include the requested assessment method, these are now included in **section 6** of the amended SIA provided at **Appendix B** of this report.

Recommendation 9: Ethnographic content analysis (ECA)

DPIE has requested a copy of **Appendix F** referenced in the exhibited SIA but not included. This has now been included in the amended SIA provided at **Appendix B** to this report.

Recommendation 10: Reassess positive impacts (wellbeing)

The DPIE assessor raised two points in relation to the assessment of positive impacts arising from the economic impacts of the project, including:

- additional discussion and information in relation to the potential positive flow on social implications of the economic benefits in relation to potential improvements to social cohesion, wellbeing or distributive equity; and
- positive economic impacts cannot be considered as part of the assessment by the consent authority as they fall outside the scope of what can be considered the "locality".

The SIA has been amended to include further information regarding the local benefits of the project including:

- Section 5.2.2 provides further discussion relating to vulnerable groups – unemployed or under employed people, these amendments highlight the opportunity that new employment opportunities the proposal would present;
- Section 6.7.1 includes further discussion on the local supply chain that sand from Stockton quarry services. Sand supplied to local construction material producers is material that directly influences the cost of materials to consumers (i.e. cost effective construction materials) and provides for flow on economic benefits including employment and construction affordability;
- Section 6.7.2 further articulates the positive economic benefits and increased employment opportunities associated with the project within the local community; and
- Appendix G includes details of donations made by Boral's Stockton quarry to local community, non-profit or government facilities (schools).

In relation to comments made about the ability of a consent authority to consider impacts beyond the "locality" of the project, Boral considers this comment to highlight the inappropriateness of the policy in responding to "small" scale resource projects that are unlikely to have the significant or wide ranging impacts on social cohesion or demographic profiles that are often associated with large scale mining projects.

The economic effects cannot be reasonably concentrated within a small peri-urban, low density residential suburb. Moreover, a "locality" for the purposes of the *Environmental Planning & Assessment Act1979* is not limited to the ASI and therefore, the positive economic effects are considered relevant to the consideration of the application. The importance of the project beyond the immediate ASI and broader "locality" is reflected in its categorisation as "State Significant Development" triggered by the volume of material proposed to be extracted and its value to the supply chain.

5.2.6 Mitigation, scenarios and monitoring

The DPIE assessment of the SIA sought review and, where relevant, possible amendment to mitigation, development scenarios and monitoring. The assessment centred around four recommendations, each is considered in turn below.

Recommendation 11: Review mitigation measures in light of changes/review of methodological matters

As set out in response above, the SIA methodology applied and followed has been reviewed. In the circumstance, the methods applied are considered appropriate to the scale and intensity of

the project. Taking this into account, no amendment to the mitigation measures is considered necessary.

Recommendation 12: Management of public safety

The assessment of the SIA indicates that the use of Boral site staff may effectively mitigate the risk to public safety associated with people entering the site without authorisation and seeks Boral to continue this practice.

For the purposes of clarification, Boral actively manages the safety of their sites with respect to both employees and the public. Zero Harm is key to Boral's business goals and objectives. Boral's ongoing commitment to managing the safety of the site and specifically references to managing unauthorised access is set out **section 7.2.2** of the amended SIA provided at **Appendix B.**

Boral would continue to actively manage unauthorised access to the site during operations hours using site where and as necessary.

Recommendation 13: consider the "not approved" scenario

The SIA has been amended to expand on the "reasonably foreseeable alternative scenarios" to include the recommended "not approved" outcome.

These matters are now considered in **section 6** of the amended SIA provided at **Appendix B** to this report. Ultimately, if the proposed development were not approved the quarry may be forced to close. Closure of the quarry, were the dredge operation no approved, could occur as soon as 2021 based on the limitations of the existing approval and remaining reserves. This would mean the loss of existing and future employment opportunities directly and indirectly associated with the operation. Combined with the flow on economic impacts to the broader locality, region and the State.

It is likely that the closure of the quarry would contribute to an increase in the cost of construction products, driving competition for remaining resource and therefore cost of sand materials. Ultimately, these increased costs are passed onto consumers and reflected in the cost of projects, including residential, infrastructure and commercial construction and delivery costs.

Ultimately the potential for adverse social impact of not proceeding, in Boral's opinion, far outweighs the potential social impacts of proceeding.

Recommendation 14: update monitoring framework

The monitoring framework was reviewed in light of the amendments made to the SIA. No amendments have been made to the monitoring framework as there was no amendment to the assessment of the identified impacts or mitigation measures.

5.3 Environment Protection Authority

The Environment Protection Authority (EPA) has made a submission in support of the project and requested conditions of consent.

5.3.1 Conditions of consent

Boral has reviewed the proposed conditions and raises no objection.

5.4 Port Stephens Council

Port Stephens provided a response on the following range of issues:

- Drainage;
- Traffic and transport;
- Groundwater Dependant Ecosystems (GDEs);
- Biodiversity – koala feed tree, survey rigour and effort, offset strategy and rehabilitation; and
- Groundwater monitoring.

Of the issues raised only those comments relating to Biodiversity and Groundwater require a response.

5.4.1 Biodiversity

Council Officers raised nine matters in relation to ecology. For the purpose of establishing consistency between submission themes, five of these comments have been grouped under the theme of “biodiversity”. The remaining comments are addressed under the themes of groundwater, rehabilitation and offset strategy.

Port Stephens’ Council Comprehensive Koala Plan of Management – performance criteria

The Port Stephen’s Council Comprehensive Koala Plan of Management (CKPoM) is empowered through State Environmental Planning Policy (Koala Habitat Protection) 2019 (SEPP KPH). Specifically the document draws power through Part 2 *Development Control of koala habitats*, clauses 8 -10 (inclusive). The specific wording throughout this part makes clear the extent and limitations of SEPP KPH with respect to State significant development, as each clause references *“council’s determination of the development application”.*

As DPIE is not a “Council” the provisions of Part 2 do not strictly apply and as such there is no mandate for compliance or consistency.

Notwithstanding the above, the BDAR has been amended to address performance criteria of the CKPoM, this is contained in **Table 14** of the amended BDAR provided at **Appendix C** of this report. The proposed development is not considered to be inconsistent with the broad aims and objectives of the CKPoM to ensure the preservation of habitat and protect koala populations. The area proposed to be cleared is predominantly rehabilitation of a former quarry pit that was cleared in 1994, noted to have occurred after the Council undertook mapping of the area in 1992 and 1993 to establish the areas of the Koala Habitat. In this regard, it is Boral’s view that the source mapping and characterisation used by Council for their CKPoM is redundant.

Flora and fauna surveys undertaken as recently as 2020, confirm that the site, and in particular the project area, does not support any known koala populations and based on Boral’s 28 year occupation of the site has never been observed to accommodate or support local koala populations. The removal of rehabilitation and the general confinement of works to areas of previous historical disturbance ensures that surrounding areas of remnant vegetation is undisturbed, notably these undisturbed areas would continue to provide movement corridors and habitat connectivity to any local populations.

Port Stephens’ Council Comprehensive Koala Plan of Management – tree replacement

While the CKPoM may be considered in the assessment as a guideline reference document, the *Biodiversity Conservation Act 2006* (BC Act), the Biodiversity Assessment Method (BAM) and Biodiversity Development Assessment Report (BDAR) provides the primary framework and assessment tool for the determination of impacts and mitigation. Under the Act, local level development applications and State significant development applications are guided by separate provisions. In this regard, we note that the Act provides for offset obligations as determined by the BDAR and BAM. Boral’s offset strategy is set out in **section 7** of the amended BDAR (refer to **Appendix C**). It is not feasible for the offset obligations dictated by Council’s CKPoM to be implemented. Details of the proposed offset strategy are addressed below.

Consistency with assessor requirements

Council Officers sought the status of the BDAR to be certified in accordance with the requirements of section 6.15 (1) of the BC Act 2006.

The amended BDAR contains a declaration from Niche Environment detailing the names and qualifications of all involved in the preparation of the BDAR, four of whom are “accredited

assessors" for the purposes of the Act. The BDAR also includes the date on which the report was finalised.

Threatened Fauna – Survey and presence

Council officers reviewed the exhibited BDAR and recommended further survey effort in relation to three threatened fauna species including the Bush stone Curlew, the Wallum Froglet and the Mahony Toadlet.

Niche Environment has, where appropriate, undertaken additional surveys in accordance with the relevant guidelines. The outcome of these surveys is provided in **Table 4**.

Table 4: Summary of fauna survey effort (2020)

Species	Survey Effort	Timing	Outcome
Bush stone curlew	• Extensive survey tracks across the project area surveying for nests; and • Nocturnal and call playback surveys were undertaken on five occasions	May to July	Species not detected
Wallum Froglet	Spotlighting transect surveys immediately following 20mm rain event	May to June	Species not detected.
Mahony Toadlet	Not completed – Habitat not considered present on site.	October	Assumed not present due to habitat.

The amphibian survey was not conducted for the Mahony Toadlet as this survey period does not occur till October – November. However, based on observations made by Niche of the habitat features of the site during rain events it is considered unlikely that the species would occur. This conclusion is based on conditions observed during rain events which confirmed even during heavy rain events no significant pool habitat or inundation areas are created within the project area, nor within the patch of Swamp Sclerophyll Forest close to the site (refer to **Figure 9** in the BDAR provided at **Appendix C**).

The conditions observed during the targeted survey for the Wallum Froglet are consistent with the long term experience and observation of the quarry manager who has worked at the quarry for 24 years. The quarry manager confirmed that the site does not retain water following rainfall, with the exception of the 2007 storm event involving the Pasha Bulker where pools formed following days of heavy rainfall in the former quarry pit. This event was an anomaly, with the conditions unlikely to be repeated.

Accordingly, it is considered unlikely that the Mahony's Toadlet would be encountered on the site due to the lack of suitable habitat.

Threatened Flora – Survey and presence

In relation to the flora survey effort and results, Council Officers raised the following:

- Consistency of flora survey methods with guidelines. In particular the appropriateness of random meander surveys in detecting “cryptic” species in particular orchids; and
- The timing of surveys conducted for *Corybas dowlingii and cryptostylis hunteriana*

DPIE’s “Plant Survey Guidelines” were not released until April 2020, while the project was on exhibition as such these could not feasibly be considered in the preparation of the exhibited BDAR. Following exhibition, a review of the BDAR has been undertaken, and the details of survey effort and methods have been reviewed and are contained in **Table 8** (p. 16) of **Appendix C.** In relation to the two nominated orchid species the following is noted:

- The natural characteristics of the site, including soil type and elevation did not provide suitable habitat for the *Corybas dowlingii.* Surveys were conducted during the BAM recommended period of July and August. Surveys did not detect the species; and
- The survey period recommended by the BAM for the *cryptostylis hunteriana* is between November and February. While a targeted survey was not conducted during this period the likelihood of the species being present was considered in detail based on the natural characteristics of the site and plant. Given the species is reliant on a symbiotic relationship with mycorrhizal fungus and the limited potential for habitat to be present within the large area of disturbance left by earlier quarrying operations, it is considered highly unlikely that the *cryptostylis hunteriana* is present on the site.

5.4.2 Groundwater

Two matters were raised in connection with the theme of groundwater.

Groundwater dependant ecosystems

As set out in **section 1.4**, these matters will be addressed through a further and separate Response to Submissions report.

Monitoring program

As set out in **section 1.4**, these matters will be addressed through a further and separate Response to Submissions report.

5.4.3 Rehabilitation and landscape management plan

Council would like Boral to prepare and submit for approval an amended Rehabilitation and Landscape Management Plan prior to the commencement of any works on site.

As set out in Clarifications, the subject development application is a standalone consent. As such Boral, retracts comments relating to the amendment of existing management plans. Plans developed and implemented for the purposes of the project will be separate and standalone documents. They will reflect:

- the terms of any future consent;
- the detail contained within the relevant sections of the EIS; and
- any amended or revised information submitted as part of the Report to Submissions.

Notwithstanding the above, as set out in **section 1.4**, these matters will be addressed in more detail through a further and separate Response to Submissions report.

5.4.4 Offset strategy

Following the completion of further on site fauna and flora surveys, the offset liability has been revised and where necessary species and habitat credits included. While not all targeted surveys could be completed due to seasonality, presence has been assumed for those species identified as requiring further consideration until determinative information can be collected. Boral's offset strategy is set out in **section 7** of the exhibited BDAR. Following a further review of the strategy, Boral confirms that the strategy to be adopted would be to pay direct into the fund or acquire the necessary credits from the market. Both options are accepted methods of meeting the offset liability of the project.
Notwithstanding the above, the offset strategy has been refined, adopting a staged approach to biodiversity offset liabilities, aligning obligation triggers to the extraction stages.

5.4.5 Local infrastructure contributions

Port Stephens has no objection to the proposed development with regard to traffic and transport, noting that Transport for New South Wales (TfNSW) is the Roads Authority for Nelson Bay Road (which includes the on and off ramps) and the majority of the haulage route relied on for transport of goods, services and access. Despite this acknowledgement, Council has advised DPIE that Boral is liable for contributions under the adopted Local Infrastructure Plan (LIP).

Boral uses a maximum of 200 metres of the local public road network being that portion of Coxs Lane leading from the Nelson Bay Road off ramp to the Crown Reserve. The access road across the Crown Reserve is required as Council has not constructed the final alignment of Coxs Lane that would otherwise provide legal access to Boral's land. Refer to **Figure 4**.

Taking into account the limited use of the local controlled and fund road network, Boral was previously granted an exemption from the payment of contributions.

Figure 4: Extent of Local Road used to access Boral holdings.

Under Council's adopted LIP, Council seek to impose an annual cost of up to $63,000. This contribution can only be directed towards the maintenance of the road for which they are collected (p.31). Typically Council's maintenance schedule and priorities are set out in an adopted Capital Works Plan. Boral notes that Port Stephens Council has an adopted capital works program for the period 2019 – 2029 which makes no reference to the need for any upgrades or maintenance for Coxs Lane, Fullerton Cove.

Taking into account the above, Boral seeks a variation to the LIP on the grounds that the rate of contributions is both unreasonable and unnecessary in the circumstances given the limited degree to which Boral uses the local road network and the minimal maintenance costs that would be associated with the same.

Moreover, as there is no legal public access point to Boral's land, which necessitates Boral to pay an ongoing rent to the Crown to ensure continued and legal access combined with any costs associated with maintenance and construction.

On balance, it is considered wholly unreasonable to charge a contribution levy to maintain a negligible portion of local road for which no maintenance requirements have been identified under the current capital works plan and the when Council has failed to provide a fully constructed legal access point to Boral's land and for which Boral wears the ongoing cost of providing the same.

5.5 Biodiversity Conservation Division

The Biodiversity Conservation Division (BCD) submission includes comments made by the National Parks and Wildlife Service (NPWS). The comments of NPWS have been included as an individual subsection within this section.

The BCD made comment in relation to three principal theme areas including biodiversity, aboriginal heritage and waters and coast. All are considered in detail in the following subsections.

5.5.1 Biodiversity

The BCD raised several matters requiring attention and further assessment under the BDAR. These included:

- Additional survey effort in relation to fauna;
- Additional survey effort in relation to flora; and
- Correction and clarification of assessment data.

The following sections respond to matters raised specifically for consideration in the submission of the BCD.

Hollow Bearing Trees: Habitat potential

BCD has requested further information and consideration of the potential for hollow bearing trees to be used by hollow dependant candidate species such as the brush-tail phascogale and some species of owls.

Species credit fauna, including the brush-tail phascogale, masked owl, powerful owl, and barking owl are addressed in section 4 of the amended BDAR (refer to **Appendix C**). Details of the threatened fauna survey set out in the exhibited BDAR have been amended to reflect the requirements of each threatened fauna species using the species information provided in Threatened Biodiversity Database Collection (TBDC) (as at May 2020 prior to field survey) and additional survey guidelines and advice regarding the BAM which were not available at the time of the original survey undertaken in 2019. Recent surveys did not detect the presence of the Brush-tailed Phascogale, nor threatened owls despite extensive survey effort.

The threatened owls (Powerful Owl, Barking Owl, Masked Owl) are regarded as dual credit species, with the offsetting requirement triggered if breeding habitat is present. Based on the lack of detection during the targeted field survey as per the relevant guidelines, the likelihood that threatened owl are breeding within the project area is considered relatively low.

Whilst not captured in the TBDC, other factors that may have contributed to the lack of usage of the subject site by the threatened owls include:

- Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80 - 240 cm) that are at least 150 years old. No such trees occur within the project area (refer to the summary of hollows provided in **section 5.1.3** of this report); and

- The Masked Owl prefers breeding within moist eucalypt forested gullies, or caves. Such features are absent from the project area.

As described throughout the amended BDAR, the project area predominately consists of rehabilitated land within a former quarry pit. As such, much of the habitat that is present is of a relatively young age (i.e. Tree hollows not yet developed in tube stock), and has a very low resilience (i.e. native recruitment of native flora is generally low). This may have attributed to the lack of usage of the site by the Brush-tailed Phascogale. Furthermore, this species has not been detected on-site during earlier field campaigns such as those undertaken by ERM in 2006 Records for the Brush-tailed Phascogale within the locality are also sparse.

Targeted flora surveys required

The BCD recommended that targeted flora surveys be undertaken to align with the requirements of the BAM.

DPIE's "Plant Survey Guidelines" were not released until April 2020, while the project was on exhibition as such these could not feasibly be considered in the preparation of the exhibited BDAR. Following exhibition, a review of the BDAR has been undertaken, details of survey effort and methods have been reviewed and are contained in **Table 8** (p. 16) of **Appendix C.** The amended BDAR includes updated figures that include details of transects.

Mahony's Toadlet targeted survey

The BCD has determined that the site represents suitable habitat for the Mahony's Toadlet and has recommended that targeted surveys be undertaken during the relevant seasonal survey period or the species presence assumed. Boral notes that the basis for the BCD request is the research paper entitled *A new species of Australian frog (Myobatrachidae: Uperoleia) from the New South Wales, mid-north coast sandplains.*

The BCD draws predominantly on the following matters as basis for determining that Boral's site would represent suitable habitat:

- The Mahony's toadlet (the toadlet) is known to inhabit several locations in the Port Stephens area including Fingal Bay, Grahamstown, Oyster Cove, Medowie, Nelson Bay (golf club) Medowie, Williamtown and the Stockton dune complex. In relation to the latter BCD references the fact that the toadlet has been identified on a nearby (yet unidentified) sand quarry;
- The toadlet is described by Clulow *et al*. (2016) as a *habitat specialist, inhabiting coastal ephemeral and semi-permanent swamps and swales, and occasionally man-made*

dams, in heath or wallum habitats almost exclusively on a substrate of white/leached sand;

- The species is *"well known"* to occur in patches of dry forest well away from any water body (i.e. >0.5 kilometres from any known waterbody); and
- The species is frequently recorded/reported as *U. laevigata.*

Boral has reviewed the research paper by Clulow et al (2016), the NSW Scientific Committees Determination Report and has performed searches of online databases, including BioNet and the Atlas of Living Australia. Using these sources the following is noted regarding the distribution and occurrence of the toadlet:

- Clulow et al (2016) identified only seven (7) sites of a possible 21 across Port Stephens as supporting the toadlet. Of these, two were noted as containing ephemeral waterbodies, the remaining five site were recorded as containing either permanent or semi-permanent;
- All vegetation types within the Port Stephens area found to be supporting the toadlet were described as "swamp", consistent with the habitat description provided by Clulow et al (2016) that the species predominantly inhabits areas of Paperbark swamp (noted to form part of the swamp sclerophyll vegetation community);
- No sites listed in Table 4 of Clulow et al (2016) are located within Fullerton Cove, the nearest site investigated is the Williamtown airport, where the species was not recorded;
- Two records are registered on Bionet at a location approximately 4 kilometres east of the Stockton Quarry within the Worimi Conservation Land south of Mackas Sand Quarry. Notwithstanding this, the majority of all recorded sightings of the toadlet occur in Tomago and Oyster Bay; and
- The NSW Scientific Committee – Preliminary Determination notes that of the eight previous recorded descriptions of the toadlet, only two described the species as resembling the *U. laevigata.* In comparison Clulow et al, 2016, makes the observation that *it was immediately apparent that these specimens did not conform to any species of Uperoleia described at the time based upon the markings and, in particular, ventral patterns*.
- All publicly available, peer reviewed and reputable sources, consistently report the distance the toadlet is encountered from water as 400 metres. Records of the toadlet at distance from waterbodies (i.e. up to 400 metres away) occurred during only non-breeding periods.
- Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species, even on disturbed sites.

The project area contains no permanent or semi-permanent water bodies. Nor is there substantial intact vegetation for the majority of the proposed extraction area due to previous clearing activities. Moreover, recent surveys following 20mm rainfall events confirm that the site does not result in ephemeral ponding. Based on this information it is evident that the site does not contain habitat that would be suitable for the toadlet.

Accordingly, no further amphibian surveys are considered necessary as there is little potential for the Mahoney Toadlet to occur within the project area.

Further information, clarification and justification

BCD requested that the following information be provided or clarified in support of the BDAR:

- Plot field data sheets;
- Disconnects between the exhibited BDAR and the credit calculator;
- Correct the area of PCT 1646 *Smooth-barked Apple / Blackbutt / Old Man Banksia woodland on coastal sands of the Central and Lower North Coast* identified in Appendix 2 [of the exhibited EIS]; and
- More detailed justification as to why some fauna candidate species were not assessed.

The BDAR has been amended and is provided **Appendix C** to this report. In response to the matters raised by the BCD (as set out above) the following is provided:

- Appendix 3 of the amended BDAR contains plot data. It is noted that plot data sheets cannot be provided as information was collected electronically and therefore there are no “raw data” sheets. Boral can, on request, provide the BCD with the raw data files in excel should they be necessary.
- The biodiversity credit calculator has been updated to reflect data collected during field surveys completed over May to August 2020. The Biodiversity Credit Calculator has been reviewed and is consistent with the information provided in the amended BDAR. The updated credit calculator will be submitted under separate cover to the BCD on submission on the Response to Submissions Report (Volume 1).
- The correct area was 2.91 hectares. Notwithstanding this minor error, Niche has re-stratified all vegetation mapping within the project area as a consequence of additional surveys and detailed mapping of hollow bearing trees. The location of hollow bearing trees within the project area are those that have typically not been previously disturbed or where isolated or scattered remnant trees are present following earlier disturbance. The stratification of the site, under the amended BDAR (**Appendix C**) has taken into account mapping stratification advice and guidance from the Biodiversity Conservation Trust (BCT) provided in March 2020 that is relevant to the preparation of BDARs.

- Table 10 of the amended BDAR (**Appendix C**) provides a detailed description of survey work undertaken for candidate fauna species. Where a species was not the subject of a targeted survey justification has been provided in accordance with the request of the BCD.

5.5.2 Aboriginal heritage

Boral acknowledges the request of the BCD that an Aboriginal Cultural Heritage Management Plan (ACHMP) be prepared in consultation with the registered Aboriginal parties (RAPs) and that any such plan include protocols for managing any Aboriginal objects or human remains encountered during quarry development and operation works for the life of the project.
Boral is willing to accept an appropriately worded condition of consent requiring the ACHMP be prepared and approved prior to the commencement of works on site.

5.5.3 Water and coast

The following comments were received from the BCD in relation water and coasts.

Final land form

As set out in **section 1.4**, these matters will be addressed through a further and separate Response to Submissions report.

Rehabilitation strategy and criteria: freshwater wetland

As set out in **section 1.4**, these matters will be addressed through a further and separate Response to Submissions report.

Long term water quality monitoring and management

As set out in **section 1.4**, these matters will be addressed through a further and separate Response to Submissions report.

5.5.4 National Parks and Wildlife

The BCD has raised the following matters in relation to National Parks and Wildlife service in respect to the potential impacts of the project on the adjacent Worimi Conservation Lands.

Groundwater dependant ecosystems

This matter will be responded to as part of a further and separate report. Refer to discussion in **section 1.4.**

Windblown project

Boral has sought a further and separate consent for the purpose of the dredging activities. As a standalone State significant development, the application does not propose to modify the existing consent and therefore does not seek to amend the conditions or parameters of the existing consent to extract on the windblown dunes.

Landownership and description: Worimi Conservation Lands

Boral acknowledges that there was an error in the mis-description of the adjacent lands. Boral corrects any such statement that these lands as the Worimi Conservation Lands, Aboriginal owned and jointly managed with NPWS by the Worimi Conservation Lands Board of Management.

5.6 Hunter Water

Hunter Water raised three points for consideration and response, including:

- Whether dredging reflected best practice in terms of sand extraction;
- Groundwater management and monitoring; and
- Confirmation for the water source and use for dust suppression.

The following section has responded to comments regarding best practice extraction methods only. All other matters relating to water will be addressed as a further and separate response report.

5.6.1 Best practice resource extraction

Hunter Water has objected to the proposed quarry on the grounds that dredging does not reflect “best practice”.

Boral, as an experienced industry operator, is not aware of any recognised standards prepared by industry or government that state the wet extraction of sand resources does not align with best practice. As such there is no definitive guidelines or industry body that advocates for dry extraction methods over wet extraction methods. The method adopted by an operator is driven by the accessibility, quality and location of a resource deposit.

It is acknowledged that there is dominance among established and operating quarries in the Port Stephens area to utilise a dry extraction approach. However, this is driven by the accessibility of the resource and most likely the balance of outcomes (i.e. the potential for

adverse impacts when all relevant matters have been considered and assessed), not by an indefensible claim of “best practice”.

The move towards dredging is reflective of the status of the resource and reserves in the area. Such that those easily accessible resources (such as windblown sands or unvegetated dunes above the groundwater level) have been depleted and it is necessary to modify and adapt to ensure a continued sand supply.

Despite the localised dominance of dry land extraction methods, inland sand dredging (i.e. dredging outside marine, estuarine or river environments) is an accepted approach to quarry operations and can be undertaken to achieve “best practice”. An example of this is Boral’s operations at Dunmore Sand and Soils that has been operating on the south coast of NSW for over 30 years without incident. However, more broadly we note that dredging applications are routinely lodged for sand resource extraction with the following active applications currently registered on DPIE’s major project site:

- Howlong Sand and Gravel Quarry Expansion – Earthmoving Resources Project (response to submissions stage); and
- Hanson Tweed Sand Plant Expansion of an existing operation, for 950,000 tpa by dredging (30 – 35 million tonne resource) – SEARs issued.

Notably, neither of these projects have received comments advising applicants that the method is not acceptable on the grounds of “best practice”.

In relation to the proposed development, the quarrying approach or method has been developed and selected with the view to avoiding impacts. This avoidance strategy has informed the analysis and identification of preferred options at every step of the project from site selection to plant material identified for use on site. This systematic review of all facets of the site’s operation was set out in detail in the EIS in Table 1.1, section 1.2.2. For the ease of reference this has been extracted and is provided as **Appendix E** to this report.

The project approach adopted by Boral in the context of their Stockton site is considered to be reflective of best practice. The project approach has sought to limit adverse impact through extracting within an area previously disturbed thereby reducing the extent of remanent vegetation clearing and limiting the potential for adverse impacts on cultural heritage while ensuring large buffers to adjacent private and public lands reducing adverse amenity impacts.

Hunter Water has provided no evidence that supports their comments that the project has failed to demonstrate best practice and in this regard the comment should not be given determinative weight.

5.7 Department of Planning, Industry and Environment – Water/Natural Resource Regulator

DPIE Water raised several key matters requiring further detailed assessment, including:

- The need to account for incidental water take;
- Re-calculation of the total annual water take; and
- Completion of a groundwater model (class 1) to support the assessment of potential impacts.

These matters are currently undergoing further review following a meeting with DPIE Assessments and Water teams on 21 July 2020. A further and separate response to submissions report (RtS, volume 2) will be provided addressing these and all related matters.

5.8 NSW Health

NSW Health submission has made comment in relation to long term management, drinking water, and community engagement.

5.8.1 Mosquito management

NSW Health has sought the submission of a mosquito management plan.

The Hunter Health Mosquito Management Strategy recommends the management of freshwater mosquitos through a combination of physical and vegetative responses, including management of aquatic vegetation and ensuring that large bodies of water have high wind or wave action together with predatory fish to reduce larval development.

The coastal location of the site together with the operation of the dredge will ensure that the pond achieves movement within the water that will discourage larvae establishment within the macrophyte zone. This can be further enhanced through ensuring that any vegetation planted is managed with respect to density and decomposition to reduce breeding habitat. In this instance the introduction of predatory fish species or the use of chemical agents is not considered suitable.

As the management of mosquitoes is linked to the management of vegetation, appropriate measures will be implemented as part of the ongoing landscape and final rehabilitation management plans prior to the commencement of any onsite operations to expose the groundwater table.

Boral is willing to accept that the requirement for mosquito management form part of a detailed landscape management and rehabilitation plan. This can be resolved as a condition of consent.

5.8.2 Drinking water

All site drinking water is provided in bottled and packaged form dispensed by a commercial provider's cooling towers. All taps in kitchens and bathrooms are clearly labelled and identified as not being suitable for consumption.

As drinking water is provided by a third party in a bottled or packaged form, Boral is not a supplier of drinking water as defined by the *Public Health Act 2010* and therefore does not trigger the requirements of Division 2 Quality Assurance Programs of the *Public Health Regulations 2012*.

Taking into account the above, Boral will accept a condition to this effect on any future approval as a means of providing certainty to NSW Health.

5.8.3 Community engagement

NSW Health requests that Boral continue to engage genuinely with the community through the project assessment and establishment phases as well as developing a complaints response and management plan.

Boral has operated Stockton Quarry for 28 years and has used an adaptive organic community engagement model that aims to be dynamic and responsive to the community that we operate within. As Boral's operation is separated from most residential communities and "hidden" from view from most vantage points due to setbacks and vegetative screening, community members are often unaware of the operation. While this reflects positively on Boral's operation of the site it means that community members are often unresponsive to Boral's attempts to engage. Notwithstanding this, Boral utilises a range of engagement methods from letter box drops, door knocks and social media to communicate planned projects and routine works.

As the site is an established operation, we have an existing complaints hotline and response system. Boral has a central registration for all site incidents, including complaints, that ensures

they are investigated and appropriate action is taken. This protocol will continue to operate if the project is granted approval.

5.9 Division of Resources and Geosciences

The Division of Resources and Geosciences (DRG) has made the following comments.

5.9.1 Annual production data

The DRG seeks a condition of consent requiring the provision of annual production data for the site. This is a standard condition for extractive industries and Boral raises no objection to such a condition being placed on any consent.

5.9.2 Consultation in relation to biodiversity offset areas

Boral's current biodiversity offset strategy is likely to involve a payment into the biodiversity conservation trust fund or the purchase of credits from the market.

Notwithstanding the above, should Boral pursue land based credits through the identification and establishment of a stewardship site we would endeavour to engage with the DRG as part of this process.

5.9.3 Resource report

The Department of Geosciences has noted that the Secretary's Environmental Assessment Requirements sought the preparation and submission of a resource report.

This report was accidentally omitted from the EIS and has been submitted under separate cover directly to the DRG. The DRG has acknowledged receipt of the report and made no follow up enquiries.

5.10 Transport for NSW

Transport for NSW (TfNSW) has reviewed the Traffic Impact Assessment (TIA) and the EIS and raised no objection to the proposal on the grounds of adverse significant impact to the regional road network or requirement to upgrade to roads. Boral notes the response of TfNSW.

5.11 DPI Agriculture

The authority provided no comment.

5.12 Ausgrid

The authority provided no comment.

6 Response to public submissions and community groups

A total of 11 public submissions were received from six individual community members and five interest groups.

The following section has addressed all submissions made by community groups and individuals organised around primary theme. Based on all submissions received the primary areas of concern or interest were groundwater and traffic, followed by biodiversity, quarrying method and socio-economic impacts.

As set out in **section 1.4** of this report, all matters relating to water (ground water and surface water) have been withheld from this response. A further and separate RtS will be lodged in due course responding to these matters.

6.1 Groundwater

A total of seven (7) community submissions raised concerns relating to groundwater. Of these three (3) were community groups and four (4) were individuals from within the community.

A total of seven sub-themes were identified in submissions raising groundwater. These included:

- Generalised (unspecified) comments of impact;
- Water demand and balance;
- Relationship to other water users
- Quality of the Hydrogeological assessment;
- Availability of water allocations;
- Water Quality (contamination – general); and
- Water Quality (Poly-fluoroalkyl substances (PFAS)).

Of the submissions raising groundwater the majority (five submitters) were concerned with PFAS. Within this subtheme, a total of seven discreet issues were identified, including:

1. matters relating to the absence of a discussion of PFAS in the exhibited EIS;
2. questions in relation to what laboratory limits referred to when talking about PFAS levels;
3. comments relating to the source of PFAS in the groundwater;
4. PFAS management zones with reference to the site and the proposed operation;
5. the potential for groundwater to mix and contribute to PFAS migration;
6. management of PFAS; and
7. the perceived uncertainty and risk associated with the project in proximity to the PFAS management zone.

As set out in **section 1.4** of this report matters relating to groundwater are undergoing further assessment. As such responses to these matters will form part of a further and separate Response to Submissions, volume 2 to be submitted at a later date.

6.2 Biodiversity

A total of five submissions raised matters relating to the theme of biodiversity. The matters raised included the following:

- Survey effort and assessment in relation to fauna types and species (birds and koalas);
- Potential impact on wildlife corridors, particularly koala movement corridors; and
- Boral's adopted offset strategy and the offset framework generally.

As discussed in **sections 5.4.1** and **5.5.1**, additional survey effort has been completed for several species. Moreover, the BDAR has been amended to more thoroughly detail and justify why certain species (flora and fauna) were not the subject of targeted surveys. This detail is contained in **Table 10** of the amended BDAR (refer to **Appendix C**).

6.2.1 Habitat and movement corridors

Several submissions have raised concern regarding the removal of vegetation from within an area of the site mapped as "supplementary habitat" under the Port Stephens Koala Plan of Management (KPoM).

The KPoM habitat mapping was developed based on data collected and collated between 1992 and 1996. The information used ranged from community based surveys of reported koala sightings (1992), vegetation mapping based on the interpretation of aerial photographs (1992 – 1993) and a field based survey (c. 1996) using 110 plot sites (96 primary and 14 supplementary). While the methodology is accepted within the industry as suitable for the purpose of adopting a broad scale policy approach, it should not be used as a means of blocking suitable development where detailed site specific studies are capable of demonstrating that the interpolated, broad brush policy framework is incongruent with the on the ground reality.

The project site was cleared of remanent vegetation in 1994 to allow for the extraction of sand resources to RL5m AHD. Notably the mapping data used to identify Boral's site as "supplementary" was collected prior to the implementation of the 1994 consent. Accordingly the vegetation used to inform this "categorisation" of land no longer exists.

In the 28 years Boral has owned and operated the site, there have been no Koala sightings. A month of monitoring using camera traps did not manage to record the presence of any koalas and no scats or scratchings were identified on or around any trees within the project area.

Despite the presence of trees listed under the newly adopted State planning policy, there is no physical evidence of koala use or movement through the site.

The project footprint leaves large tracts of Boral's land with remanent vegetation that provides connectivity to adjacent landholdings. Accordingly, the project will not disrupt any potential migration of Koala's through these established corridors.

6.2.2 Fauna

The following section considers and responds to matters raised by community interest groups and individuals relating to fauna survey effort and outcomes. It is noted that comments relating to impact on Koala populations were largely focused on the legal and planning framework, these matters are addressed in detail in **section 6.6.2** of this report.

Adequacy of avian surveys and assessment

One submission has raised concern regarding the extent of avian surveys undertaken to inform the Biodiversity Development Assessment Report (BDAR). Specifically the submissions raises the following points:

- The seasonal timing and duration of surveys;
- The lack of nocturnal (night) surveys to determine the presence/absence of owls;
- The veracity of the Bionet Atlas search conducted; and
- The quality of the assessment of potential avian species likely to be present.

Details of the surveys completed to inform the BDAR based on faunal types are set out in **Table 10** of the amended BDAR provided at **Appendix C** to this RtS. In respect of surveys for birdlife, DPIE has not yet published the 'Bird Survey Guidelines' that would provide guidance in relation to the preparation of BDARs. Niche (Boral's biodiversity/ecological consultant) was advised by the Biodiversity Conservation Division of DPIE in June 2020 that the most relevant guidelines available should be applied. These guidelines included the 2004 Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (working draft) (DECC2004) and the Lake Macquarie City Council (LMCC 2014a) Flora and Fauna Guidelines Version 4.2. Taking this into account, the following surveys, relevant to determining the presence avian species in the project area, were conducted:

- Camera trapping (one month, May to July);
- Spotlighting (five occasions through the months of May to July);
- Diurnal survey (five occasions, throughout the months of May to July);
- Nocturnal survey – call back (five occasions, throughout the months of May to July);

- Nocturnal survey – stage watching (five occasions, throughout the months of May to July); and
- General survey transacts and tracks.

The amended BDAR has been prepared on the basis of the most up to date guidelines for the purpose of completing a BDAR. Following the completion of the surveys, **Table 14** of the BDAR has been further revised. Refer to **Appendix C** of this report.

Presence of Owls on the site

Concern was raised that the assessment had not considered the potential for owl to use the site. Based on survey data collected from the site over May to August 2020, the following was noted:

- There was no evidence of owl usage (pellets or prey) at the base of hollow bearing trees and none of the camera traps captured images of hollow-dwelling species; and
- Surveys were conducted during the appropriate months for the Barking Owl, Powerful Owl and the Masked Owl. None were observed on the site, nor were nests recorded as being present. It is considered unlikely that the site contains breeding habitat for any of the identified species of Owl.

6.2.3 Offset strategy

Several submissions have objected on the grounds that they do not agree with the biodiversity offset framework and requested that the consent authority “not automatically accept” a payment option.

The same submitters have correctly identified that the legal framework currently supports three primary means of meeting offset obligations;

1. The establishment of a biodiversity stewardship site;
2. Purchase available credits from the market; and/or
3. Pay into the biodiversity conservation fund.

While Boral has presented an option to pay directly into the fund, this offset strategy proposed was the result of detailed project analysis and refinement aimed at meeting the “avoid, mitigate and manage” framework. The exhibited EIS in **Section 1.2.2** sets out the project alternatives Boral considered in developing and identifying the preferred project. In this instance, the option with the least environmental impact involves the removal of planted rehabilitation vegetation. Whilst the impact could not be avoided, it has been mitigated to the degree possible by avoiding the need to remove large areas of remanent vegetation.

6.3 Traffic and transport

A total of seven submissions raised concern regarding traffic and transport related matters. The range of issues generally covered,

- the increase in truck movements;
- the cumulative effect of other truck movements (project + other operating quarries); and
- vehicle class.

A detailed traffic and transport study was undertaken. The assessment was discussed in **section 12** of the exhibited Environmental Impact Statement and provided as **Appendix H**.

6.3.1 Increased vehicle movements

Submissions raised the following specific concerns relating to the potential for increased vehicle movements to have an adverse effect on the local and regional traffic network:

- general concern regarding the increased number of heavy vehicles on the local road network;
- impact of additional vehicles on Nelson Bay Road;
- impact of using Coxs Lane/Fullerton Cove Road/Cabbage Tree Road Haulage route;
- road congestion; and
- need for road upgrades.

The proposed increase in vehicle movements has been considered by Transport for NSW (TfNSW) and Port Stephens Council. Both agencies have resolved that the proposal will not adversely impact the capacity of the traffic network, generally or within specific reference to Nelson Bay Road.

In relation to the increase of vehicle movements of particular transport routes, Section 2.6 of the Traffic Impact Assessment (TIA) (**Appendix H** of the exhibited EIS) sets out all traffic routes to be used by Boral trucks. This section details that all vehicles access Nelson Bay Road via the Coxs Lane on ramp and vice versa (accessing Coxs Lane by the Nelson Bay Road off ramp). As such the proposed development will not impact on the Coxs Lane/Fullerton Cove Road/Cabbage Tree Road route (refer to **Figure 5**, page over).

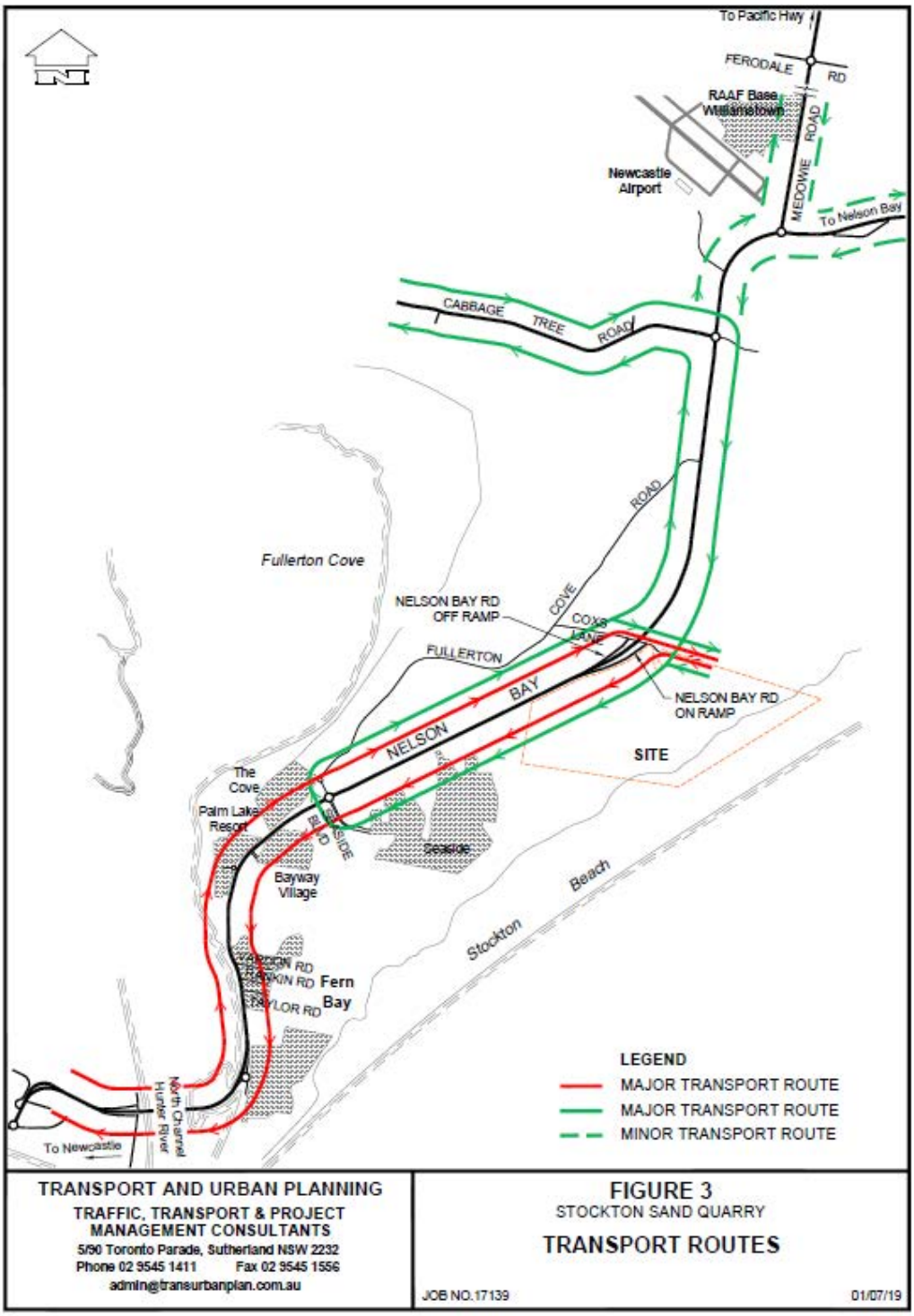
6.3.2 Cumulative impact

A detailed regional traffic impact assessment (TIA) was undertaken by Transport and Urban Planning Pty Ltd and formed **Appendix H** to the exhibited EIS.

The TIA in section 4.0 describes the *Existing traffic conditions,* section 4.8 specifically addresses other quarries operating and recently approved (at the time of lodging the application) which includes Cabbage Tree Road Quarry (section 4.8.1) and Fern Bay Seaside Village (section 4.8.2).

TfNSW has reviewed the TIA and the traffic data and model used to inform the preparation of the TIA. TfNSW and Council have both concluded that the proposed development will not adversely impact the existing traffic network.

Figure 5: Transport routes (source: TUP, TIA 2019).



6.3.3 Vehicle class

The TIA has assessed the proposal using both heavy vehicle movements and light vehicle movements. The split reflects the following:

- heavy vehicle movements being those associated with the delivery and removal of materials; and
- light vehicles used by staff and visitors attending the site.

A detailed breakdown of vehicle movements and type are set out in **sections 2.8** and **3.10** of the TIA and are summarised in the **Table 5**.

Table 5: Summary of all vehicle movements by purpose and vehicle class

Purpose	Vehicle type	Number/frequency
Employee and Visitors	Light vehicles	24 per day
Sand product (export and importation of VENM)	Heavy vehicles	284 per day
Water delivery	Light vehicle	16 per day (maximum)
Fuel Truck	Light vehicle	2 per week
Waste collection	Light vehicle	4 per month
Servicing and maintenance	Light vehicle	2 per month
Septic system pump out	Light vehicle	2 every 7 weeks

All of the above vehicle movements, together with the background traffic movements in combination with recently approved quarries (refer to section 4.8.1 of the TIA) have been considered in the TIA.

As set out in **section 6.3.1** and **6.3.2**, both TfNSW and Council have accepted the findings of the submitted TIA. In this regard it is not considered necessary to further consider the potential for impact on the relevant transport network.

6.4 Quarrying method

Four submissions commented that the proposed quarrying method (using wet extraction methods) is inconsistent with other quarrying methods used by other operators in the Port Stephens area.

This matter has been addressed in response to comments made by Hunter Water. Refer to **Section 5.6**.

6.5 Socio-economic

Four submissions raised socio-economic matters that they feel have not been adequately addressed/justified or that warrant the refusal of the application. These include:

- Tourism impacts;
- Balance of outcomes (positive financial impacts do not outweigh all other effects of the proposal); and
- Additional trucks will adversely impact casual road users.

6.6.1 Tourism impacts

No specific tourist ventures or locations were identified as likely to experience adverse impacts associated with the project. The absence of any specific reference to a particular venue or destination combined with the variety of factors that influence tourist destination choices make it difficult to determine whether the project would have a positive or negative impact on tourist numbers in the local area.

Notwithstanding the above, the dunes immediately east of Boral's holdings are currently used for the purpose of tourist operations including four wheel driving and quad biking tours. To date Boral's operations behind the windblown dunes have had no impact on this established tourism venture. Taking into account that the Stockton Beach tourist economy and Boral have successfully coexisted for the last 11 years, it is considered unlikely that local tourism would suffer as a consequence of the proposal.

6.6.2 Balance of outcomes

Two submissions have raised the concern that the positive economic impacts associated with the project do not, on balance, outweigh the potential for adverse impact.

The project has been carefully designed to minimise the potential for impacts (direct and indirect). Boral is of the view that the project reflects the best possible outcome for the community and the industry. All identified impacts are capable of being managed to ensure minimal to no harm to the environment and nearby receivers.

The project benefits extend beyond direct financial gain, including ongoing and new employment opportunities and continuity in the supply chain for key resources that ensure a sustainable and functioning construction industry.

6.6.3 Impact to casual road users

Two submissions have raised the potential for increased truck movements to adversely impact on the experience of casual road users in the region.

Roads are a shared asset between all users, including local residents, business and visitors. The traffic generated by the project has been assessed by Transport for NSW and Port Stephens Council. Each agency has resolved that the network capacity of their respective road assets can accommodate the anticipated increase in vehicle movements.

Given that there is capacity in the road network to absorb the proposed vehicle movements, there is no evidence to support the submitter's comments that trucks would impact (positively or negatively) on a casual road user's experience.

6.6 Planning frameworks and assessments

The following section responds to submissions that raised matters relating to the planning framework, including consistency with legislation, strategic planning directions, and planning instruments.

6.6.1 Consistency with strategic planning directions

Several submissions have made comment that they do not believe the project is consistent with the directions of the Hunter Regional Plan 2036, specifically:

- Direction 14: *Protect and connect natural areas*
- Direction 15: *Sustain water quality and security*

The Hunter Regional Plan 2036 is a high level strategic planning document that is used to inform the growth and development of a region over a 20 year period. The plan is crafted around four main goals including:

- Leading the regional economy of Australia;
- A biodiversity-rich natural environment;
- Thriving communities; and
- Greater housing choice and jobs.

The proposed development is not inconsistent with the goals of the plan. The development will contribute to the regional economy and the development of a thriving community through adding:

- $9 million in annual direct and indirect regional output or business turnover;
- $5 million in annual direct and indirect regional value added;
- $2 million annual direct and indirect household income; and
- 25 direct and indirect jobs,

Combined with the above, the continued operation of the site would ensure continuity in the supply chain of materials into the construction market that will support the delivery of new and expanded housing options. Additionally, the proposal to extract within an area of earlier disturbance reduces the loss of high value environmental assets.

Operations such as Boral's are key to ensuring the attainment of the goals of the Hunter Regional Plan 2036 and supporting recovery of the NSW and regional economy in the current social and economic climate.

Direction 14: Protect and connect natural areas

Direction 14 of the Hunter Regional Plan aims to invest in conservation (including biodiversity offsets) that protects, and where possible, enhances habitat connections to deliver multiple benefits to the environment and the community. The direction (or objective) is supported by five key actions all of which focus on areas of "high environmental value", these are considered in **Table 6**.

Table 6: Consistency of project Direction 14 HRP 2036

No.	Action	Consistency
14.1	Identify terrestrial and aquatic biodiversity values and protect areas of high environmental value to sustain the lifestyle, economic success and environmental health of the region	98 per cent of the land area to be used for the purpose of extraction is rehabilitation vegetation, in terms of environmental value the land is considered to be degraded habitat lacking in mature species and vegetative complexity. By locating the proposed project over an area of earlier impact, Boral is minimising, if not avoiding, adverse impact to high value biodiversity areas. The project is considered consistent with this action
14.2	Identify and strengthen biodiversity corridors as places for priority biodiversity offsets.	This is not a matter relevant to the proposed development.
14.3	Improve the quality of, and access to, information relating to high environmental values.	This is not a matter relevant to the proposed development.
14.4	Protect biodiversity by maintaining and, where possible, enhancing the existing protection of high environmental value areas; implementing appropriate measures to conserve validated high environmental value areas; developing local strategies to avoid and minimise the impacts of development on areas of high environmental value and biodiversity corridors; and identifying	The project has been intentionally designed to focus the development on an area of previous disturbance to ensure that the removal of remanent vegetation was avoided and where unavoidable minimised. This ensures the retention of high value environmental areas on site, including the retention of existing corridors north and south of the extraction area. Boral is not responsible for the preparation of local strategies as such this aspect of Action

No.	Action	Consistency
	offsets or other mitigation measures for unavoidable impacts	14.4 cannot be delivered by the project. The project includes the delivery of offsets aligned with accepted legislative requirements.
14.5	Secure the long term protection of regionally significant biodiversity corridors.	As stated above, the project does not significantly reduce or impact on existing corridors. This project is not inconsistent with the action.

Direction 15: Sustain water quality and security

Direction 15 is aimed at managing and protecting available water resources across the region. The project has been designed to ensure the protection and preservation of water quality.

As set out in **section 1.4** of this report matters relating to groundwater are undergoing further assessment. As such responses to these matters will form part of a further and separate Response to Submissions, volume 2 to be submitted at a later dat.

6.6.2 Koala protection and habitat policy

The Hunter Koala Preservation Society (HKPS) has lodged a submission raising concerns relating to the NSW regulatory and policy framework that seeks to protect koalas and koala habitat. Intrinsic to this submission is the effect of Australian 2019/20 summer bushfire season on wildlife communities and the efficacy of current policy settings and legislative frameworks in responding to this reported impact.

While Boral acknowledges the comments of HKPS, the many concerns raised are matters of policy that are beyond the scope of this development application. Whether the HKPS agrees with or supports the framework is matter beyond the legal provisions of the EP&A Act 1979 and a matter beyond Boral's control.

Notwithstanding the above, Boral has undertaken further data collection within the project area. This data collection and analysis further confirms that despite the presence of tree species listed under the amended State instrument for the protection of Koala Habitat, there are no Koalas present within or using the site.

6.7 Amenity

The following section responds to submissions that have been made in relation to matters affecting amenity, including road traffic noise and air quality.

6.7.1 Road traffic noise

One submission raised road traffic noise associated with the increased vehicle movements.

The potential impacts of increased road traffic movements and associated noise was considered in the Noise Impact Assessment (**Appendix G** of the exhibited EIS). The Noise Impact Assessment (NIA) considered road traffic noise exposure levels along Nelson Bay Road, Cabbage Tree Road and Medowie Road against the industry standard, the NSW EPA *Road Noise Policy* (RNP). Section 3.3 of the NIA identified the noise criteria of the RNP based on road type (freeway/arterial road and local roads) as well as the time of the time of day (day vs night). Section 4.4 of the NIA concluded there would be less than 0.2 dBA increase in road traffic volumes during busy weekday movements. Based on this outcome the proposal was compliant with the adopted standards and it is considered unlikely that the development would impact on sensitive receivers located within proximity to the quarry or haulage routes.

Furthermore, it is noted that the Environment Protection Authority (EPA) have reviewed the proposal and raised no concerns with the noise impact assessment.

6.7.2 Air quality

One submission questioned the conclusions of the air quality assessment. The submission sought that the relevant regulatory agency provide a review and assessment of the report.

The EPA is the key regulatory agency for the assessment and management of air quality in NSW. The EPA reviewed and responded to the exhibition of the EIS, supporting the project and raising no concerns with the air quality assessment.

No further consideration or assessment of these matters is necessary.

6.8 Rehabilitation and final landform

Two public and community group submissions raised matters relating to rehabilitation of the land. The issues raised within this category were largely matters requiring clarification or matters requiring a response from DPIE (i.e. matters of enforcement).

The submissions raised a range of matters including:

- Rehabilitation commitments;

- Rehabilitation/remediation assurances;
- Enforcement of rehabilitation;
- Practicality of the final landform; and
- Description of the final landform.

As these matters relate to and/or extend from a discussion of groundwater matters, responses to these submissions and matters will be addressed in volume 2 of the Response to Submissions Report.

6.9 Climate change & greenhouse gas emissions

One submission has raised the potential generation of greenhouse gas (GHG) emissions associated with haulage and the potential the contribution of this element may have on climate change.

GHG emissions associated with haulage is determined by calculating the CO_2 present in likely fuel consumption of trucks used to collect and distribute sand from the site. The transportation (or haulage) of 750,000 tonnes of sand using trucks would require approximately 2,809,375 litres of diesel fuel. To determine the likely GHG emitted as a consequence of transportation related activities based on fuel consumption, the calculation methodology of the United States Environment Protection Authority (US EPA) has been adopted making allowance for conversion to the metric system.

The values used by the US EPA are set in accordance with the IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 (Energy), the Intergovernmental Panel on Climate Change, Geneva, Switzerland (IPC, 2006) and assume that all carbon in diesel is converted in CO_2.

$$2{,}680 \text{ grams of } CO_2\text{/litre of diesel} = 2.680 \times 10^{-3} \text{ metric tons } CO_2\text{/litre of diesel}$$

Therefore the likely emissions generated by transportation associated with the project is approximately 6,630 t CO2-e per annum, representing approximately 0.1% of all transport related emissions[1] reported between March 2018 to March 2019 (Australia's National Greenhouse Inventory: March 2019).

[1] "Transport" related emission sources include road transport (passenger vehicles, light commercial vehicles, trucks, buses and motorcycles), domestic air transport: commercial passenger and light aircraft on domestic routes using either aviation gasoline or jet kerosene. International air transport is reported but not included in Australia's total emissions (in line with international guidelines), coastal shipping: domestic shipping and small craft. International shipping is reported but not included in Australia's total emissions (in line with international guidelines), rail transport: railways, but not electric rail, where fuel combustion is covered under the electricity sector, and Transmission of natural gas.

Transport related GHG emissions reflect 18 per cent of all GHG emissions in Australia reported between March 2018 to March 2019 (Australia's National Greenhouse Inventory: March 2019). Approximately, half of these emissions are reported by the Climate Council to be the result of private motor vehicle use.

Taking into account the proportion of emission associated with the project when considered against those generated by individuals using a private motor vehicle the project is considered to represent a negligible contribution.

Taking into account the value derived from the project in ensuring the continuity of critical building materials into a key industry for the both the region and the State, the potential impact is considered to be reasonable and within acceptable limits.

6.10 Coastal processes

Two submission asserted that the proposed extraction may adversely affect coastal processes, in particular that the project will lead to the de-stabilisation of the Stockton sand dunes.

The exhibited EIS was informed by a report prepared by Professor Short, a specialist in coastal geomorphology, relevant extracts from this report are contained in sections 2.5.6 and 14.3.2 of the exhibited EIS. A copy of the report was omitted as an oversight from the EIS and is now provided at **Appendix E**. The conclusion of Professor Short in relation to the potential effects of the project on coastal processes

The site is surrounded by at least 500 m of densely vegetated dunes and is located at least 500 m and downwind from the nearest mobile dunes and at least 1 km from the Stockton beach shoreline. Given the size and nature of this buffer zone it cannot and will not have any physical interaction with or impact on these systems, namely beach processes or the movement of sand from the beach into the mobile dunes and their encroachment on the vegetated hind dunes. The predominant impacts will be in the immediate vicinity of the site itself in the excavation, buffering and revegetation of the surrounding dune slopes. Once they are landscaped and rehabilitated they should remain vegetated and stable.

As set out in the EIS and the exhibited rehabilitation strategy (refer to **Appendix O**), Boral will implement appropriate ground stabilising methods including the strategic use of VENM and plantings to ensure the stability of the landform around the dredge pond.

6.11 Technical studies

The following section addresses submissions that have raised concern with Environmental Impact Statement and supporting technical reports.

6.11.1 Bias

One submitter raised concern that the technical studies and assessment documentation was prepared by and on behalf of Boral and therefore must be considered biased to present the best possible view of the project.

The NSW Planning system requires that a proponent undertake detailed assessment of potential impacts against regulatory guidelines and instruments. The majority of technical reports are supported by data that is verified by government agencies as part of the assessment process. Were the reports found to not align with the expectation of government, Boral would be requested to submit further and more detailed information. In this regard, Boral notes that in response to the EIS the majority of agencies have accepted Boral's assessments reflective of the high quality of the reports and assessment team engaged to support the project.

6.11.2 Errors or omissions

The Hunter Bird Watchers Society raised concern that the BDAR contained errors or omissions. These have been addressed in **section 6.2** of this report.

7 Conclusion

This RtS (volume 1) report provides a comprehensive response to the Government Agency, Industry, and Community submissions received in response to the exhibition of the EIS relating to biodiversity, traffic, amenity, socio-economic, quarrying methods, coastal processes, climate change, the planning framework and strategic policy directions.

As set out in section 1.4, this RtS is intended to be supplemented and expanded on by a further and separate report, the RtS (volume two), that will address all matters relating to and extenuating from ground and surface water.

The process of review that has occurred as a result of the response to submissions process has not resulted in any substantial amendments or revision to the project approach or methodology requiring re-assessment of any matters. Additional flora and fauna surveys have been undertaken to confirm the absence of key flora and fauna species. Where surveys could not be completed due to seasonality constraints presence for some species has been assumed.

Based on the outcome of the review and the additional technical work completed, the EIS where supplemented and revised by this report and its appendices are considered to demonstrate a high value project with minimal environmental impact.

The development will secure an additiaonl 9 million tonnes of sand resource for use in the building and construction markets, locally and throughout the region and wider State. The continued and sustained demand for sand and sand related products is critical in supporting key industry in the recovery of exonomy and in supporting the continued growht of the region.

APPENDIX A Submissions Matrix

Stockton Quarry: Dredging Project - Submission Matrix

No	Submitter	Response Type	Groundwater										Biodiversity							
			Impact (general)	Water Quality (contamination)	Availability/WAL	Impact on GDEs	Modelling	PFAS	Demand/water balance	Assessment quality (hydro report)	Relationship to other users	Groundwater Dependant Ecosystems	Policy Framework	Survey efforts, rigour & methods	Quality of assessment	missing information/detail	Hollow Bearing Trees	Fauna Impacts	Offset strategy & sites	Habitat and Movement Corridors
1	Port Stephens Koala Inc	object											1		1			1	1	
2	EcoNetwork - Port Stephens	object		1				1					1					1	1	1
3	Port Stephens Bird watchers	object												1	1					
4	Soliders Point Community Group	object						1												
5	Tomaree Ratepayers and Residents Association Inc.	object	1					1	1		1							1	1	1
6	Miceal O'Brien	object	1	1																
7	Lindsay Clout	object		1				1												
8	Anon (ID reference 713391)	object																		
9	Elspeth Armostrong	object						1										1		
10	Anon (ID reference 713406)	object																		
11	Anon (ID reference 713471)	object	1		1					1	1									
Community submission theme subtotals			**7**										**5**							
12	Dept. of Resources & Geosciences	comment																	1	
13	Hunter Health	comment																		
14	Hunter Water	comment		1	1															
15	Port Stephens Council	comment				1						1		1	1			1	1	
16	Crown Lands	comment																		
17	Biodiversity Conservation Division	comment				1	1					1		1	1	1	1	1		
18	DPIE Water/NRAR	comment			1				1			1								
19	Environment Protection Authority	support																		
20	Heritge NSW	comment																		
21	Ausgrid	comment																		
22	DPIE - Agriculture	comment																		
23	Transport for NSW	comment																		
24	DPIE - Social Impact Assessment	comment																		
Agnecy submission theme subtotals			**4**										**3**							
Sub theme totals			**3**	**4**	**3**	**2**	**1**	**5**	**2**	**1**	**2**	**3**	**2**	**3**	**4**	**1**	**1**	**6**	**5**	**2**
Theme Totals			**11**										**8**							

No	Submitter	Response Type	Rehabilitation					Traffic and Transport								Quarrying method			Culture & Heritage		Planning Framework & Assessment	
			Reconsider leaving open pond	Final landform - RL height & pond extent	Suitability of strategy for birdlife	Commit to a detailed strategy	Enforcement	Trucks (general)	Cumulative assessment (other quarries)	Vehicle class	Increased truck movements (Road Capacity)	Increased truck movement (congestion and safety)	Increased truck movements (need for road upgrades)	Access Rd alignment	Developer contributions	Inconsistent with other operations/ new and uncertain method	Best practice	Limit quarrying to dry extraction	Aboriginal Archaeology	Non-Aboriginal	Koala Protection & Habitat Policy (State or Local)	Consistency with strategic planning directions
1	Port Stephens Koala Inc	object																			1	1
2	EcoNetwork - Port Stephens	object						1	1		1					1						
3	Port Stephens Bird watchers	object			1																	
4	Soliders Point Community Group	object									1	1	1			1						
5	Tomaree Ratepayers and Residents Association Inc.	object				1	1	1	1							1					1	1
6	Miceal O'Brien	object																				
7	Lindsay Clout	object																				
8	Anon (ID reference 713391)	object						1	1	1		1										
9	Elspeth Armostrong	object						1	1			1				1						
10	Anon (ID reference 713406)	object						1			1	1	1									
11	Anon (ID reference 713471)	object						1														
Community submission theme subtotals			**2**					**7**								**4**			0		**2**	
12	Dept. of Resources & Geosciences	comment																				
13	Hunter Health	comment																				
14	Hunter Water	comment															1	1				
15	Port Stephens Council	comment				1									1						1	
16	Crown Lands	comment												1								
17	Biodiversity Conservation Division	comment	1	1															1			
18	DPIE Water/NRAR	comment																				
19	Environment Protection Authority	support																				
20	Heritge NSW	comment																				
21	Ausgrid	comment																				
22	DPIE - Agriculture	comment																				
23	Transport for NSW	comment																				
24	DPIE - Social Impact Assessment	comment																				
Agnecy submission theme subtotals			**2**					**2**								**1**			1		**1**	
Sub theme totals			**1**	**1**	**1**	**2**	**1**	**6**	**4**	**1**	**3**	**4**	**2**	**1**	**1**	**4**	**1**	**1**	**1**	**0**	**3**	**2**
Theme Totals			**4**					**9**								**5**			**1**		**3**	

No	Submitter	Response Type	Socio-economic					Water (general)		Amenity Impacts		Other		Environmental Impact Statement				Post consent matters (management and monitoring plans)								No comments
			Tourism impacts	positive economics not outweighing impacts	Impact of trucks on casual road users	Engagement - ongoing & genuine	SIA Rigour	Hierarchy of water use	Health (potable drinking water)	Air quality	Acoustic (Noise)	Greenhouse Gas (haulage) and climate change	Coastal Processes	Consent structure	Errors & ommissions	Technical Studies (quality and bias)	Description Accuracy	Annual reporting data	Mosquito Mgmt Plan	Independent Audit	Fill Management Procdures	Groundwater monitoring (event based and life of project)	Remedial action plan	Separate consents WB& Dredge	EPL reviewed	
1	Port Stephens Koala Inc	object																								
2	EcoNetwork - Port Stephens	object																								
3	Port Stephens Bird watchers	object																								
4	Soliders Point Community Group	object	1									1	1		1											
5	Tomaree Ratepayers and Residents Association Inc.	object		1						1		1				1										
6	Miceal O'Brien	object		1																						
7	Lindsay Clout	object																								
8	Anon (ID reference 713391)	object	1		1																					
9	Elspeth Armostrong	object																								
10	Anon (ID reference 713406)	object											1													
11	Anon (ID reference 713471)	object						1			1															
Community submission theme subtotals			**4**					**1**		**2**		**3**		2				**0**								**0**
12	Dept. of Resources & Geosciences	comment													1			1								
13	Hunter Health	comment				1			1										1							
14	Hunter Water	comment																		1	1	1				
15	Port Stephens Council	comment																				1				
16	Crown Lands	comment																								
17	Biodiversity Conservation Division	comment												1	1							1	1	1		
18	DPIE Water/NRAR	comment																								
19	Environment Protection Authority	support																							1	
20	Heritge NSW	comment																								1
21	Ausgrid	comment																								1
22	DPIE - Agriculture	comment																								1
23	Transport for NSW	comment																								1
24	DPIE - Social Impact Assessment	comment					1																			
Agnecy submission theme subtotals			**2**					**1**		**0**		**0**		**2**				**6**								4
Sub theme totals			**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**3**	**1**	**0**	**1**	**1**	**1**	**1**	**3**	**1**	**1**	**1**	**4**
Theme Totals			**6**					**2**		2		**3**		**4**				**6**								4

APPENDIX B Amended Social Impact Assessment

Stockton Sand Quarry Dredging | State Significant Development

SOCIAL IMPACT ASSESSMENT

Prepared for Boral Resources (NSW) Pty Ltd | 26 November 2019

Stockton Sand Quarry Dredging

STATE SIGNIFICANT DEVELOPMENT | SOCIAL IMPACT ASSESSMENT

Prepared for Boral Resources (NSW) Pty Ltd
26 November 2019

PR63

	Prepared by	Reviewed by
Name	Jamie Seaton	Luke Farrell
Company	Element Environment	Element Environment
Position	SIA and Community Engagement LeadSIA and Community Engagement Lead	Senior Environmental ConsultantSenior Environmental Consultant
Project Role	Lead SIA AuthorLead SIA Author	Project ManagerProject Manager
Signature		
Date	26 November 201926 November 2019	26 September 201926 September 2019

DOCUMENT CONTROL

Revision	Date	Description	Prepared by	Reviewed by
0	9 September 20199 September 2019	For Boral review	Element Environment	Boral Resources (NSW) Pty Ltd
1	24 September 2019	Revised for Boral review	Element Environment	Boral Resources (NSW) Pty Ltd
2	26 November 2019	Revised for Boral review and submission to DPIE	Element Environment	Boral Resources (NSW) Pty Ltd
3	8 September 2020	Post exhibition review and amendment	Element Environment	Boral Resources (NSW) Pty Ltd

Certification Page

Lead author declaration

I, Dr Jamie Seaton, certify that the Social Impact Assessment (SIA) component of the Stockton Sand Dredging Environmental Impact Statement (EIS) contains all information relevant to the SIA for the project, and that the information is not false or misleading. My qualifications and experience are listed below.

Qualifications:

1. Bachelor of Science Hons. (Human Geography)

2. Community Development Diploma

3. Doctorate of Philosophy (Human Geography).

Experience:

I am trained in social science methodologies and I have demonstrated SIA skills in government, private and education settings. I have managed and authored SIAs for extractive industry projects in New South Wales and Queensland.

Date: 26 November 2019

Jamie Seaton - SIA and Community Engagement Lead

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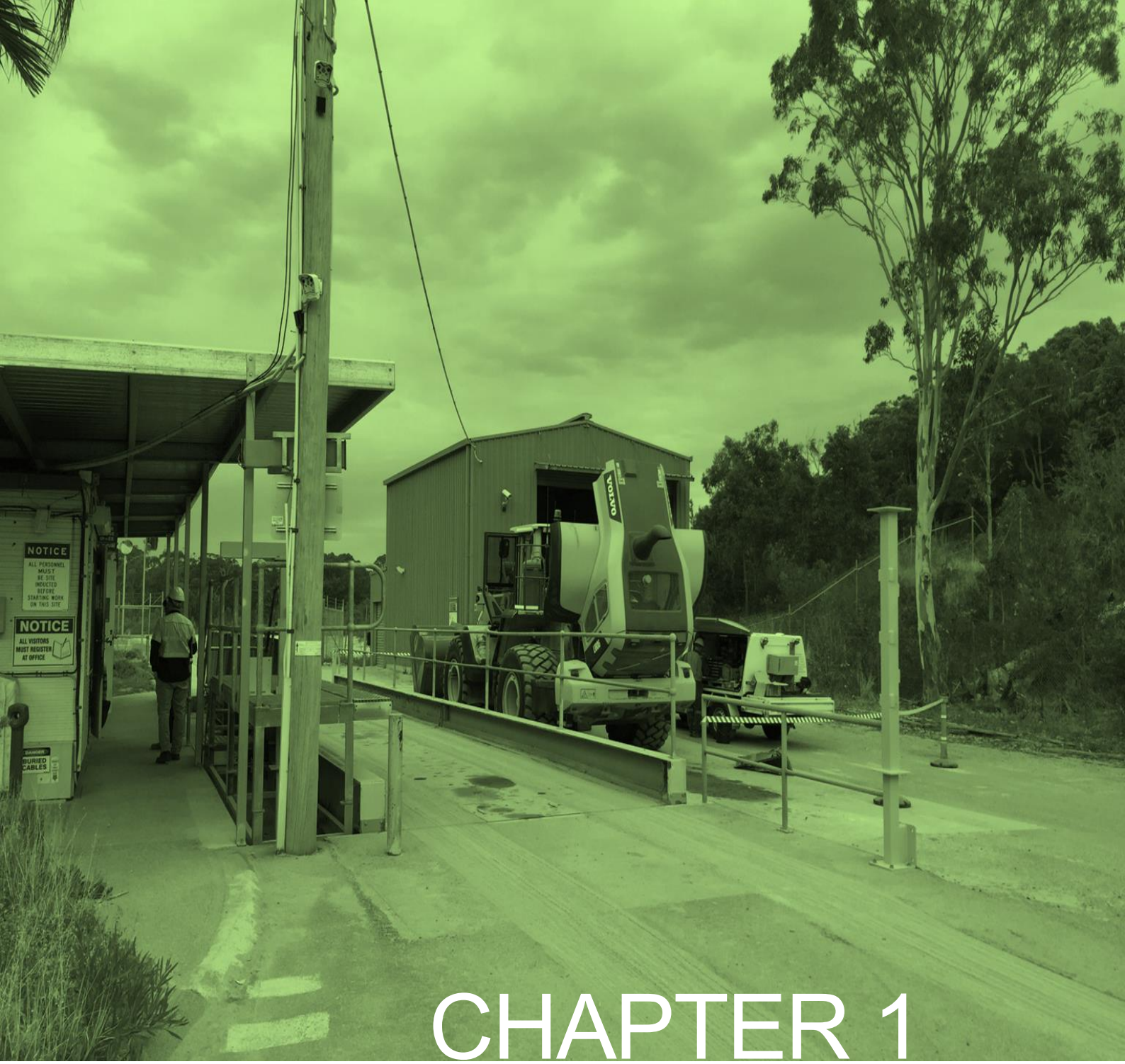


CHAPTER 1

INTRODUCTION

1 INTRODUCTION

This Social Impact Assessment (SIA) has been prepared to support the State Significant Development (SSD) application by Boral Resources (NSW) Pty Ltd (Boral), for the proposed dredging operation of the Stockton Sand Quarry (hereafter referred to as the 'site' or the 'quarry'). The SIA adopts the framework set out in the *Social Impact Assessment Guideline* (the Guideline), published in September 2017 by the NSW Department of Planning, Industry and Environment (DPIE) (NSW Department of Planning, Industry and Environment, 2017).

The first chapter of this report provides a project overview, a description of the site and existing operations, an outline of the proposed project, objectives of the SIA, the Secretary's environmental assessment requirements (SEARs), and a structural outline of this report.

1.1 Overview

Boral owns and operates the quarry, a long standing operation that currently extracts sand from the windblown (transgressive) sand dunes of Stockton Bight and transports up to 500,000 tonnes per annum (tpa) of sand product for use in the building, landscaping and construction markets.

Due to current and future demand for sand in the local Hunter and Sydney regions, Boral is seeking approval for continued and expanded operations at the site through a SSD application. The proposed development (hereafter referred to as the 'project') involves the extraction of sand from the inland vegetated dunes by front-end loader/excavator to a depth of 4 metres (m) Australian Height Datum (AHD) in Stage 1, and subsequent dredging from 4 m AHD to -15 m AHD. The project would seek to permit a site wide increase on the dispatch limit to 750,000 tpa (i.e. the windblown sand extraction area and the project operations combined) up until 2028 after which the site wide limit would reduce to no more than 500,000 tpa. The project would be for a period of up to 25 years.

This environmental impact statement (EIS) has been prepared by Element Environment Pty Ltd (Element), on behalf of Boral for submission to the DPIE to satisfy the provisions of Part 4 of the *Environmental Planning & Assessment Act 1979* (EP&A Act).

1.2 Existing operations

As highlighted in Chapter 3 of the EIS, sand extraction has taken place in various locations on the site since 1976 when G. Hawkins and Sons was initially granted consent.

Boral acquired the site in 1992. Under Boral's ownership there have been two primary development consents granted, including:

- DA 2010/94: The 'inland extraction area' (also known as pits 1 – 6) granted by Port Stephens Council in May 1996; and
- DA 140-6-2005: The 'windblown sand extraction area' (also known as pit 7) located on the transgressive dunes adjoining Stockton Beach granted by the Department of Planning in 2006.

The inland extraction operation on the vegetated dunes occurred above 5 metres AHD and ceased in 2008 and rehabilitation has been ongoing.

The windblown sand extraction area started operations in 2008 and in accordance with condition 5 of the development consent has 20-year life, due to cease in 2028.

The existing operation is located approximately 375 m south east of the project site, referred to as the windblown sand extraction area. This area is approved to operate until 2028 and dispatch

up to 500,000 tpa from the site. The approved scope of works and method for the existing operations generally includes the following:

- extraction of sand annually through regular harvesting of windblown sand and dry excavation of the dune mass, and transport of up to 500,000 tonnes annually;
- processing at the pit face by mobile power screen;
- maintenance of the haul road to transport sand from extraction area;
- haulage of product from existing depot/weighbridge to Nelson Bay Road and the wider road network; and
- progressive rehabilitation of extracted areas.

1.3 Project area

The project area is wholly within Boral's existing quarry landholding. It is identified as the 'proposed clearance area' in Figure 1. It contains all areas to be disturbed by the project operations and covers an area of approximately 37 hectares (ha).

The project area is generally consistent with the same disturbance footprint associated with the former inland extraction area approved under the 1996 development consent with the exception of areas to east and south east of Lot 3 and along the southern edge to allow for the construction of new haul roads.

The approved scope of works and method for Boral's existing operations generally includes the following:

- extraction of sand annually through regular harvesting of windblown sand and dry excavation of the dune mass, and transport of up to 500,000 tonnes annually;
- processing at the pit face by mobile power screen;
- maintenance of the haul road to transport sand from extraction area;
- haulage of product from existing depot/weighbridge to Nelson Bay Road and the wider road network; and
- progressive rehabilitation of extracted areas.

1.4 The proposed project

Sand from the former inland extraction area was only extracted to 5 m AHD under the original 1996 development consent. The sand resource above 5 m AHD was exhausted in 2008 and in accordance with the conditions of consent the operations have ceased.

The project involves the extraction of sand from within the former inland extraction area (inclusive of pits 1 – 6) from the existing ground level to a depth of 15 m below sea level (-15 m AHD). As extraction will intercept the groundwater table (at approximately 1 m AHD) the primary method of sand extraction will involve dredging.

There is an estimated 9 million tonnes of sand resource within the project extraction area. The project would seek to permit a site wide increase on the dispatch limit to 750,000 tpa (ie the windblown sand extraction area and the Project operations combined) up until 2028 after which the site wide limit would reduce to no more than 500,000 tpa. The increase in the site wide dispatch limit is sought to permit maximum flexibility across the two projects areas (located on the same site). A concurrent administrative amendment to DA 140-5-2006 to allow for the site wide dispatch limit increase would be lodged with DPIE.

Mobile plant and equipment utilised at the site would operate across both project areas and a docket system at the weighbridge would monitor outgoing product as a site total.

To account for market fluctuations in demand, Boral are seeking a development consent period of 25 years for the SSD approval.

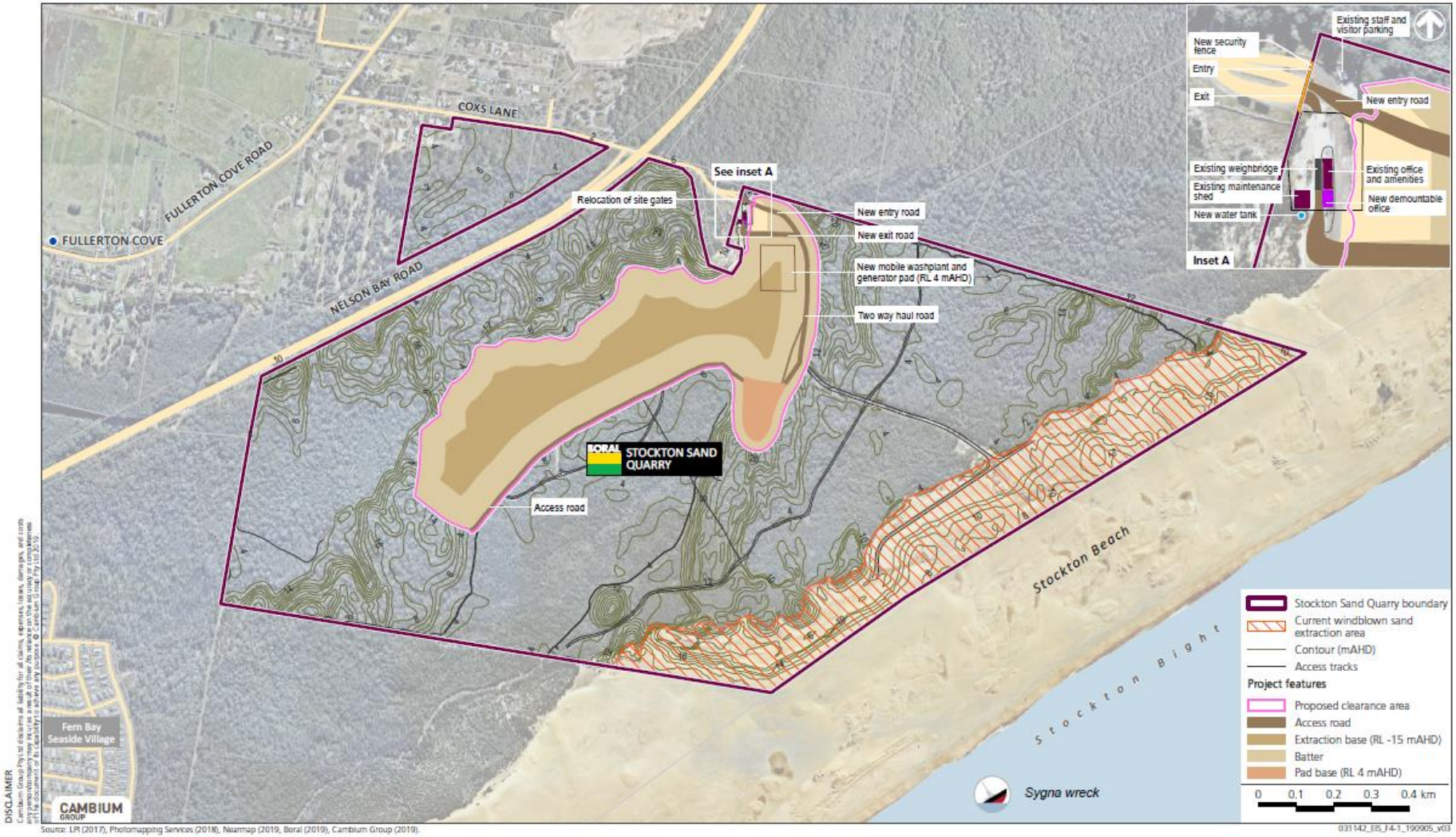


Figure 1 - The project

1.5 Objectives of the social impact assessment

The release of the Guideline (NSW Department of Planning, Industry and Environment, 2017) by DPIE has significantly increased the prominence of SIA in the broader NSW EIS process. Upon its release and at the present time, the Guideline applies to all SSD for resource projects, where the SEARs were issued after the publication date.

The Guideline outlines some mandatory requirements to be met by SIA practitioners in NSW. It contains objectives applicable to NSW state significant resource projects (ie state significant mining, petroleum production and extractive industry projects), outlines best practice engagement techniques, and provides a process for assessing, determining and responding to social impacts. The objectives contained in the Guideline have been adopted for this SIA and include:

- providing a clear, consistent and rigorous framework for identifying, predicting, evaluating and responding to the social impacts of state significant resource projects, as part of the overall environmental impact assessment (EIA) process;
- facilitating improved project planning and design through earlier identification of potential social impacts;
- promoting better development outcomes through a focus on minimising negative social impacts and enhancing positive social impacts;
- supporting informed decision-making by strengthening the quality and relevance of information and analysis provided to the consent authority;
- facilitating meaningful, respectful and effective community and stakeholder engagement on social impacts across each EIA phase, from scoping to post-approval; and
- ensuring that the potential social impacts of approved projects are managed in a transparent and accountable way over the project life cycle through conditions of consent and monitoring and reporting requirements.

1.6 Secretary's environmental assessment requirements

SEARs were issued for the project by DPIE in 2018 following the publication of the Guideline. The SEARs state that this report must address key social issues including a detailed assessment of the potential social impacts of the development that builds on the findings of the Social Impact Assessment Scoping Report, in accordance with the Guideline, paying particular consideration to:

- the full range of categories of potential social impacts identified in Section 1.1 of the Guideline;
- how impacts (positive and negative) may be distributed among different groups in the affected communities;
- the principles in Section 1.3 of the Guideline;
- ensuring that the person preparing the SIA has appropriate qualification and experience as outlined in the Box 4 of the Guideline; and
- the review questions in Appendix D of the Guideline.

Table 1 identifies where the SEARs are addressed in this report.

1.7 Structure of this report

The structure of this report is influenced by Guideline requirements. Once the legislative and social policy context of the study is established (Chapter 2), the methodology for scoping and preparing the SIA is described (Chapter 3). Results of the SIA data collection is presented in chapters titled SIA Scoping Phase and Community Engagement Outcomes, and Existing Social Baseline (Chapter 4 and Chapter 5 respectively). An analysis of the results, structured according

to the social impact categories outlined in section 1.1 of the Guideline (see Appendix A), is provided in Chapter 6, followed by the conclusion of the study (Chapter 7), and SIA recommendations (Chapter 8).

The structure of this report also observes the 'Review Questions' contained in Appendix D of the Guideline. The Review Questions are essentially a checklist for the author to confirm that the SIA Guideline has been complied with, in undertaking the SIA and preparing this report. A compliance matrix is presented in Table 1 to identify where the Review Questions are addressed in this report.

Table 1 – Compliance matrix

Review Question (Appendix D of Guideline)	Location in this report
General	
Has the applicant applied the principles in Section 1.3? How?	Chapter 3, 6 and 7
Does the lead author of the Scoping Report meet the qualification and skill requirements in Box 2?	Certification page
Does the lead author of the SIA component of the EIS meet the qualification and skill requirements in Box 4?	Certification page
Has the lead author of the SIA component of the EIS provided a signed declaration certifying that the assessment does not contain false or misleading information?	Certification page
Community engagement for social impact assessment (Section 2)	
Does the SIA include adequate explanations of how the engagement objectives have been applied? How?	Chapter 3
Does the SIA demonstrate that there has been a genuine attempt to identify and engage with a wide range of people, to inform them about the project, its implications and to invite their input? How?	Chapter 3
Does the SIA demonstrate that an appropriate range of engagement techniques have been used to ensure inclusivity and to ensure the participation of vulnerable or marginalised groups? How?	Chapter 3
Scoping – area of social influence (Section 3.1)	
Does the Scoping Report identify and describe all the different social groups that may be affected by the project?	Section 4.1.3
Does the Scoping Report identify and describe all the built or natural features located on or near the project site or in the surrounding region that have been identified as having social value or importance?	Section 5.2 and 5.3
Does the Scoping Report identify and describe current and expected social trends or social change processes being experienced by communities near the project site and within the surrounding region?	Chapter 4 and 5
Does the Scoping Report impartially describe the history of the proposed project, and how communities near the project site and within the surrounding region have experienced the project to date and others like it?	Chapter 4 and 6
Scoping – identifying social impacts (Section 3.2, Appendix A and Appendix B)	
Does the Scoping Report adequately describe and categorise the social impacts (negative and positive), and explain the supporting rationale, assumptions and evidence for those categories?	Chapter 4 and 6
How has feedback from potentially affected people and other interested parties been considered in determining those categories? Does the Scoping Report outline how they will be engaged to inform the preparation of the SIA component of the EIS?	Chapter 4
Does the Scoping Report identify potential cumulative social impacts?	Chapter 4

Review Question (Appendix D of Guideline)	Location in this report
Social baseline study (Appendix C – Section C1)	
Does the SIA component of the EIS discuss the local and regional context in sufficient detail to demonstrate a reasonable understanding of current social trends, concerns and aspirations?	Chapter 5
Does the SIA component of the EIS include appropriate justification for each element in the social baseline study, and provide evidence that the elements reflect the full diversity of views and potential experiences in the affected community?	Table 3
Does the social baseline study include an appropriate mix of quantitative and qualitative analysis, and explain data gaps and limitations?	Chapter 5 Section 3.2.5
Prediction and analysis of impacts (Appendix C – Section C2)	
Does the SIA component of the EIS include an appropriate description of the potential impacts in terms of the nature and severity of the change and the location, number, sensitivity and vulnerability of the affected stakeholders?	Chapter 6
Does the SIA component of the EIS identify potential impacts at all stages of the project life cycle?	Chapter 6
Does the SIA component of the EIS appropriately identify and justify any assumptions that have been made in relation to its predictions?	Chapter 6
Does the SIA component of the EIS include appropriate sensitivity analysis and multiple scenarios to allow for uncertainty and unforeseen consequences? If relevant, does it include comparisons with studies of similar projects elsewhere?	Chapter 6
Evaluation of significance (Appendix C – Section C3)	
Does the SIA component of the EIS explain how impacts were evaluated and prioritised in terms of significance?	Chapter 6
Does the evaluation of significance consider cumulative aspects where relevant?	Chapter 6
Does the evaluation of significance consider the potentially uneven experience of impacts by different people and groups, especially vulnerable groups?	Chapter 6
Responses and monitoring and management framework (Appendix C – Sections C4 and C5)	
Does the SIA identify appropriate measures to avoid, reduce, or otherwise mitigate any significant negative impacts of the project, and justify these measures?	Chapter 7
Does the SIA explain and justify measures to secure and/or enhance positive social impacts?	Chapter 7
Does the SIA component of the EIS impartially assess the acceptability, likelihood and significance of residual social impacts?	Chapter 7
Does the SIA component of the EIS propose an effective monitoring and management framework?	Chapter 7
Modifications (Introduction – application)	
Are the social impacts associated with the modification expected to be new or different (in terms of scale and/or intensity) to those that were approved under the original consent? If yes, apply the review questions above to the SIA component of the environmental assessment.	Not applicable

CHAPTER 2

LEGISLATION AND POLICY

2 LEGISLATIVE AND SOCIAL POLICY CONTEXT

2.1 Legislation

The EP&A Act sets the legislative context for this study. The objects of the EP&A Act are to:

- promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the state's natural and other resources;
- facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment;
- promote the orderly and economic use and development of land;
- promote the delivery and maintenance of affordable housing;
- protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats;
- promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage);
- promote good design and amenity of the built environment;
- promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants;
- promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the state; and
- provide increased opportunity for community participation in environmental planning and assessment.

The SEARs (and therefore the Guideline) are issued under the provisions of the EP&A Act, and therefore set legislative requirements that this study must accommodate.

2.2 Community plans and strategies

Regional plans which reflect the aspirations of the community have been developed by the state Government and local authority associated with the project. These plans are outlined below.

2.2.1 Hunter Regional Plan 2036

The *Hunter Regional Plan 2036* (NSW Department of Planning and Environment, 2016) was released by the NSW State Government in 2016 and aimed to guide future land use planning priorities and decisions in NSW over a 20-year period. It is not intended to be a step-by-step approach to all land use planning, but instead intends to guide subsequent and more detailed land use plans, development proposals and infrastructure funding decisions. The plan was developed following consultation on a Lower Hunter discussion paper produced in 2014, involving councils and other stakeholders.

The 'vision' of the plan is for the Hunter Region to be the "leading regional economy in Australia with a vibrant new metropolitan city at its heart" (NSW Department of Planning and Environment, 2016, p.8). The plan outlines four goals (and subsequent directions) to achieve its vision. The Hunter Development Corporation will deliver, coordinate and be accountable for achieving the vision and goals of the Plan.

The goals are for the Hunter region to be/have:

1. the leading regional economy in Australia;
2. a biodiversity-rich natural environment;

3. thriving communities; and
4. greater housing choice and jobs.

2.2.2 Port Stephens Council Local Strategic Planning Statement

The Port Stephens Council (PSC) *Local Strategic Planning Statement* (LSPS) (Port Stephens Council, 2018) is the tool that gives local-level effect to State government regional plans by informing local statutory plan making and development controls. It also provides the link between the *Council Community Strategic Plan 2018-2028* (Port Stephens Council, 2018, see below) and land use planning.

This link is important as it establishes a means for visions and community priorities (determined by the community and conveyed to PSC during its community consultation activities) to be realised in planning practice. It also important for this SIA as it enables the social baseline and assessment of social impacts to be tailored to the visions and community priorities conveyed to and recognised by PSC. The relationship between the PSC LSPS, PSC *Council Community Strategic Plan 2018-2028* and the SIA baseline is identified in section 3.2.1.

Guided by PSC constituents, the LSPS identifies the following twelve priorities for PSC to implement:

1. support the growth of strategic centres and major employment areas;
2. make business growth easier;
3. support tourism development and attract events;
4. ensure suitable land supply;
5. increase diversity of housing choice;
6. plan infrastructure to support communities;
7. conserve biodiversity values and corridors;
8. improve resilience to hazards and climate change;
9. protect and preserve productive agricultural land;
10. create people friendly spaces in our local centres where people can come together;
11. integrate land use and transport planning; and
12. enhance inter-regional connections.

2.2.3 Port Stephens Council Community Strategic Plan 2018-2028

PSCs strategic plan (Port Stephens Council, 2018) is the primary corporate community strategy of the organisation. It was developed with input from residents, community groups, business and government representatives. The purpose of the plan is to:

- identify community aspirations and priorities over the next ten years;
- outline PSC's role in delivering these priorities;
- work with other governments and agencies to achieve our community's priorities;
- provide for community participation in decision making; and
- provide a basis of accountability and consistency in reporting.

The strategic plan establishes four focus areas for Port Stephens. Each focus area has a sub-set of 'key directions' which outline its priorities. Subsequent to each focus area, there are also a range of objectives and outcomes which guide practitioners in implementing the plan until 2028.

The four focus areas of the plan are:

1. our community - Port Stephens is a thriving and strong community respecting diversity and heritage;

2. our place - Port Stephens is a liveable place supporting local economic growth;
3. our environment - Port Stephens' environment is clean, green, protected and enhanced; and
4. our council – PSC leads, manages and delivers valued community services in a responsible way.

This SIA recognises the community consultation efforts that PSC made in determining the community aspirations and priorities of their constituents. The SIA relies upon PSCs work as a key input into the SIA. The alignment of community aspirations and priorities with the social baseline is made clear in section 3.2.1 of this report.

2.2.4 Connecting the Hunter – a regional approach to infrastructure

Connecting the Hunter was developed by the Hunter Branch of Regional Development Australia (RDA) (Regional Development Australia Hunter, 2010) and aims to establish a regional approach to the Hunter Valley's growth strategies. It provides a framework to identify, assess and meet the Hunter's long-term future infrastructure needs. RDA Hunter consulted widely throughout 2010. It encouraged discussion with regional partners and government to identify infrastructure priorities.

The infrastructure priorities outlined in the strategy include:

- capitalising on past successes and the better use of existing infrastructure;
- addressing planning inefficiencies and inconsistencies that hinder investment;
- planning for future infrastructure needs within a long-term, strategic, comprehensive and consistent regional framework;
- maintaining appropriate levels of investment in human capital, knowledge and information infrastructure;
- improving the liveability, sustainability and productivity of Newcastle, the region's capital;
- securing north-south and east-west corridors for future rail capacity expansion;
- acquiring land for road and rail expansion;
- improving sea and air links to Newcastle Port;
- completing the F3 to M2 link road;
- developing the case for High Speed Rail between Newcastle and Sydney;
- establishing a Regional Transport Authority;
- advocating for the Hunter and Central Coast to be priority areas for the rollout of the NBN;
- encouraging further research development and investment in renewable energy technology; and
- securing future water security.

2.2.5 Port Stephens Planning Strategy 2011-2036

The strategy developed by PSC aims to provide high level strategic direction for spatial planning in the Port Stephens Local Government Area (LGA). It intends to guide land use allocation and other provisions of the Port Stephens Local Environmental Plan (LEP) (NSW Parliament, 2013), and a range of other planning documents used to regulate development and ensure conservation in the LGA. It recognises that "all communities in Port Stephens [LGA] are considered to be significant and all play an important role in how Port Stephens functions as an area" (Port Stephens Council, 2011, p. 64).

Council's strategy outlines eight directions for residential, commercial and industrial development in Port Stephens:

- a framework for growth and conservation;
- analysis of commercial and industrial land;
- centres and hierarchy;
- accommodating more housing;
- employment and industries;

- rural production and landscapes;
- conservation areas; and
- transport.

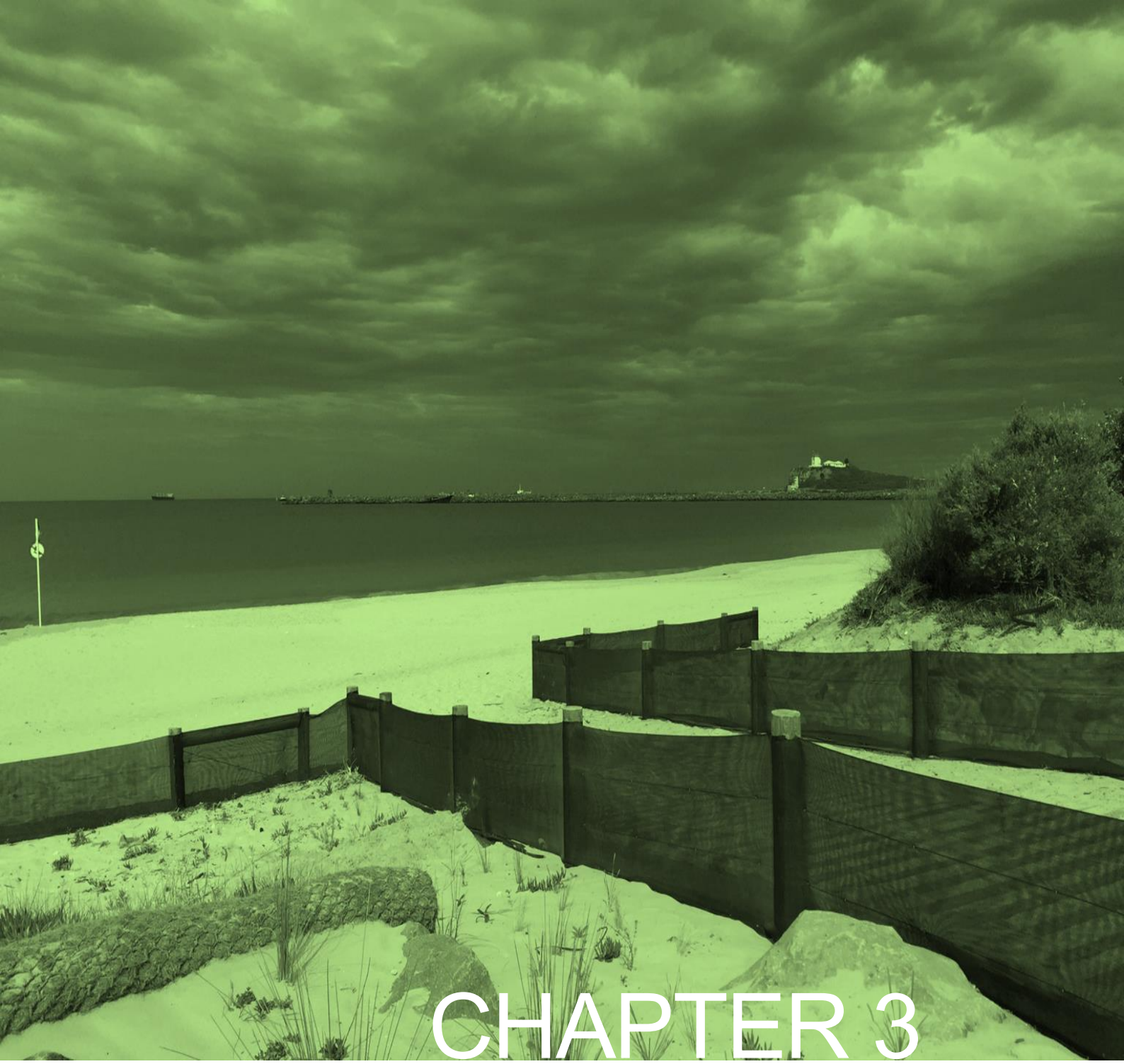
2.2.6 Hunter Economic Infrastructure Plan

The *Hunter Economic Infrastructure Plan* (Regional Development Australia Hunter, 2013) was created by the Hunter branch of RDA. It was developed to enable a whole of supply chain view of mining related activities in the Hunter region. The plan considered and assessed major infrastructure requirements in the Hunter region including:

- ports;
- rail;
- electricity;
- roads; and
- water.

RDA determined that that roads and water warranted further investigation in their assessment. Those issues attracted most attention in the plan, particularly from the perspective of coal mines operating in the Hunter region.

In relation to road infrastructure investment, the plan recommends road infrastructure upgrades, addressing safety needs associated with forecast additional mine traffic flows, improved freight and commuter travel times, and a focus on community and social issues. In relation to water security, the plan recommends that the Government undertakes an analysis of industry water requirements to support growth under various drought scenarios, and provide industry with the necessary up-to-date information to manage risks associated with water supply and drought.



CHAPTER 3

METHODOLOGY

3 METHODOLOGY

The methods described below enabled the collection of data to address the social impact categories defined in the Guideline (refer Appendix A). Whilst this chapter describes the SIA methodology, it does not identify which social impact category each method is designed to address. This link is made clear in Chapter 4 (and summarised in Table 10). Following Chapter 4, the results of the SIA are presented and discussed according to the social impact categories, to ensure compliance with the Guideline.

3.1 Methodology for scoping the SIA

The preliminary SIA for the project was supported by a number of methods outlined in the *Stockton Sand Quarry Dredging Preliminary Environmental Assessment* (Element Environment, 2018). These methods are summarised below.

3.1.1 Scoping tool

The scoping tool contained in the Guideline was a method implemented during the SIA scoping phase. The process of applying the scoping tool involved:

1. using early engagement result as inputs to the scoping tool and considering each 'matter' (ie amenity, access, built environment, heritage, community and economic) and its subcategories, before determining how likely it is that project activities will cause an impact to it;
2. for each matter, considering and assessing the material characteristics of any likely impact;
3. for each matter, considering stakeholder/community opinions and sentiment towards the project activities;
4. for each matter, determining whether or not a social impact will arise from the project activities, and then developing a rationale for the decision; and
5. for each matter, determining the level of assessment (and engagement) required in the EIS preparation phase, and selecting from the following list the most appropriate SIA type:

    - desktop: another specialist study or section of the EIS will provide all the information and analysis needed to predict, evaluate and develop a response to the social impact, including relevant primary and secondary research, qualitative and quantitative data, and appropriate engagement with potentially affected people, to establish a baseline and support predictions. If this is the case, the SIA component of the EIS only needs to review the data and findings from the other sources through a SIA lens and cross-reference and integrate them into the overall social baseline and assessment.
    - standard: most information and analysis needed to predict, evaluate and develop a response to the social impact will be provided by another specialist study or section of the EIS, but it will need to be supplemented with further evidence gathering and analysis to fill any gaps and obtain a complete picture from a SIA perspective.
    - comprehensive: only limited or no information and analysis will be provided by another specialist study or section of the EIS. If so, the author/s of the SIA component of the EIS will need to undertake the evidence gathering and analysis needed to predict, evaluate and develop a response to the social impact.

6. each matter and its associated level of assessment (determined by the scoping tool) was considered in the context of the social impact categories specified in section 1.1 of the Guideline. Refer to Appendix A for a list of these categories.

3.1.2 Stakeholder identification and analysis

A stakeholder is a group, individual or organisation that is interested in, affected by, or has the capacity to influence a project (Brereton, 2005). Figure 2 contains a general list of people and organisations that are likely to be stakeholders in most projects. This list was valuable for providing a starting point for the stakeholder analysis conducted in the SIA scoping phase. There will however, always be locally-specific groups and locally specific circumstances that influence the local cultural context (Vanclay, 2015).

The locally-specific Project stakeholders are known to Boral courtesy of their long-term presence in the Fullerton Cove area. As part of the scoping exercise, a high-level stakeholder analysis was undertaken first by leveraging the knowledge held by Boral staff. Two senior staff members were interviewed to determine the most prominent stakeholders associated with the project. The interviews were held during February 2018 and each had a one-hour duration (approximately). Following the interviews, a further desktop analysis (of files held by the project team related to previous community engagement, and online sources) was completed to identify other stakeholders potentially interested in the project. The project stakeholder list is contained in the stakeholder matrix (see section 4.1.3).

Residents	• Within the affacted area • Immediate neighbours
People in host communities	• Those that relocate as a result of a planned resettlement or through their own migration • People in communities near where construction workers or other in-migrants will be located
Other communities	• More distant residents whose livelihoods may be affected as a result of the project • Communities near associated works such as irrigation channels, quarries, roads, railways, and transmission line corridors
Project employees	• Construction workers and their families
Indigenous people	• Non-resident Indigenous or other land-connected peoples who may have spiritual attachment to the land/river
Non-government organisations (NGOs)	• Local, national and international NGOs (for example, conservationists) interested in ecological or heritage values that may be influenced by a project
Other stakeholders	• Developer and associated contractors, regulatory agencies, local regional and national governments, funding or development agencies

Figure 2 - Stakeholders likely to be involved with a project (Vanclay, 2015)

3.1.3 Written and interactive engagement methods

Early engagement for the project was implemented via a community engagement program, undertaken during 2018. A range of methods were utilised during the program to engage stakeholders and provide an opportunity to interface with Boral about the proposed operations. A

description of each method used is provided in Table 2. Note the intent of Table 2 is not to describe the engagement outcomes or identify the stakeholders targeted by each method. These are identified in section 4.1.3 (refer Table 11).

Table 2 – Written and interactive scoping phase engagement methods

Method	Description
Phone call	The project team contacted the Port Stephens Member of Parliament (MP) to provide a project update and answer any questions raised.
Letter	A letter inviting feedback about Boral's operations, via a link to an online survey. This was distributed to residents (via random sample) living near the project in early March 2018.
Email	The project team distributed emails to provide project updates to stakeholders. Emails included an overview of the project, details about consultation activities including interviews (below), and the project newsletter.
Interviews	Interviews with residents (via the random sample doorknock) living in Fern Bay and Fullerton Cove in early March 2018.
Newsletter	A newsletter inviting feedback about Boral's existing operations, informing the community about the project, and offering individual meetings with residents in Fern Bay and Fullerton Cove. Newsletters were distributed during May 2018, February 2019, and July 2019. The newsletter was made available for download from the project website, and emailed to government agencies and elected representatives.
Meeting and invitations to MPs	Meeting invitations were sent via email to the NSW Member for Port Stephens and the Federal Member for Paterson during April 2018. The email offered to provide a briefing of the project to the MPs.
Meetings with PSC	A meeting with PSC planning staff was held during May 2018. At the meeting Boral staff presented an overview of the project. A second meeting between Boral staff and Councillors from PSC was held during July 2018 and involved a briefing to inform Councillors about the project. Boral staff then invited questions from the Councillors in attendance.
Consultation with Worimi Local Aboriginal Land Council (LALC)	Boral's National Indigenous Affairs Manager consulted the Worimi LALC via a meeting with the Worimi LALC CEO and board members in January 2018.

3.1.4 Area of social influence development

The Area of Social Influence (ASI) for the project and a description of its development were contained in the project scoping report, included in the *Stockton Sand Quarry Dredging Preliminary Environmental Assessment* (Element Environment, 2018). Further engagement activities did not yield any information to warrant a modification of the ASI for the EIS.

The Guideline (NSW Department of Planning, Industry and Environment, 2017) explains that the term 'locality' does not have a prescribed meaning or refer to a fixed, pre-defined geographic boundary. This observation was adopted for the project. Care was taken to determine the ASI comprising the area within the actual project boundary, but also the geographies external to the site where social impacts may arise.

The ASI was developed on the premise that relationships within and between scales will affect what people understand as impacts (Vanclay & Esteves, 2011). This means that people may not perceive social impacts created by a project to be those felt exclusively within or immediately adjacent to the project boundary, or at a time when operations are conducted on site. Instead, it is possible for impacts to be felt at locations outside the project boundary and at any time of day (particularly in the event of long-distance haulage routes or complex supply chains). These time and space relationships between the project site and communities, economies, infrastructure, and resources (both human and natural), were explored using a mixed-methods approach during the ASI development. The specific methods adopted were:

1. semi-structured interviews with key Boral project personnel familiar with the existing operations on site and the local communities near the project site;
2. semi-structured interviews with residents (via random sample “Stakeholder Perception Benchmark” doorknock) living near the project site;
3. feedback from residents obtained during a doorknock of randomly selected residential properties in Fern Bay and Fullerton Cove in early March 2018; and
4. analysis of historical correspondence records.

The development of the ASI considered factors including but not limited to:

- supply chains;
- haulage of resources;
- transport of goods;
- materials and equipment;
- movement of workers (drive-in-drive-out/fly-in-fly-out working arrangements);
- natural features and recreational values (eg coastal sand dunes of Stockton Bight);
- ancillary infrastructure; and
- reputation of other extractive industries in the area.

Data Sources used to develop the ASI

Both primary and secondary data sources were collected and analysed in developing the ASI. Primary data derived from the semi-structured interviews was reliable given the comprehensive knowledge of the project that the key project personnel held (two interviews were conducted with long-term Boral employees). Interviews with residents in the two suburbs closest to the project site similarly provided reliable qualitative data.

Secondary data in the form of historical correspondence records associated with the existing operations was used to further develop an understanding of the ASI. This data provided an insight into the issues that the community have raised with Boral in past years, and the general sentiment towards the project.

Results of the scoping activities which assisted the development of the ASI are shown in Chapter 4.

3.2 Methodology for preparing the SIA

3.2.1 Existing social baseline

An analysis of the existing population was undertaken to establish the social baseline for the project. Secondary data was obtained from the most reliable sources available, primarily being the *2016 Australian Census of Population and Housing* (Australian Bureau of Statistics, 2018). During the scoping phase it was determined that the Fern Bay and Stockton (Fullerton Cove) populations should be included as distinct entities in the baseline. This is due to the fact that Fern Bay is a relatively new community with a residential estate under development at the time of writing, whereas the Stockton area closest to the project contains an established community with more mature properties. Socio-economic indicators for both populations were therefore collected.

Data collected for Fern Bay has been compared to the Statistical Area Level 2 Stockton – Fullerton Cove. The Fern Bay SSC (or State Suburb) and Stockton-Fullerton Cove SA2 (Statistical Area 2) census geographies were selected as the basis of the census data analysis below. This is because census data was only available for the Fern Bay area as a State Suburb dataset, and therefore it was the most accurate available. The Statistical Area 2 dataset was selected for Stockton-Fullerton Cove because the scale represents a community that interacts together socially and economically, and it allows a more detailed analysis than the inferior statistical area

or suburb datasets (Australian Bureau of Statistics, 2018). The socio-economic variables discussed below align with the community profile measures adopted by the Australian Bureau of Statistics (ABS). Where available and relevant, comparative data at the NSW state level was obtained and forms part of the baseline.

A wide range of social indicators were considered prior to conducting the statistical analysis and developing the baseline. The selection of social indicators was made based on those contained in the PSC *Community Strategic Plan 2018-2028* (Port Stephens Council, 2018). The strategic plan is PSC's primary corporate community strategy, developed with community input. It was therefore logical to use complimentary indicators in the baseline. This selection method provided confidence that the social indicators represented the health and wellbeing values, and interests of the communities (Vanclay, 2015) surrounding the project. Each social indicator and its relevance to the four focus areas[1] contained in Council's plan, is outlined in Table 3.

Table 3 - Relationship between social indicators and PSC Community Strategic Plan 2018-2028 (Port Stephens Council, 2018)

Focus Area listed in the *PSC Community Strategic Plan 2018-2028*	Relevant social indicator contained in the baseline
Community: C1 Community diversity - Our community accesses a range of services that support diverse community needs C2 Recognised - traditions and lifestyles - Our community supports the richness of its heritage and culture C3 Community partnerships - Our community works with Council to foster creative and active communities	Community profile Population projections Family composition Indigenous population Place of birth Multiculturalism Education, employment and training Educational status
Place: P1 Strong economy, vibrant local businesses, active investment - Our community has an adaptable, sustainable and diverse economy P2 Infrastructure and facilities - Our community's infrastructure and facilities are safe, convenient, reliable and environmentally sustainable P3 Thriving and safe place to live - Our community supports a healthy, happy and safe place	Employment by industry Weekly income; individual and household Council satisfaction survey (Q2) Road safety statistics SEIFA
Council: L1 Governance - Our Council's leadership is based on trust and values of Respect, Integrity, Teamwork, Excellence and Safety L2 Financial management - Our Council is financially sustainable to meet community needs L3 Communication and engagement - Our community understands Council's services and can influence outcomes that affect them	Council satisfaction survey (Q15) Election participation rates

[1] The 'Environment' focus area is not addressed in the SIA baseline, as a baseline consisting of environmental indicators is contained in the EIS.

3.2.2 Existing social infrastructure

An online desktop search was the method used to determine the existing social infrastructure associated with the project. Data was sourced from a range of websites including:

- PSC website (Port Stephens Council, 2019);
- PSC Community Directory (Port Stephens Council, 2018);
- NSW Department of Education (NSW Department of Education, 2018);
- NSW Health (NSW Health, 2018); and
- NSW National Parks and Wildlife Service (NSW National Parks and Wildlife Service, 2018).

3.2.3 Further engagement methods

As described above, scoping engagement for the project comprised a comprehensive community engagement program undertaken during 2018. Following the publication of the SEARs applicable to the project, a range of further engagement methods were implemented to emphasise and seek feedback about the project. Each of the methods implemented for further engagement are described in Table 4.

Table 4 - Further engagement methods

Method	Description
Written methods	
Project newsletter (including community drop-in sessions detail)	The newsletter was released during February 2019 and distributed online, via email, and in hard copy to project stakeholders. It explained the value of sand as a building and construction industries commodity, and the importance of sand operations at Stockton. It provided project details and described proposed operational changes. The newsletter also provided details about the community drop-in session and extended an invite to all readers. Another newsletter was released during July 2019. It provided an EIS progress update and advice about lodgement of the SSD. It presented the refined proposal for the quarry, listed the specialist studies underway, and invited ongoing feedback from the community.
Community drop-in sessions notification	On 7 February 2019, the notification was delivered to individual private properties located closest to the project, in the Fullerton Cove and Fern Bay residential areas. The notification invited recipients to the sessions to discuss any proposed operational changes. It emphasised proposed traffic changes, and the interest of the project team in obtaining feedback about that topic. It provided project contact details (including those of the Quarry Manager) for residents that could not attend on the scheduled date and encouraged recipients to provide feedback via the dedicated project communication channels.
Emails	Emails sent from Boral's Stakeholder Relations Manager to project stakeholders (including PSC Mayor and Councillors) during the first quarter of 2019. The emails contained a project update including project contact details, and the project newsletter and community drop-in sessions notification (for emails sent post its release). They invited feedback about the project. Similar emails were again sent to the stakeholders in July 2019, with a copy of the July 2019 newsletter.
In-person interactive methods	
Meeting - Worimi LALC	During February 2019 Boral's Indigenous Affairs Manager met with the CEO Worimi LALC. The purpose of the meeting was to consult the LALC on the aspects of the project and seek its feedback.
Site tour (Newcastle MP)	During February 2019 the Newcastle MP was consulted about the project and invited to a site visit. The invitation was accepted, and

Method	Description
	members of the project team escorted the Newcastle MP during the visit. Boral staff provided details about the project and addressed questions raised by the Newcastle MP.
Community drop-in sessions	Community drop-in sessions were advertised locally and held on 14 February 2019 in a reserved space in the McDonalds restaurant at Williamtown. The McDonalds restaurant was identified as a suitable for several reasons. First, there is no community building or infrastructure in Fullerton Cove (the immediately adjacent community to the project) available to appropriately stage a community information session. Secondly, the Williamtown McDonalds is a local 'landmark' well-known to those familiar with the area. It is positioned prominently on the region's main road, is minimal distance from the primary community (Fullerton Cove) affected by the project and is very accessible to the majority of stakeholders (ie easy parking and at grade entry). Thirdly, the McDonalds was able to cater to the spread of hours deliberately chosen to ensure the fullest participation of interested stakeholders - morning hours primarily aimed at older residents and parents of young and school aged children, afternoon/evening hours for employed, business people, and regional commuters.. Four members of the project team were present at all times, and available to all attendees. A Boral banner was erected in a prominent position at the restaurant entry, and directional posters were placed nearby to assist individuals to find the drop-in session location (see Figure 3).
Consultation with Office of Port Stephens MP	Following the meeting held at the office of the Port Stephens MP during the scoping phase of the project, a return visit was made on 14 February 2019. The MPs office was advised about the community drop-in session and provided an update about the project and planning process.
Consultation with local neighbours	Consultation via a doorknock with local quarry neighbours was undertaken in August 2019. The doorknock targeted a random selection of properties on Coxs Lane, Fullerton Cove Road, and George Street. Residents were invited to provide feedback about the existing quarry operations and the project, and provided with an update about the SSD.
Media methods	
Website	Information about the Project including the project newsletters and community drop-in sessions notification, details of the community drop-in sessions, and Project contact details was hosted on the Boral Quarries Stockton (Fullerton Cove) website (Boral, 2018). The website was referenced in all material developed for the project and provided a central repository of information associated with the project. A major update of the project information on the website was undertaken during February 2019.
Facebook campaign	On 12 February 2019, the Boral Facebook site hosted a social media post about the project. The post highlighted the demand for sand for building and construction industries and referred to the planning proposal. It encouraged readers to visit the Boral Quarries Stockton (Fullerton Cove) website to obtain more detail. The Facebook post is provided in Appendix B.


McCafé
36 Flavours
CHOOSE ONE OR MIX ANY TWO
FANTA
CAUTION WET FLOOR
BORAL
zero|one|ten
OUR INTENT
zero
Belief and commitment to Zero Harm
one
To be recognised as #1
ten
Continuously Improving

Figure 3 – Community drop-in session at McDonalds Restaurant Williamtown

3.2.4 Social impact assessment methods

A range of methods were selected for the SIA. Each method was adopted to address one or more of the matters determined by the DPIE scoping tool, to require further social impact investigations. The selection process involved:

1. populating the DPIE scoping tool with the relevant information;
2. determining the level of assessment prescribed by the scoping tool; and
3. selecting a method or a combination of methods to satisfy the level of assessment, bearing in mind:

    - the specific social matter to which the assessment related;
    - the availability of existing data held by the project team (if any); and
    - feasibility of the methods (eg time, cost, reliability).

The methods adopted for the study are outlined below. The social matters to which each method relates are identified in Chapter 4.

Ethnographic content analysis (media analysis)

Altheide's (1996) Ethnographic Content Analysis (ECA) was selected and adapted as the method to assess impacted social matters identified during the scoping exercise. ECA is a qualitative media analysis methodology used to obtain, categorise and analyse different media documents (such as newspapers and magazines) in addition to other forms of media delivered online and via television. ECA is an approach which blends the "traditional notion of objective content analysis with participant observation to form ethnographic content analysis" (Altheide, 1996, p. 2). It is therefore unlike the traditional positivist and quantitative approach to media analysis which engages in a rigorous quantitative testing of phenomena against a template devoid of human

interface (Guba & Lincoln, 2005). Instead ECA encourages the investigator to be reflexive and interactive, and it enables an element of ongoing discovery as progress is made towards the SIA research goal. It is in this vein that ECA enables documents to be "studied to understand culture or the process and the array of objects, symbols, and meanings that make up social reality shared by members of a society" (Altheide 1996, p.2).

The characteristics of ECA are clearly distinguished from those associated with quantitative approaches (QA) to media analysis (see Table 5 for a comparison). Unlike QA which is concerned with statistical reliability, Altheide (1996) suggests that the emphasis of ECA is fixed more so on research 'validity'. Although itself a term commonly associated with statistical tests, validity in this sense refers instead to the degree of rigour in a research project, as determined by the interpretive community who check the research for credibility and good practice (Bradshaw & Stratford, 2005). ECA is also dissimilar to QA in terms of researcher involvement. Each of the research phases in an ECA approach is very individualistic in the sense that the main investigator is 'involved' with the concepts, relevance and development of the protocol and the way in which items are collected for purposes of later analysis (Altheide, 1996). Furthermore, in contrast to QA, data collection for ECA is predominantly undertaken using a purposive or theoretical sampling technique and is not intended to provide a representative sample (refer Bradshaw and Stratford, 2005).

As shown in Table 5, ECA focuses on narrative data (in addition to numerical data that is more commonly associated with QA) and always allows the researcher to make analytical commentary on this data. This approach not only involves the measurement of the frequency and extent of terms consistent with QA approaches, but it also enables the investigation of text meaning, and encourages the provision of descriptive information (Altheide, 1996). The qualitative text analyst produces this descriptive information by repeatedly exploring the sampled texts, and by noting the peculiarities contained in the sample (Roberts, 1997). It is through this process that the analytical concepts emerge and are applied to the text in ECA research. Roberts (1997) describes this as a key difference between QA and ECA; on the one hand "quantitative researchers specify their measures and their tests in advance…on the other hand, qualitative [ECA] researchers typically explore their data, applying one classification scheme after another, before settling on that scheme (or schemes) that in their view resonates best with their data" (Roberts 1997, p.2). Analysis therefore "takes place throughout the entire research process, a study is shaped and reshaped as a study proceeds, and data is gradually transformed into findings" (Watt, 2007, p. 95).

Table 5: A comparison of quantitative media analysis and ECA (source: Altheide 1996)

Characteristic	Quantitative approach to media analysis (QA)	Ethnographic approach to media analysis (ECA)
Emphasis	Reliability	Validity
Primary Researcher involvement	Data analysis and interpretation	All phases
Sample	Random or stratified	Purposive or theoretical
Type of data	Numbers	Numbers; narrative
Narrative description and comments	Seldom	Always
Concepts emerge during research	Seldom	Always
Data analysis	Statistical	Textual; statistical

Characteristic	Quantitative approach to media analysis (QA)	Ethnographic approach to media analysis (ECA)
Data presentation	Tables	Tables and text

Applying ECA to the SIA using online news articles

The most important element of the entire ECA exercise is the protocol (or a data collection sheet). It is "a way to ask questions of a document; a protocol is a list of questions, items, categories or variables that guide data collection from documents" (Altheide 1996, p.26). It is therefore an essential utility of ECA. The protocol itself consists of two tables – Table A and Table B - as shown in the example in Figure 4. Table A, the first of the two tables, has nine columns with the following headers and definitions:

1. case number – a number sequentially allocated to each article analysed (ie number '1' was allocated to the first article analysed, number '2' to the second and so on);
2. search string – the phrase used to search for online news articles, via the search function on the publications webpage;
3. source publication – the title of the newspaper which contained the article. Each article analysed in this ECA exercise was sourced from the *Port Stephens Examiner* website;
4. date of article – the production date of the newspaper article (found on the web page). Note only articles collected from June 2011 to February 2019 were collected;
5. title – the title of the newspaper article;
6. frame – a numeral, corresponding to a particular Frame in Table B which is allocated during the analysis of a *Port Stephens Examiner* article;
7. theme – a numeral, corresponding to a particular Theme in Table B which is allocated during the analysis of a *Port Stephens Examiner* article;
8. discourse - a numeral, corresponding to a particular Discourse in Table B which is allocated during the analysis of a *Port Stephens Examiner* article; and
9. notes – miscellaneous information specific to an article can be included in the notes column.

TABLE A

Case No.	Search string	Publication	Date of article	Title	Frame	Theme	Discourse	Notes
1	Sand trucks + stockton and Sand tr	Port Stephens Examiner	23/01/2019	Different paths for Port Stephens state election candidates	1	1	1	
2	Sand trucks + stockton and Sand tr	Port Stephens Examiner	3/01/2019	Whale carcass removed from One Mile Beach	DQ			
3	Sand trucks + stockton and Sand tr	Port Stephens Examiner	18/10/2018	No Sand Mining in Bobs Farm action group reformed after pr	2	2	2	
4	Sand trucks + stockton and Sand tr	Port Stephens Examiner	3/10/2018	Bobs Farm sand mine proposal is back on the table	2	2	3	
5	Sand trucks + stockton and Sand tr	Port Stephens Examiner	20/09/2018	Residents turn out to meeting to hear proposal for Anna Bay	3	3	3	

TABLE B

Frames		Themes		Discourses	
Political attention to quarries and	1	Political opposition to road	1	Excessive quarry trucks using public infrastructure	1
Community attention to quarries	2	Community opposition to road impacts	2	Negative impacts on families and schools	2
EIS and infrastructure/traffic plan	3	Infrastructure/traffic studie	3	Additional truck movements (negative sentiment regarding	3
Road maintenance funding	4	Quarry trucks damage road	4	Quarry operators should share road maintenance burden	4
		Quarry benefits outweight	5	Additional truck movements (neutral sentiment regarding r	5
				Negative impacts for community safety	6
				Sand haulage route debate	7

Figure 4 – ECA protocol

A new record containing the above information was added to Table A each time an article containing a narrative about dust or safety (being two social matters identified during the scoping exercise) was read.

The second table (Table B) contained in the protocol lists all the categories (Frames, Themes and Discourses) that emerged from the *Port Stephens Examiner*. Table B is best understood as a 'lookup table' or a 'storage table' which holds the categories that are individually applied to *Port Stephens Examiner* articles during analysis. The three columns in Table B (refer Figure 4) have the following headers and definitions:

1. frames - "very broad thematic emphases or definitions of a report" or "a way of discussing the problem or the kind of discourse that will follow" (Altheide 1996, p.30);
2. themes - "general meanings or even 'miniframes for a report'" or "the recurring typical theses that run through a lot of reports" (Altheide 1996, p.30); and
3. discourses - "a series of representations, practices and performances through which meanings are produced" (Johnston & Gregory, 2000, p. 178).

Each *Port Stephens Examiner* article that mentioned or suggested an association to the target social impact matter was analysed for its relevance to the project. Using Table B, this objective was achieved by developing a Frame, Theme and Discourse for each article. As each article was read, the message it conveyed about the project was considered, and the most appropriate Frame, Theme and Discourse was allocated to it. Articles that did not contain content meeting the definitions of a Frame, Theme and Discourse were disqualified from the ECA. It is important to note that the Frames, Themes and Discourses developed and entered into Table B reflected only the manifest content of the news articles. Manifest content is the descriptive information contained in a media message that is easily recognised and immediately digested by the reader. Manifest content has been described as the information existing 'on the surface' of a text document, and it contrasts with latent content which is characterised by information 'hidden beneath the surface' of a text document which is obtained through deeper analysis (Lombard & Snyder-Dutch, 2002). The Frames, Themes and Discourses were developed, defined in one or two sentences, and added to Table B as they emerged from reading each article. The categories were therefore 'stored' in Table B, and they were assigned a numerical code which was eventually copied into the corresponding cell in Table A.

Rather than being produced at the end of the collection and analysis of newspaper articles, both tables which comprise the protocol are drawn up prior to commencement and entries are gradually and progressively added to it during the execution of ECA. Each time a pertinent article containing a discourse relevant to the target social impact matter was read, a new record was added to Table A. In addition, if no suitable categories (ie Frames, Themes or Discourses) existed in Table B, then new categories were developed and added to that table. The information added to each new record in the protocol corresponds with details sourced from each individual *Port Stephens Examiner* article. The protocol was therefore expanded as the newspaper sample was read.

There were 10 key steps involved in carrying out the ECA method, and whilst being fundamental to the practice of ECA, the Protocol is not utilised until step four. The following section will outline all 10 steps and further illustrate the utility of the Protocol described above.

The ten steps of ECA

The implementation of ECA to *Port Stephens Examiner* articles involved carrying out 10 of the key steps defined by Altheide (1996). Each of these 10 steps is listed below, along with a description of how it was applied in the context of the *Port Stephens Examiner* analysis.

- Step 1: Pursue a specific problem and opportunities to be investigated.

The SIA scoping tool identified social matters that required assessment as part of the SIA. These assessments resemble the problems and opportunities that need to be investigated.

- Step 2: Become familiar with the process and context of the information source. Explore possible sources of information.

Given its position as the most dominant and popular text media publication in the Port Stephens region, the *Port Stephens Examiner* is a unique source of social narratives. The publication broadcasts the views held by society in respect to topical issues and it does so in a standardised process. This process involves the regular and frequent publication of news topics in a uniform format. Articles from the publication are made available online and free of charge. For these reasons it was adopted for the ECA exercise.

- Step 3: Become familiar with several examples of relevant documents and select a unit of analysis.

Familiarity with individual *Port Stephens Examiner* articles was gained by completing a scoping activity. This activity involved conducting an online search for a *Port Stephens Examiner* article, using the search string “Sand trucks + Stockton”. The search was conducted using the search function on the *Port Stephens Examiner* webpage. The search string returned a page of search results, and the five highest ranked articles with Stockton mentioned in the title were read. The process enabled recognition of the layout of the articles and other sections of the page (eg comments section and advertisements) which were not analysed. At this step in the ECA it was revealed that articles returned in the search with the titles “Mega Gallery**:** The week in pictures”, “Photos of the week” and letters to the editor appearing under various titles, gave little value to the ECA. The content was rarely associated with the SIA objectives, reviewing the content was time prohibitive, and the articles were therefore excluded from the ECA (unless their value was immediately discernible in the website search results).

During the initial scoping activity, a decision was made concerning the unit of analysis to be incorporated into the ECA exercise. A ‘unit of analysis’ refers to the portion or segment (eg a particular page, an individual article, a certain paragraph) of relevant articles that will actually be subject to ECA. It was decided that the entire individual articles (including any heading, body text, caption text and/or images) that mentioned or suggested an association to the target social impact matters would be the unit of analysis. This decision was made “because it was clear from the content of the messages [contained in the *Port Stephens Examiner* articles] that they could not be further reduced before analysis without losing valuable contextual information” (Markman & Simons, 2003, p. 16).

- Step 4: List several categories (variables) to guide data collection and draft a protocol (data collection sheet).

Step 4 marked the phase where a protocol (or data collection sheet) was first introduced to the ECA exercise. Categories (ie Frames, Themes and Discourses) that emerged from the articles read during Step 3 were entered into a draft Protocol (refer Figure 4). In terms of discourses, there were initially four observed in the *Port Stephens Examiner* that conveyed specific information regarding the target social impact matters. They included:

1. excessive quarry trucks using public infrastructure;
2. negative impacts on families and schools;
3. additional truck movements (negative sentiment regarding road quality); and
4. quarry operators should share road maintenance burden.

At this step of the ECA, these understandings of the project were derived only from the description immediately recognised within each article. Subsequently, the above four categories only reflected the manifest content of the news articles. These categories were entered into the protocol as they emerged.

- Step 5: Test the protocol by collecting data from several documents.

At Step 5 the additional articles were collected to test the protocol. An additional search was made at this time using the search string "Sand trucks + Nelson Bay Road". During the collection and analysis activities there were additional Frames, Themes and Discourses that emerged from the manifest content of the news articles. An entry was created in the protocol for each article, and the protocol expanded progressively as a consequence.

- Step 6: Revise the protocol and select several additional cases to further refine the protocol.

A revision of the protocol was undertaken when all articles (obtained at the time) that mentioned or suggested an association to the target social impact matter had been tentatively analysed. The revision involved checking the definitions of all categories to ensure that they were succinct and appropriate for the articles that they represented. Modifications to inadequate categories listed in Table B of the protocol were made as needed. The modifications were made in one of four ways; categories were renamed, re-defined, split into two, or merged into one.

- Step 7: Arrive at a sampling rationale and strategy (eg theoretical, purposive, opportunistic, cluster or stratified).

Following the consideration of a range of sampling techniques, theoretical sampling was the technique adopted. Theoretical sampling involves “the selection of material based on emerging understanding of the topic under investigation” (Markman & Simons, 2003, p. 17). The theoretical sampling technique was adopted in order to identify and refine knowledge of narratives about the quarry, over time. At Step 7, other sampling parameters were confirmed such as the publication date range. Articles published between June 2011 and February 2019 were considered for the ECA method. This date range was selected as it commences when the most recent modification to the 2006 development consent was made. The consent was modified to include more appropriate controls to manage interactions with the public in active extraction areas. A logical extension of this scenario is that any social impacts derived from the project may have been reduced as a result of the modification. The date range would therefore capture any new or ongoing impacts, expressed through the media. Any articles published outside of the subject date range were excluded from the study.

- Step 8: Complete data collection for the target social matter.

The relevant search strings were applied and the collection of relevant *Port Stephens Examiner* articles continued in a sustained and rigorous fashion until all articles returned via the online searches had been covered. As articles were collected, they were added to the protocol following the procedure outlined earlier (ie a record of each article was created in Table A of the protocol using its attribute details, and each article was categorised with a Frame, Theme, and Discourse in Table B).

At the completion of Step 8 the sample had been obtained, each article in the sample had been subject to a manifest content analysis, and the results from these analyses had been recorded in the protocol. The results provided a means to understand the implications of the SSD for the target social impact matter, via the discourses being circulated amongst the population.

- Step 9: Consider the content analysis results shown in the ‘discourse’ column. Write summaries or overviews of the key findings.

Once every *Port Stephens Examiner* article listed in Table A of the protocol had been analysed and the results had been entered into the ‘discourse’ column, then the individual results were considered. Summaries were produced of each discourse, and they were the key findings of the ECA exercise.

- Step 10: Integrate the findings including the discourse interpretations and key concepts into the SIA report.

The final step of the ECA involved collating the results contained in the protocol and the discourse summaries into the SIA report. Chapter 6 contains the results.

Participant observation

Participant observation (PO) is a conventional method used in the social sciences. It is "considered a staple in anthropological studies, especially in ethnographic studies, and has been used as a data collection method for over a century" (Kawulich, 2005, p. 25)**.** The method provides a researcher with a means to collect data about cultural phenomena and the social settings in which they arise. In practice, this involves the researcher either openly or covertly examining the daily life of people under study, by "observing things that happen, listening to what is said, and questioning people, over some length of time" (Becker & Geer, 1957, p. 28).

In her thorough analysis its characteristics, Pearsall (1965) explained that PO is at once a role, a means of getting data, and a methodology for understanding human behaviour in natural contexts. Explanations of these three aspects of the method are offered below:

- role: PO implies the roles of a participant and an observer being present in a social setting. On the observer's side, the role is temporary and to a degree 'unnatural'. He [sic] may choose from a limited number of forms along a continuum from that of complete observer to that of complete participant" (Pearsall, 1965, p1). Gold (in Kawulich, 2005) nominates four roles that exist on this continuum (see Figure 5), which specify the degree to which the researcher involves himself/herself in participation in the culture under study:

    1. At one extreme is the *complete participant*, who is a member of the group being studied and who conceals his/her researcher role from the group to avoid disrupting normal activity. The disadvantages of this role are that the researcher may lack objectivity, the group members may feel distrustful of the researcher when the research role is revealed, and the ethics of the situation are questionable, since the group members are being deceived.
    2. In the *participant as observer* role, the researcher is a member of the group being studied, and the group is aware of the research activity. In this role, the researcher is a participant in the group who is observing others and who is interested more in observing than in participating, as his/her participation is a given, since he/she is a member of the group. This role also has disadvantages, in that there is a trade-off between the depth of the data revealed to the researcher and the level of confidentiality provided to the group for the information they provide.
    3. The *observer as participant* role enables the researcher to participate in the group activities as desired, yet the main role of the researcher in this scenario is to collect data, and the group being studied is aware of the researcher's observation activities. In this role, the researcher is an observer who is not a member of the group and who is interested in participating as a means for conducting better observation and, hence, generating more complete understanding of the group's activities. While the researcher may have access to many different people in this situation from whom he/she may obtain information, the group members control the level of information given.
    4. The opposite extreme role from the complete participant is the *complete observer*, in which the researcher is completely hidden from view while observing or when the researcher is in plain sight in a public setting, yet the public being studied is unaware of being observed. In either case, the observation in this role is unobtrusive and unknown to participants.

- means of gathering data: once a role outlined above is selected and the researcher is 'immersed' in the social setting, the researcher can record his/her observations about the person or group being studied. With a "reasonable vantage point, the right tools, and tables for documentation researchers can begin to collect, compare and count the presence, movement and features of individuals, groups and populations in defined spaces" (Laurier, 2010). The researcher can observe and record all aspects of the subject(s) behaviour in relation to the SIA research question(s). These may include nonverbal expression of feelings,

interaction between participants or their natural setting, how participants communicate with each other, and how much time is spent on various activities (Schmuck in Kawulich, 2005); and

- methodology for understanding human behaviour in natural contexts: In its purest methodological form, PO is the process of "establishing rapport within a community and learning to act in such a way as to blend into the community so that its members will act naturally, then removing oneself from the setting or community to immerse oneself in the data to understand what is going on and be able to write about it" (Kawulich, 2005, p. 24). As described above however, the degree to which a researcher intends to 'blend in' is dependent on the role he/she assumes for the activity. Whatever the case, when implemented successfully, the method will yield data from which the researcher will be able to analyse the human behaviour of interest, and ultimately arrive at a conclusion about the SIA research question(s).

Below it is explained how the methodology was applied in the context of the project.

Application of PO to the project

The *Stockton Sand Quarry Dredging Preliminary Environmental Assessment* (Element Environment, 2018) identified unauthorised access to the quarry as a potential community safety risk. Despite mitigation measures (eg security fencing including a gate locked after hours, high visibility line and signage, closed circuit television [CCTV], equipment and safe batter requirements, trespass procedures, and operating hours) being implemented by Boral, there have been safety incidents associated with members of the public accessing the quarry haul road to gain access to and from the beach. A total of nine incidents were recorded during the 2016-2017 reporting period, predominantly associated with recreational vehicles and pedestrians entering the quarry either unintentionally or deliberately to access the beachfront. The SIA scoping phase concluded that further engagement should be undertaken with the prominent recreational dune user groups to adequately assess this community safety matter.

During the EIS preparation phase of the SIA study, it was determined that further engagement with the user groups was not feasible. On the advice of quarry staff, this is due to the fact that members of the public that travel on the public road towards the site and the few that attempt to enter site without authority, are generally unidentified. The few that arrive to the quarry either recognise they are trespassing and leave quickly, or choose an access route that avoids contact with Boral staff. Their visit is fleeting in nature, establishing a dialogue with them is rarely possible, and accordingly, no contact details are possessed by the project team. In summary, there was little prospect of conducting 'further engagement' activities with the individuals concerned.

Due to this scenario, PO was selected for this SIA as an alternate method used to explore instances of potential or actual unauthorised access to the existing quarry, by members of the public. As an alternative to direct engagement with the public, it was an ideal method. This is because it enabled the project team to collect and record data about the behaviour of members of the public (ie the participants) travelling on the public road towards the quarry, including those who actually intended to enter the quarry, despite the difficulties outlined above.

Boral weighbridge staff volunteered their time to make observations about the participants. The weighbridge staff are permanently present at the entry to the quarry during operating hours, and they have visibility of the entry either by direct sight or CCTV footage. Accordingly, they were positioned perfectly to make and record observations. The staff were provided with an overview of the methodology, advice about what observations were required for the SIA, recording instructions, and a template to collect the necessary data. The SIA Lead Author provided this advice. Given the lack of opportunity for the weighbridge staff to be 'immersed' in the social setting, the role they adopted was predominantly that of a 'complete observer' (refer Figure 5).

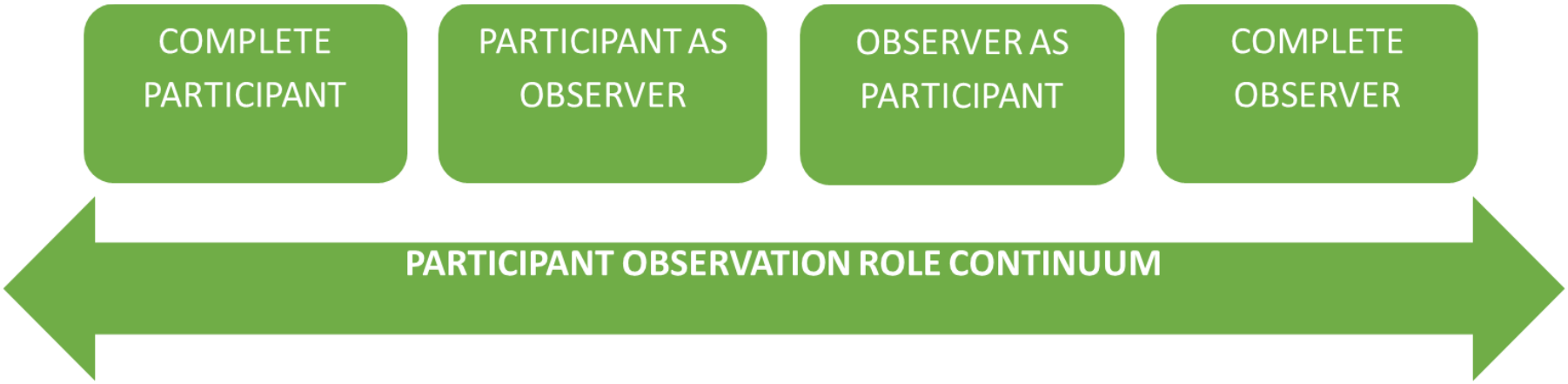


Figure 5 – Participant Observation role continuum (adapted from Gold in Kawulich, 2005)

On the rare occasion where contact was made with the participant, the role adopted was that of an 'observer as participant'. The data sheets were submitted to the SIA Lead Author for analysis at the completion of the exercise.

The PO activity commenced in early January 2019 and ceased in late March 2019. The EIS program was the main driver of the selected date range. The timeframe covered the warmer months of the year which generally attract a relatively larger volume of tourists and other dune users to the beach, so it was assumed to be the most reliable period in terms of capturing observations about the broadest range of participants possible.

The research questions which led the PO activity are:

- do the participants seem to be intentionally or unintentionally accessing site?;
- what is their known or predicted purpose for accessing site?; and
- was their safety put at risk?

Visual impact assessment

A visual impact assessment (VIA) should describe the likely nature and scale of changes in views resulting from a development, and changes to visual amenity experienced by the receptors (Knight & Therivel, 2018). In particular, the VIA conducted as part of the SIA was adopted in response to the possibility (considered during the project scoping phase) that Stockton Beach dune users could see the location of the project site. To investigate the matter, a site visit was conducted to make a visual observation from the dune system, at a location within the quarry boundary that was above the highest point of the publicly accessible area of the dune system adjacent to the quarry. Photographs were taken at the location, and existing photographs were also obtained from the Boral Quarry Manager.

The VIA applied by Andrews et. al. (2012) was adopted for this study. It enables the potential visual impact of the project to be assessed in relation to viewpoints of the dune users. The significance of potential visual impacts was assessed by considering:

1. magnitude - this relates to the magnitude of visual change in the landscape, and its proximity to the viewer. The magnitude of visual change is strongly influenced by the level of visibility of the proposed new work. This results from the combination of scale, extent, distance and duration of the views; and
2. sensitivity - in relation to the quality of the view and how sensitive it is to the proposed change. Visual sensitivity depends on the nature of the existing environment and on the likely response from people viewing the scene. People driving on a busy road and/or at high speeds are likely to be less sensitive to a change in the environment since they are focused on changes in traffic conditions and driving, compared to someone who is enjoying a recreational experience or someone who is viewing the scene from their living room.

The categories of magnitude and sensitivity of visibility are defined in Table 6.

Table 6 - Categories of magnitude and sensitivity (Andrews, Colclough, & Corkery, 2012)

Rank	Description
Negligible	Very minor loss or alteration to one or more key elements/features/characteristics of the baseline visual character (ie pre-SSD approval view) and/or introduction of elements that are consistent with the visual character to the existing landscape character (ie approximating the 'no change' situation).
Low	Minor loss of/or alteration to one or more key elements/features/characteristics of the baseline visual character (ie view pre-SSD approval) and/or introduction of elements that are consistent with the existing landscape character.
Moderate	Partial loss of/or alteration to one or more key elements/features/characteristics of the baseline visual character (ie view pre-SSD approval) and/or introduction of

Rank	Description
	elements that may be prominent but not considered to be substantially uncharacteristic of the existing landscape character.
High	Substantial to total loss of key elements/features/characteristics of the baseline visual character (ie view pre-SSD approval) and/or introduction of elements considered to be totally uncharacteristic of the existing landscape character.

As described above, the magnitude and sensitivity of potential visual impacts to existing views would depend on a combination of scale, extent, distance and duration of the views. Impacts were assessed by applying a consistent set of criteria to the highest dune viewpoint. The criteria are outlined in Table 7.

Table 7 - Visual impact criteria (Andrews, Colclough, & Corkery, 2012)

Criteria	Definition	Rating
Duration of view		
Long term	>1 hour	High
Moderate term	30 minute to 1 hour	Moderate
Short term	<30 minute	Low
Number of viewers		
High	>1,000	High
Moderate	100-999	Moderate
Low	<100	Low
Viewer sensitivity (type)		
Resident	N/A	High
Pedestrian/cyclist		Moderate
Motorist		Low
View sensitivity		
Pristine landscape	N/A	High
Moderately modified landscape		Moderate
Significantly modified landscape		Low
View distance/proximity		
Short	< 100m	High
Medium	100m-500m	Moderate
Long	>500m	Low

Semi-structured interview

Interviewing was selected as a SIA method to further explore the possibility that Stockton Beach dune users could see the location of the project site. An interview was conducted in a semi-structured format using a list of predetermined questions. This format provided a flexible structure which allowed the interviewer to create and ask questions about situations as they emerged, and the interviewee to digress and express views freely (Vilela, 2018).

The work of Bradshaw and Stratford (2005) with regard to qualitative research design and rigour, was helpful in designing the semi-structured interview methodology. The authors provide guidance in relation to participant selection and sampling. Their work explains that in qualitative research, the number of people we interview, communities we observe, or texts we read, is less important than the quality of who or what we involve in our research, and how we conduct that research. Their work emphasises that 'purposive' sampling is typical in this type of research, and that the sample is not intended to be representative given the emphasis is usually on the analysis of meanings. These principles were applied to the SIA interview, and the owner of a dune quad bike adventure business was invited to participate. The business operates daily escorted quad bike tours of the Stockton Beach dunes.

The implementation of the method involved:

1. developing the pre-determined interview questions, designed to explore the social matters identified in the scoping tool;
2. sending an interview invitation letter to the participant. The letter explained the purpose of the interview, the intention to record it, and provided some frequently asked questions. It explained that consent was required, and sought to obtain it in a "free, prior and informed" (Vanclay, 2015, p. 6) fashion;
3. obtaining participant consent;
4. arranging an interview date;
5. conducting and recording the interview;
6. drafting and conducting a qualitative analysis of the interview transcript; and
7. extracting transcript content for use in the SIA assessment.

3.2.5 Data limitations

Upon reflection of the methods implemented for this SIA, two obvious data limitations are discernible. The first of these relates to the poor attendance at the community information drop-in sessions held during the EIS preparation phase. Despite the sessions being well-advertised, adequate notice being given to the community, and the venue being accessible, attendance at the session was underwhelming (details are provided in Chapter 4). A greater number of attendees would have undoubtedly increased the volume of feedback about the project, which in turn would have strengthened the SIA. Other methods implemented for the study (eg ECA, semi-structured interview, consultation with neighbours, and the site-tour) would have positively offset the data weakness presented by the level of attendance at the community information drop-in sessions.

A potential data limitation was also evident in the PO methodology adopted for this SIA study. As outlined above, quarry weighbridge staff took responsibility for the data collection aspect of the activity instead of the Lead SIA Author. Data was provided to the author rather than the data being *generated by* the author. If both the weighbridge staff and the author interpreted the behaviour of participants in any given social setting, then there would be potential for variation in those interpretations. It is only possible to speculate on how this scenario might influence the accuracy of observations made about human behaviour at the quarry. However, the instructions and data collection template provided by the author to the weighbridge staff would have mitigated the

potential for variation. Furthermore, the decision to place data collection responsibility with the weighbridge staff was justified in either case, as any alternative which removed that responsibility from weighbridge staff would have been both cost and time prohibitive.

3.2.6 Participatory engagement and under-represented groups

The research methods (refer Table 4) were selected to foster genuine stakeholder participation. The principal methods designed to enable participation of a wide cross-section of the community were the community drop-in sessions and consultation with local neighbours via a doorknock (Refer Table 4). These methods enabled access to a completely random sample of affected stakeholders and therefore are very likely to have provided equal opportunity for all relevant demographics (especially those people living in the ASI) to participate in the engagement activities.

The engagement methodology design recognises that some groups or individuals may be more willing to share their views and ideas in an informal setting or via non-face-to-face communication channels rather than in an organised community information session. For this reason, alternative participatory methods were implemented. The alternative methods catered for any stakeholders with an informal participation preference and included the:

- project newsletter (including an invitation to provide feedback via telephone or email);
- stakeholder emails and meetings;
- project webpage (including an invitation to provide feedback via telephone or email); and
- facebook campaign.

Participation of under-represented or potentially marginalised groups[2] in the engagement process was a focus of the Project team. Social baseline data (Chapter 5) indicates that:

- an older population resides in both Fern Bay and the Stockton – Fullerton Cove areas in comparison to broader NSW;
- the Indigenous populations in the geographies nearest the project are under-represented compared to the non-Indigenous populations; and
- less people area working and incomes are lower than NSW averages.

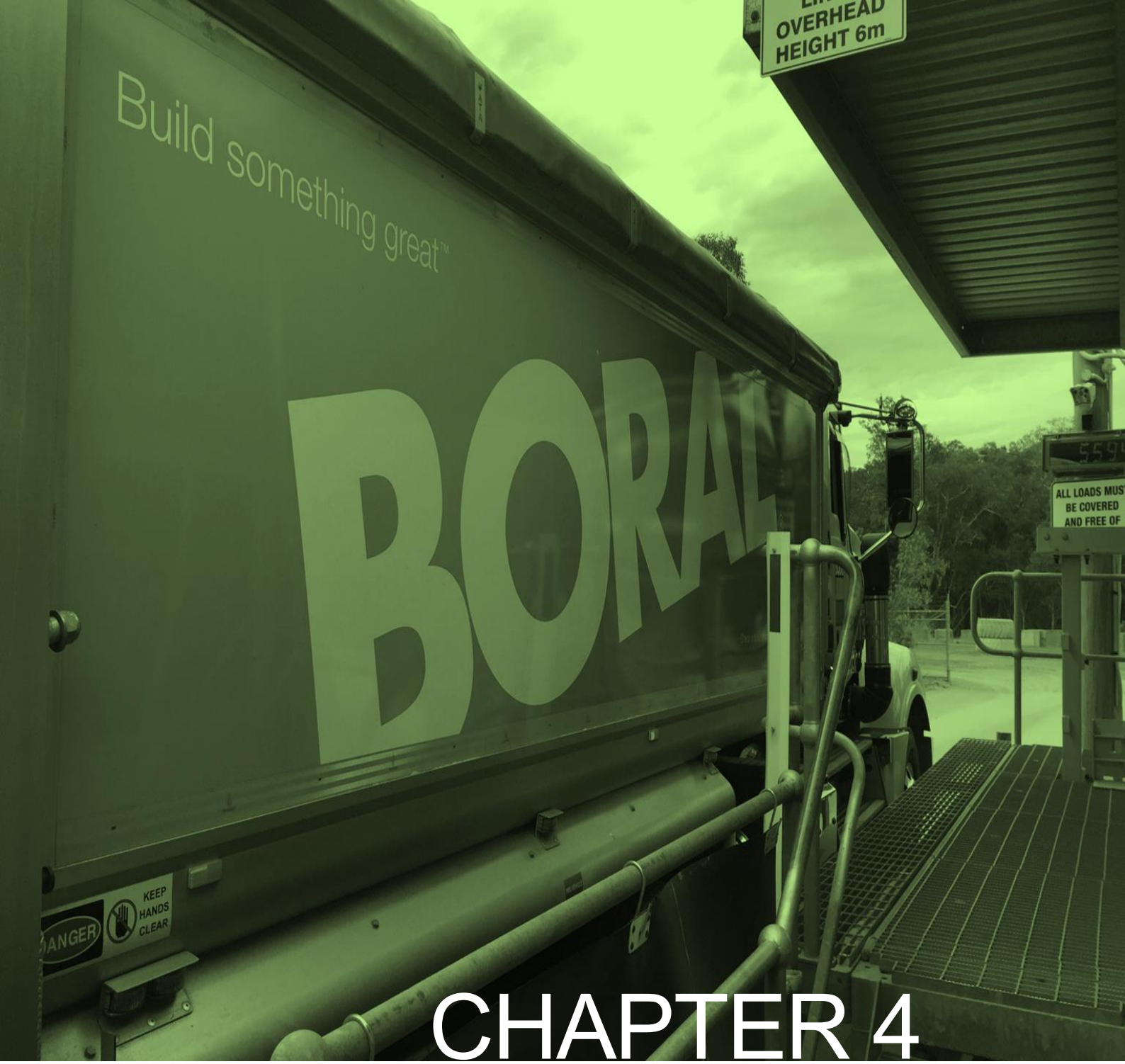
Engagement methods were tailored to each of these groups, as illustrated in Table X.

Finally, the engagement methods also enabled decision-making participation. For example, as custodians of the Worimi Conservation Lands nearby to the Project, it was appropriate that the Worimi LALC Chief Executive Officer (CEO) was provided with decision-making participation during the engagement process. This was enabled through consultation with the CEO and consulting additional stakeholders nominated by the CEO. Table 13 presents the results of this process.

[2] To add rigour to the identification of such groups, reports of comparable projects were reviewed. Nil vulnerable or marginalised groups were explicitly identified in the Fullerton Cove Sand Quarry environmental assessment (GHD, 2015) which relates to the sand quarry development closest in both proximity and type to Boral's operation. The next closest comparable project is the Macka's Sand development at nearby Salt Ash. The environmental assessment (Umwelt, 2009) for this development did not identify vulnerable or marginalised groups. However, the Worimi people featured prominently in the report and the need for Macka's Sand Development was driven by the financial benefits it would yield for them.

Table X – Engagement methods designed for under-represented or potentially marginalised groups

Population group	Engagement method	Participation considerations
Older people	Community information sessions	Session held in morning hours Venue selected with accessible parking and at-grade entry for mobility impaired Venue selected on main transport route with access to public transport Use of plain-English in invitations delivered in hard-copy across the ASI for those with information technology difficulties
	Doorknock	Visiting properties to cater for those unable to travel to community information sessions due to mobility or other impairment Use of plain-English in invitations delivered in hard-copy across the ASI for those with information technology difficulties
Indigenous people	Consultation with CEO Worimi LALC	Providing engagement decision-making opportunity in relation to stakeholders nominated for consultation by the CEO
Unemployed people or people with lower incomes	Doorknock	Visiting properties to cater for those unable to afford travel to community information sessions or internet access Delivery of hard-copy communications to cater for those unable to afford access to communication collateral and/or printing
	Community information sessions	Venue selected on main transport route with access to public transport (catering to those unable to afford private transport options)



CHAPTER 4

SIA SCOPING AND ENGAGEMENT OUTCOMES

4 SIA SCOPING PHASE AND COMMUNITY ENGAGEMENT OUTCOMES

A SIA scoping exercise was conducted to identify and assess social impacts associated with the project. The purpose of the SIA scoping exercise was to highlight what aspects of the natural or human environment (refer to the social impact categories in Appendix A) are expected to be impacted upon by activities associated with the project, how those impacts should be assessed and to what level of detail. During the scoping phase, early community engagement activities were conducted, the scoping tool (NSW Department of Planning, Industry and Environment, 2017) was used to determine the matters applicable to the project, key stakeholders were identified, and the ASI was developed. Outcomes of these undertakings are provided below.

4.1 Scoping phase outcomes

4.1.1 Early engagement results

The early engagement activities conducted by the project team enabled stakeholders to provide feedback about the project. The feedback was relevant to the SIA scoping phase and was used to consider what social impacts might warrant investigation. The results of the early engagement activities are outlined below, listed by the type of activity.

Letter inviting feedback about Boral's operations

No response or feedback about the project was received by the project team following the distribution of the letter to households nearby to the project site. The survey contained a link to an online survey which invited all recipients to submit their opinions. Nil residents completed the survey.

Emails

In response to emails sent to PSC Councillors separately to inform them about the consultation program for the project (including March 2018 doorknock program), one reply from a Councillor was received by the project team. The reply acknowledged and expressed gratitude to the project team for the update. It contained no specific feedback.

Interviews

Interviews with residents (via the random sample doorknock) living in Fern Bay and Fullerton Cove in early March 2018 generated feedback about traffic and road infrastructure, noise, and access to Stockton Beach, as shown in Table 8. A total of 31 properties were included in the doorknock. No residents were available to be interviewed at eight properties at the time of the doorknock. Note a property with multiple occupancies (such as a gated community) was treated as a single property in Table 8.

Table 8 – Interview results (scoping phase)

Period of residence in area (if disclosed by resident)	Feedback
Fullerton Cove	
Unknown	The quarry and its related traffic is not an issue Traffic movements related to industry are not dissimilar to those at Kooragang Island Raised new entrance to Fern Bay estate under construction – possible effects on through (quarry) traffic.

Period of Residence in Area (if disclosed by resident)	Feedback
3 years	Have had a scare on the Nelson Bay Road off-ramp with a truck looking like it wasn't going to brake Have observed some 'cowboy' behaviour from drivers of non-Boral trucks 'We can't hear your operations from our house'.
37 years	Sometimes get stray trucks using laneway – we contact the quarry and have it corrected Can't hear the operations Interested in purchasing some of the cleared land at back of house (owned by Boral) Would not like to see any of Boral's land turned over to residential development similar to that at Fern Bay Happy for the quarry to continue if resource is available Great to hear of rehabilitation already undertaken and that it is continuing.
19 years	No issues with the operations Per- and poly-fluoroalkyl substances (PFAS) contamination is the major local issue 'If we have a problem, we just call to the quarry Manager' Truck traffic was a significant problem back before construction of on/off ramps to Nelson Bay Road.
18 years	'It's a great business – we don't notice it' Occasionally a stray truck runs down the laneway but the quarry deals with it 'It's really good to be engaged about your business – well done' Nil issues with the possibility of continuing the operations.
43 years	The quarry is not a problem Trucks were a major issue before the on/off ramps.
40 years	Nil problems with the site Before the on/off ramps, trucks were an issue.
Unknown	Notice sand lying on inside of the on-ramp kerb on occasions No issues with the operations at all.
Unknown	No issues with the operations Sometimes there'll be a stray truck on the laneway – just contact the site and they address it Trucks are a problem in regard to the occasional independent quarry (also on Coxs Lane adjoining Nelson Bay Road).
Unknown	Enquired about an easier accessway to beach for horse riders Don't notice the operations 'The truck drivers are great around the horses when they spot us'.
Unknown	'I didn't even know you were there'.
Fern Bay	
Unknown	We've never particularly noticed trucks as part of the Nelson Bay Road traffic flow 'It's a public road, isn't it?'.
Unknown	I have noticed trucks in traffic flow but I have no particular concerns with them 'The trucks are certainly no worse than the buses in terms of presence. They actually slow down for the roundabout, unlike the cars, allowing you to get in'.
Unknown	Trucks do not pose a problem 'Cars queue across the roundabout and make it harder to join the flow, so the trucks don't actually stand out'.

Period of Residence in Area (if disclosed by resident)	Feedback
Unknown	Trucks are not a problem 'They are just another part of the rubbish traffic'.
Unknown	Boral trucks are not noticed beyond others.
Unknown	The main road is probably in need of widening as a general comment A new second entrance is being constructed at the northern end of the estate (left in, left out).
Unknown	Trucks are not a problem.
2 weeks	'We can't hear a thing'.
Unknown	We can't hear your operations from our house.
1 week	We don't notice it [the quarry].
Approx. 3 weeks	I notice absolutely nothing.
2 years	I am used to industrial noises through my employment 'I can't hear anything from your site, even in the early hours when coming home from night shift'.

Newsletter

No response or feedback was received by recipients of the May 2018 newsletter distributed to stakeholders in in Fullerton Cove and Fern Bay via hard copy, to MP offices via email, and online via the project website. The lack of response reduced the amount of data that would have otherwise been available to the SIA.

Meeting invitations

Members of the project team met with Kate Washington MP's staffers and briefed them about the project. The discussion was positive and the staffers were familiar with the issues relating to sand quarrying. The staffers raised one question about the project's implications for the water table. The project team responded that groundwater studies to date had not shown the project having a hydrogeological impact.

PSC meeting

Members of the project team presented a briefing to PSC officers and councillors respectively on 10 May 2018 and 26 July 2018. The material provided by the project team was welcomed by Council and no specific feedback was received.

Meeting invitations to Worimi LALC

Boral's National Indigenous Affairs Manager received no specific project feedback from the Worimi LALC at their meeting in January 2018.

4.1.2 Scoping tool

As outlined in the methodology chapter, the early engagement results presented above were used as DPIE scoping tool (NSW Department of Planning and Environment, 2017) inputs, and therefore assigned a relevant 'social matter' for the purpose of the scoping tool. Each social matter has a number of subcategories. For example, the Amenity matter contains subcategories including acoustic, visual, odour, and microclimate. For the purposes of this SIA, where it was determined that the project would be unlikely to impact a particular subcategory, that subcategory is not discussed below. Only those applicable to the project receive attention herein.

Matter 1: Amenity

The first Amenity sub-category determined to be applicable to the project is 'acoustic' amenity. The preliminary environmental assessment (Element Environment, 2018) determined that the project will introduce additional noise sources from the site, potentially resulting in greater noise levels experienced at residences to the south of the site and west of Nelson Bay Road. Ahead of the quantitative noise assessment which confirms acoustic impacts, early consultation with nearby residents suggested the impacts of the current operations are not significant. Residents did not raise any concerns about acoustic impacts from sources on site or from vehicles utilising the public road network. The following examples of feedback from residents in the residential area closest to the site (ie Fern Bay) highlight the comfort of the community in respect to noise impacts:

- "We can't hear a thing";
- "I can't hear anything from your site, even in the early hours when coming home from night shift"; and
- "We can't hear your operations from our house".

Confidence in the scoping phase that social impacts would arise from the project acoustics was further diminished by the fact that there is a moderate distance (approximately 500 m) between the project site and its nearest receivers.

Taking both the early consultation results and the proximity of receivers into account, the scoping exercise determined that there would be no requirement to conduct a SIA in regard to acoustic amenity, alongside the quantitative noise assessment required for the project.

The second Amenity subcategory determined during the scoping phase to be applicable to the project is 'visual' amenity. The preliminary environmental assessment (Element Environment, 2018) determined there is limited visual exposure of the project to the community, and it nominated Stockton Bight Beach as an isolated viewpoint occasionally visited by recreational dune users. Early consultation activities obtained sentiment that nearby residents hold towards the project and its influence on visual amenity. The statements offered by residents living near the project during the doorknock activity were typical of those collected:

- "We don't notice it [the quarry]"; and
- "I notice absolutely nothing".

According to the above, the scoping exercise determined that a standard SIA would be required in relation to visual amenity. The SIA would focus exclusively on the perception of social impacts created for recreational dune users, in relation to the minor initial Stockton Bight Beach viewpoint.

Matter 2: Access

The scoping exercise determined that 'road and rail network' is a subcategory of Access that is applicable to the project. The additional sand (approximately 250,000 tpa until the windblown sand development consent ceases) transported both north and south on Nelson Bay Road will require the local and regional road network to support a larger quantity of truck movements. It was anticipated that the standalone traffic impact assessment planned to be conducted for the EIS would confirm the likely impacts to the road network and determine the network access and capacity implications, much less the social impacts of increased traffic volumes.

From a social impact perspective, it was considered that road users would likely experience irritation and adverse driving conditions if the volume of heavy vehicle traffic is excessive. The 2016 census data (Australian Bureau of Statistics, 2018) indicates that the majority of inhabitants of Fullerton Cove (64.8%) and Fern Bay (74%) utilised their cars (as the driver) to get to and from their place of employment. This dependency on private vehicular use over public transport, along with the increasing population in the Fern Bay area in particular, has the potential to impact negatively on the capacity of the local road network with the proposed increase in heavy vehicles associated with the quarry. This dependency on private vehicular use will increase the exposure

of Fern Bay and Fullerton Cove residents to traffic along Nelson Bay Road in particular, potentially increasing their awareness of traffic volumes and congestion on the local road network.

Capacity issues and reduced access to the road network (for example, if Fern Bay or Fullerton Cove residents experienced queuing at the Nelson Bay Road and Seaside Boulevard intersection roundabout) would create stress for the travelling public. No traffic impact assessment to confirm such a scenario was available at the time the scoping exercise was conducted however, so comments from local residents collected during early engagement were relied upon to investigate the matter. Those comments highlighted a lack of concern with the current project related traffic situation. Examples of such comments include:

- “the quarry and its related traffic is not an issue”;
- “we’ve never particularly noticed trucks as part of the Nelson Bay Road traffic flow”; and
- “I have noticed trucks in the traffic flow but I have no particular concerns with them”.

Based on the fact that a standalone traffic impact assessment would be completed for the EIS and that residents appeared to have minimal concerns with quarry related traffic or the network capacity, the scoping exercise determined that a SIA would not be required to assess this matter. Nevertheless, the project team committed to an adaptive research approach in relation to the results of the traffic impact assessment. If results or ongoing community feedback isolated potential social issues, then more detailed social assessments would be required.

Matter 3: Built environment

The ‘public infrastructure’ subcategory (as part of the Built Environment) was determined to be applicable to the project during the scoping phase. There are close similarities between this subcategory and the ‘road and rail network’ subcategory discussed above. The distinction is that the social impact in this case would likely be created by the condition of the road network (ie the road surface quality) rather than the volume of vehicles using it. It was known that the standalone traffic impact assessment would to a degree investigate implications for the quality of public assets, though its scope would potentially exclude social impacts derived from the deterioration of such assets.

Public infrastructure or the condition of local roads was not raised by residents during the early engagement. This could be an indication that the current quality of local roads is satisfactory to the residents or further, that the residents do not consider that project related vehicles substantially influence road quality. It is feasible however to form an alternate view as to why the residents did not raise these topics. Whatever the case, it is obvious that poor quality road infrastructure will cause frustration and annoyance to any road users. Prior to the completion of the traffic impact assessment however, it was premature to predict the project would significantly reduce the quality of public infrastructure. Adopting a precautionary approach, the scoping exercise concluded that a standard SIA was required to assess this matter.

Matter 4: Heritage

As a subset of the Heritage matter, the ‘natural’ features of the site were identified in the scoping phase as being applicable to the project. A small portion of the dune system adjacent to the project site on Stockton Bight Beach (see the Figure 1) is the natural feature of interest. The Stockton Bight Beach and dune area is used for four-wheel driving, quad bike riding, hiking, horse riding and fishing among other recreational activities. During the scoping phase it was determined that a clear majority of commercial operators advertise four-wheel driving and quad bike riding (see Worimi Local Aboriginal Land Council, 2018) and it was therefore assumed that these activities would be most prominent in the subject dune location. There was no evidence to suggest that the current quarry operations impact the dune system or its recreational values. Ongoing operations were not anticipated to alter this scenario but there was a need to test this perception via further engagement with the community.

Considerations about this matter also included the Aboriginal population and stakeholder group. Fern Bay contains a small Aboriginal and Torres Strait Islander population, which has been established as approximately 3.1% of the community (Australian Bureau of Statistics, 2018). The Worimi LALC manage the Worimi Conservation Lands, which encompass the dune system adjacent to the project.

Despite the fact that Boral had an existing relationship with the Worimi LALC, the scoping phase determined that the views of this organisation and the broader traditional owner community towards the project required further investigation as part of the SIA. This was considered essential given the unique circumstances of the traditional owners. The Worimi people are under-represented in the local population (more details are provided in Chapter 5) and at the same time are custodians of the land – the Worimi Conservation Lands - closest to the Project. On the basis of the Guideline's distributive equity principle, the scoping exercise recognised the potential social impact of the project for this stakeholder group and suggested that further focussed engagement was required for the EIS preparation.

Matter 5: Community

During the scoping phase, 'safety' emerged as a Community subcategory applicable to the Project. Table 9 lists the four potential Community safety matters of the project that would be relevant from a social impact perspective and identifies the relevant section of the EIS where these matters will be addressed.

Table 9: Public safety and relevant section of EIS

Environmental Matter	Relevant chapter of EIS
Health risk and nuisance factors from particulate matter (dust)	Air quality
Increased noise associated with extraction activities, including vehicular movements	Noise
Increased traffic volumes	Traffic and transport
Unauthorised access	Hazards and risks

Firstly, the continuation of quarrying activities has the potential to emit dust, primarily from vehicle movements on site. With the implementation of adequate dust control measures, the potential for significant negative air quality impacts from the project was considered to be low, which is commensurate with the fact that no concerns were raised by the public on this matter. Therefore, it was determined that the matter would be assessed in the air quality impact assessment section of the EIS.

Secondly, the site is surrounded by rural and environmental conservation land uses, which are generally characterized by low background noise levels. There is the potential for the project to result in an increase in noise levels within the community with the recommencement of quarrying activities within an area of the site, where extraction activities have not been undertaken since 2008. No feedback was received from residents regarding noise generated by the existing site or the project. Therefore, it was determined that this matter would be assessed in the noise impact assessment section of the EIS.

Thirdly, the increased vehicle movements north and south on Nelson Bay Road have potential road safety implications. Historical safety records do not indicate this as a potential issue. Feedback obtained from residents during early engagement did however raise a safety concern:

> "I have had a scare on the Nelson Bay Road off-ramp with a truck looking like it wasn't going to brake".

This or any similar fear in the community could be exacerbated by the introduction of an increased number of truck movements.

The manner in which potential traffic impacts associated with the project would be assessed from a technical and social perspective are discussed under 'Matter 2: Access' above.

Finally, unauthorised access to the project site by members of the public, whether unintentionally or intentionally, presents a potential safety risk. Historical records indicate that the majority of past incidents relate to recreational vehicles and pedestrians entering the quarry to access the beachfront. Despite the efforts on site to prevent unauthorised access, the scoping exercise acknowledged the potential for the public to attempt to gain access to the property in the future. In this scenario, there is a possibility of potential interaction between members of the public and the project operations, which could cause a safety incident. Therefore, it was determined that a standard SIA is required to assess unauthorised site access as part of this SIA study.

Apart from the standard SIA related to unauthorised site access, the scoping exercise determined that a SIA is not required to assess these community safety matters. It was expected that the air quality, noise, and traffic impact assessments, along with the hazards and risks chapter within the EIS, would adequately address these community safety matters. Further engagement with the prominent recreational dune user groups (in relation to community safety) was planned, but was not possible for the reasons outlined in the methodology chapter. The scoping exercise also acknowledged that the hazards and risks chapter of the EIS would consider the rehabilitated post extraction landform and any new or additional potential community safety implications associated with unauthorised site access.

Matter 6: Economic

Following a consideration of the preliminary environmental assessment (Element Environment, 2018) and Economic matters in the Guideline during the scoping phase, 'natural resource use' was obviously determined to be relevant. Natural fine sand extracted from the quarry is the specific natural resource, and it's use by the project qualified for social impact assessment. The resource is an essential component to construction materials and consequently, to local and regional development projects. The influence of the project on the supply volumes for these development projects is worthy of assessment.

The 'livelihood' of employees at the quarry also emerged in the scoping phase as a subcategory of economic matters that is applicable to the project. During interviews carried out for the ASI development, Boral staff stated that five quarry employees would maintain their employment, and that all are locally based. This impact of the project qualified for further assessment.

The scoping exercise determined that a desktop SIA would be adequate to assess the (likely positive) economic impacts created by the project in relation to natural resource use and its influence on livelihoods.

Summary

A summary of the scoping tool outcomes is provided in Table 10. It lists each social matter from the scoping tool (and relevant subcategory) described above, and the associated scoping tool input. For each social matter, it identifies the relevant social impact category per Section 1.1 of the Guideline (refer Appendix A) which will frame its assessment and discussion in the subsequent chapters of this study. It also identifies which matters will be the subject of a specialist study in the EIS, the level of assessment defined by the scoping tool, and the SIA method selected to address it.

Whilst the full range of social impact categories outlined in Section 1.1 of the Guideline was considered during the scoping phase, four (ie Community, Culture, Decision Making Systems, and Fears and Aspirations) were not recognised in the scoping tool outputs as having potential to cause a social impact. In each of these four cases, there was no material suggestion in the information offered by stakeholders, that any aspect of these social impact categories would be influenced by the project. Speculation about some possible reasons for this is offered in Chapter 6.

Table 10 - Scoping tool outcomes

Social matter (relevant subcategory) and scoping tool input	Social impact category (Guideline section 1.1)	Will a specialist study be conducted for the EIS?	Level of assessment for the social impact (scoping tool output)	SIA method(s) implemented for the assessment
Amenity (acoustic) Stakeholders did not raise any concerns about acoustic impacts from sources on site or from vehicles utilising the public road network	Health and wellbeing	Yes	No SIA required	Nil
Amenity (visual) Stakeholders did not raise any concerns about visual impacts associated with the project	Surroundings	No	Standard SIA	VIA Semi-structured interview
Access (road and rail network) Residents had minimal concerns with quarry related traffic[3] or the network capacity	Access to and use of infrastructure, services and facilities	Yes	No SIA required	Further engagement and adaptive research approach in relation to the results of the traffic impact assessment
Built environment (public infrastructure) No stakeholder feedback was obtained in relation to the effect of the project on the quality of public infrastructure (ie road surfaces)	Access to and use of infrastructure, services and facilities	Yes	Standard SIA	ECA
Heritage (natural features) There was no evidence to suggest that the sites current operations impact the dune system or its recreational values	Surroundings	Yes	Standard SIA	Further engagement (consultation with Worimi LALC)
Community (safety)	Health and wellbeing	No	Standard SIA	PO

[3] One resident reported an observation of a truck using the Nelson Bay Road off-ramp in a manner deemed dangerous. It was determined in the scoping phase that an adaptive research approach would be taken in relation to this issue (ie if results or ongoing community feedback isolated traffic incidents as an issue, then more detailed social assessments would be required). Refer to the discussion of "Matter 5".

Social matter (relevant subcategory) and scoping tool input	Social impact category (Guideline section 1.1)	Will a specialist study be conducted for the EIS?	Level of assessment for the social impact (scoping tool output)	SIA method(s) implemented for the assessment
Site records confirm unauthorised site access (attempted and actual)				
Economic (natural resource use *and* livelihood) The preliminary environmental assessment established that natural fine sand derived from the quarry will influence supplies for local and regional development projects	Personal and property rights	Yes	Desktop SIA	Desktop research
Economic (livelihood) Boral staff stated that the project would extend the employment of five, locally-based quarry employees and provide additional employment.	Personal and property rights	Yes	Desktop SIA	Desktop research

4.1.3 Key stakeholders

The key stakeholders identified for the project are contained in the stakeholder matrix (Table 11). The matrix contains the key project stakeholders, and the engagement techniques applied to establish and foster a dialogue about the project.

Table 11 – Stakeholder matrix

Project stakeholder	Letter	Phone call	Email	Interview / Informal briefing / 'door knock'	Site visit / tour	Formal presentation	Community drop-in sessions notification	Community drop-in sessions	Newsletter	Meetings	Social media / online	Website / microsite
Host communities and fenceline neighbours												
Cox's Lane neighbours	X			X			X	X	X		X	X
Fern Bay residential area	X			X			X	X	X		X	X
Fullerton Cove residential area	X			X			X	X	X		X	X
Residents in wider region – Stockton/Williamtown							X	X	X		X	X
Indigenous groups												
Worimi LALC	X	X	X				X	X	X	X	X	X
Local government												
PSC Mayor	X		X			X	X	X	X	X	X	X
PSC GM	X		X			X	X	X	X	X	X	X
PSC elected councillors	X		X			X	X	X	X	X	X	X

Project stakeholder	Letter	Phone call	Email	Interview / Informal briefing / 'door knock'	Site visit / tour	Formal presentation	Community drop-in sessions notification	Community drop-in sessions	Newsletter	Meetings	Social media / online	Website / microsite
PSC planning representatives	X	X	X			X	X	X	X	X	X	X
State and federal government												
NSW Member for Port Stephens	X	X	X				X	X	X	X	X	X
NSW Member for Newcastle	X	X	X		X		X	X	X		X	X
NSW Department of Planning, Industry & Environment	X	X	X								X	X
NSW Environment Protection Authority	X		X								X	X
NSW Roads & Maritime Services	X		X								X	X
NSW Office of Environment and Heritage	X		X								X	X
NSW National Parks and Wildlife Services	X		X								X	X
Media												
Boral corporate media (ie Facebook and website)		X	X				X	X	X		X	X
Interest / activist groups												
Nil												
Business groups												
Quad bike king	X	X	X	X			X	X			X	X
Sand dune adventures		X	X				X	X		X	X	X
Sid Foggs Coaches			X	X					X			

4.1.4 Area of social influence

The nominated ASI for the project is illustrated in Figure 6. The area is comprised of a polygon containing the project site, the nearest communities including properties in Fern Bay and Fullerton Cove, and a small portion of the sand dune system adjacent to the project site. The polygon is also comprised of linear areas associated with the main transport routes proposed to be used by the project. These linear areas include Coxs Lane, and Nelson Bay Road from its intersection with Seaside Boulevard to its intersection with Cabbage Tree Road. There are no remote locations considered to be indirectly impacted.

The suburb of Fern Bay, at the southernmost extent of the Port Stephens LGA, is north of Stockton (the only suburb of Newcastle situated north of the Hunter River), and east of the north arm of the Hunter River (entrance of Fullerton Cove). In July 2010, the NSW Government approved a land release allowing for the development of approximately 684 homes at Fern Bay. This action paved the way for development associated with increased population growth identified in the *Lower Hunter Regional Strategy 2006 – 2031* (NSW Department of Planning, 2006). The regional significance of Fern Bay as a centre for employment and housing has also been outlined in the *Hunter Regional Plan 2036* (NSW Department of Planning and Environment, 2016).

Fullerton Cove is also a suburb of the Port Stephens LGA and is located to the north of Fern Bay. In the 2011 Census (Australian Bureau of Statistics, 2011), the Fullerton Cove population was just 300 people, whilst Fern Bay had a total population of 1,625. Both suburbs have experienced significant population growth between 2011 and 2016. In the 2016 Census (Australian Bureau of Statistics, 2018), the population of Fullerton Cove was 566 while Fern Bay was 2,763. Residences in Fullerton Cove are predominantly set on larger acreages (unlike the smaller residential lots in Fern Bay) along the Fullerton Road corridor. The properties in Fullerton Cove are older than those in Fern Bay and are physically separated from the project site by Nelson Bay Road and adjacent bushland.

The socio-economic profiles of Fullerton Cove and Fern Bay are outlined below. Insights into the relationships between their respective populations and the project, including social issues and concerns, were gathered during the door knock exercise (scoping phase) and submitted to DPIE.

Rationale for selecting the ASI

The task of developing the ASI was assisted by the fact that the project has a long-term history. Operations began on the site during the 1970s. Boral acquired the site in 1992 and has developed strong connections with local residents and their Stockton based employees. The influence of the project on social conditions locally is therefore well understood by Boral. This was evident during the semi-structured interviews conducted with Boral staff, which formed a basis for the ASI development. See to Table 12 for a summary of the interview results.

Historical correspondence records maintained by Boral provides evidence of complaints or issues raised by nearby residents and/or business owners. The Annual Environmental Management Reports (AEMR) submitted by Boral to DPIE in accordance with the existing development consent are one source of correspondence records. A review of the AEMRs from recent years indicate that no complaints were received about Boral's operations.

Traffic routes proposed to be used by project vehicles were considered during the ASI development. It was anticipated that most social impacts related to traffic would be experienced at the roundabout (Seaside Boulevard and Nelson Bay Road intersection). Furthermore, Coxs Lane and Nelson Bay Road from its intersection with Seaside Boulevard to its intersection with Cabbage Tree Road were considered the logical parts of the road network where social impacts derived from traffic would occur. On other roads, the volume of non-project related vehicles was expected to reduce the likelihood of a project-related social impact being created.

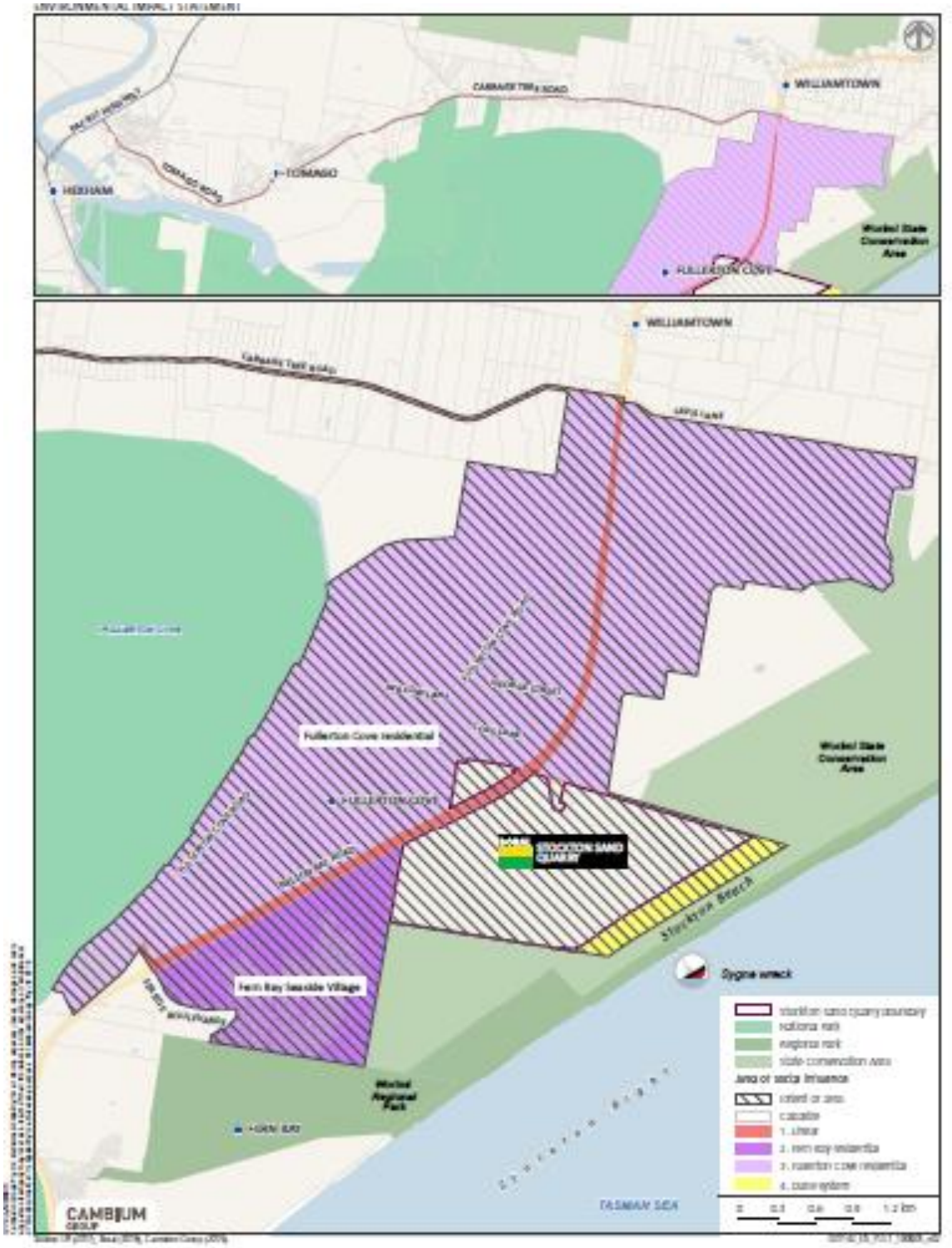


Figure 6 – Map of the ASI

Whilst not directly qualifying these assumptions, the project traffic impact assessment (Transport and Urban Planning Pty Ltd, 2019) found traffic impacts of the additional trucks associated with the operation of the project on the adjacent road network, including the principal intersections adjacent the quarry, will be satisfactory.

Aside from the project history and traffic routes, the physical features of the site were also considered as part of the initial ASI development. Due to the natural topography and vegetation surrounding the site, the project is isolated from both a physical (refer to Figure 1) and visual perspective. It is not visible from Nelson Bay Road or surrounding residential areas, and Stockton Bight Beach is the only location where the existing quarry operations have visual exposure. The project will not interfere with public access to Stockton Bight Beach. There are no formal public access points to Stockton Bight through Boral's property. These observations influenced the constrained nature of the ASI.

Table 12 - Summary of interviews with Boral staff

ASI Factor discussed during interview	Feedback obtained
Supply chains	The project would have few linkages with firms at local and regional scales. Expanded operations at the site would require the procurement of specialist equipment at start-up from an overseas supplier. It is expected that operational expenditure following the initial start-up procurement activities would be exclusively for consumables (eg fuel) and maintenance. Manufacturing businesses and local or regional suppliers would not be influenced by the project beyond existing arrangements. The workforce supply chain would not be influenced by the project. The small, locally based workforce would remain to support the project. The workforce would not generate considerable expenditure in any particular locality, or significantly influence the supply of goods to the local area.
Haulage of sand and transport of other goods	The main truck routes that would be used by the project are: ▪ Coxs Lane, Nelson Bay Road (south of Coxs Lane) and Toule Street/Cormorant Road; and ▪ Coxs Lane, Nelson Bay Road between Cabbage Tree Road and Seaside Boulevarde and Cabbage Tree Road/Tomago Road. As the project will increase sand transportation from the site by up to 250,000 tpa, the part of the truck routes most relevant to the creation of social impacts should be included in the ASI. Boral staff anticipate that truck movements would be the only aspect of the project visible to the community.
Materials and equipment	Materials and equipment required by the project would largely be limited to that which would support dredging operations. The dredge, a variety of pipes, and a wash plant would be the major items required. These items should have a minor influence on the extent of the ASI.
The movement of workers (drive-in-drive-out and fly-in-fly-out working arrangements)	Five Boral staff currently work at the site. All are locally based. The project would maintain the employment of the current staff and increase the workforce. Boral also employs truck drivers and associated support personnel. The project would not create links to regional localities via the movement of workers.
Natural features and recreational values (eg dunes at Stockton)	Boral has operated at the site over a long period of time and has not disrupted the natural and recreational values of the adjacent dune system. The project operations would continue to co-exist with natural values and recreational features. Although not disruptive, Boral staff, the local community, and recreational users acknowledge the close proximity of the project to the dune system.
Ancillary infrastructure	The project would be a standalone site. There would be no ancillary infrastructure or secondary sites that would extend its footprint beyond the existing site.
Reputation of other operations in area	There are other extractive industries operating in the area. These operations have generally attracted negative publicity in recent years in

ASI Factor discussed during interview	Feedback obtained
	relation to traffic movements and waste. Community sentiment regarding other extractive operations is generally negative[4].

4.2 Further engagement results

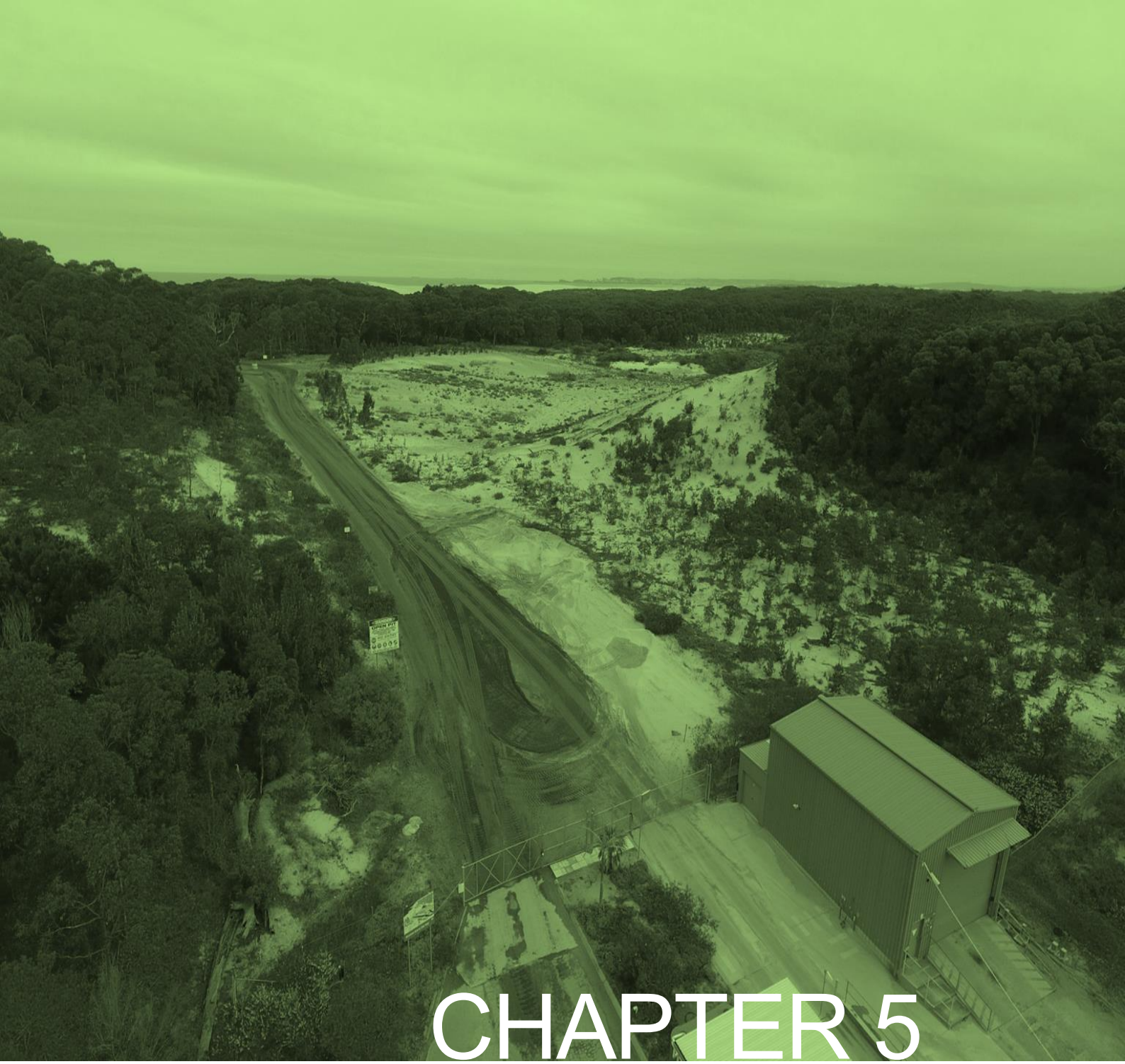
During the EIS preparation phase in 2019, the project team conducted further stakeholder engagement via the range of stakeholder engagement methods outlined in the methodology chapter. The engagement activities emphasised and sought stakeholder feedback about the project. Table 13 contains the results of the further engagement program.

Table 13 – Further engagement results

Method	Description
Written methods	
Project newsletter and community drop-in sessions notification	Following its distribution, no specific feedback from stakeholders was received. It was concluded that it did not prompt a specific interest in the project. However, one community member who received the newsletter did attend the community drop-in session (see below).
Community drop-in sessions notification	70 notifications were distributed via letter-box drop in Fern Bay, and 60 were distributed in Fullerton Cove on 7 February 2019. The residential block nearest to the project site was included in the distribution area. Following its distribution, no specific feedback from stakeholders was received.
Emails	Emails were sent to project stakeholders including the PSC Mayor and ward councillors regarding the progress of the project. One Councillor replied via email to acknowledge receipt of the project team email. No specific feedback about the project was received.
Phone briefing (informal)	A member of the project team briefed the Port Stephens MP via telephone about the Project during early February 2019. The Port Stephens MP confirmed she would like to meet the project team later in the year. The Port Stephens MP did not raise specific concerns about the project.
In-person interactive methods	
Meeting – CEO Worimi LALC	At the meeting between Boral's Indigenous Affairs Manager and the CEO Worimi LALC, no concerns about the project were raised by the CEO. The CEO made a request for consultation to occur with five stakeholders whom are either neighbours of the project, part of the Indigenous community, representatives of NSW Government agencies, or a combination of these. The CEO also requested ongoing meetings as a means to receive project updates. Boral's Indigenous Affairs Manager agreed to the requests.
Site tour (Newcastle MP)	Members of the project team escorted the Newcastle MP during the visit. Boral staff provided details about the project and addressed questions raised by the Newcastle MP. Nil concerns were formally raised with the project team during or following the site tour.
Community drop-in sessions	The community drop-in sessions advertised locally and held on 14 February 2019 attracted only two community members (a husband and wife couple) from Fullerton Cove, who received the project newsletter and community drop-in sessions notification. Consequently, little data

[4] Following the interview, a search was conducted for public commentary about other quarry operators referred to by Boral staff. See media commentary for example; McCarthy (2016) and Environmental Protection Authority (2017).

Method	Description
	was collected from the sessions. See a summary of the conversation with the couple in Appendix C.
Consultation with resident	A member of the project team had a conversation with Fern Bay resident, following the traffic query he raised with a project consultant conducting field work adjacent to the project site. The project team member explained the proposal for project related traffic, and confirmed the quantity of proposed traffic movements. The resident was satisfied with the responses. Subsequent to the conversation, the project newsletter and community drop-in sessions notification, and the community drop-in sessions notification was provided to the resident via letter-box drop
Consultation with neighbours via doorknock	See Appendix D for a summary of the consultations
Media methods	
Website	No project related feedback was received via the website feedback form or via the contact phone number listed on the webpage.
Facebook campaign	The project Facebook post (refer Appendix B) received some reply comments. Within three hours of being uploaded, the post attracted 10 'likes', one 'love', one 'share' and one positive comment from a quarry customer who was satisfied with the service he received from quarry staff. Later, it attracted one ‘angry’ emoji and two comments criticising sand extraction generally.



CHAPTER 5

THE SOCIAL BASELINE

5 EXISTING SOCIAL BASELINE

This chapter presents the social baseline for the project. The baseline is the nominated set of social indicators for communities potentially affected by the project. It provides a point of comparison – it can be used as reference data against which to measure the impacts of the project as it develops, and/or to determine the adequacy or otherwise of existing facilities (Vanclay, 2015). All data used in the baseline is derived from the *2016 Australian Census of Population and Housing* (Australian Bureau of Statistics, 2018) unless an alternate source is cited.

The unit of analysis for the regional context is the Hunter region, as defined by the *Hunter Regional Plan 2036* (NSW Department of Planning and Environment, 2016). The equivalent local contexts are the Fern Bay SSC (or State Suburb) and Stockton-Fullerton Cove SA2 (Statistical Area 2) census geographies. A comparison to NSW data is provided where possible.

5.1 Regional context

As a major Australian east coast city, Newcastle is the capital city of the Hunter Region. The city has strong historical links to the extractive industries but over the last two decades has experienced structural economic changes. Newcastle has diversified from its traditional extractive industry base to other economies including defence, education and service industries. Recently the city has benefitted from an urban renewal program led by the NSW Government, with its $650 million investment to the city centre, strengthening connections between the city and waterfront, creating job opportunities, providing new housing, and delivering attractive public spaces connected to better transport (New South Wales Government, 2019). The Port of Newcastle, Newcastle Airport, and heavy rail links facilitate the transport of freight and passengers across the region.

Beyond its capital city, the Hunter Region has unique characteristics which ensure it is one of the strongest regional economies in the country. It has proven premium farming, wine and equine industries, and prominence as a high-quality tourism destination (Deloitte Access Economics, 2013). The region boasts tourist destinations both on its coastline (eg Port Stephens, Forster-Tuncurry) and in its hinterland courtesy of the Hunter being a mature wine making region. Given its diversifying status, future growth and development of the Hunter Region will depend on number of factors including its integration with Asia, changing settlement and migration patterns tied to the greater Sydney population, transitioning to a less carbon intensive economy, digital economic advances, and accessibility in terms or road, rail and freight connectivity (Deloitte Access Economics, 2013).

The prominent socio-economic characteristics associated with the region are identified by NSW Department of Planning and Environment (2016). The Hunter economy accounted for 28% of the entire gross regional product in NSW during 2016. It is one of three best thoroughbred centres in the world, and is the oldest wine making region in Australia. Tourism figures suggest it performs strongly compared to other NSW regions, with over 3.3 million domestic overnight tourists visiting the Hunter Region in 2016. This number accounted for almost 16% of all domestic overnight tourists that visited a destination in regional NSW.

In terms of its population, the region contained 732,400 residents in 2016, and this is expected to increase to 862,250 by 2036, when a quarter of the population will be aged over 65 years of age. Age and sex data (see Table 14) provides a contrast between each Hunter Region LGA population and the NSW population during 2016. An equal number of LGAs (4) had both a lower and higher median age compared to wider NSW. The Muswellbrook LGA population is unique as it contained the lowest proportion of females and had the lowest median age compared to populations in the other geographies.

Table 14 - Age and sex comparison, Hunter LGAs Vs NSW

Council area	Proportion of males	Proportion of females	Median age
Lake Macquarie	48.4	51.2	42
Cessnock	49.7	50.3	38
Singleton	50.9	49.1	36
Muswellbrook	51.3	48.7	35
Upper Hunter	49.4	50.6	41
Dungog	50.1	49.9	45
Maitland	48.8	51.2	36
Port Stephens	49.4	50.6	45
Newcastle	49.3	50.7	37
NSW	49.3	50.7	38

Employment in the Hunter region is marginally weaker compared to the NSW state data. The region has a higher proportion of unemployed people and a smaller proportion of people in full-time work, despite having a larger proportion employed part-time. The employment figures for the region are unsurprising given buoyancy provided by mining activities. Coal mining was the industry that employed most people and accounted for 9% of the regional population during 2016. Other major industries of employment included hospitals (except psychiatric hospitals) (3.2%), aged care residential services (3.0%), supermarket and grocery stores (2.6%) and takeaway food services (2.4%).

5.2 Existing population (local context)

5.2.1 Local government

The project is situated in the Port Stephens LGA which is highlighted in Figure 7. The LGA comprises the coastline from Newcastle in the south to Nelson Bay in the north, and Paterson to the west. The Pacific Highway dissects the LGA.

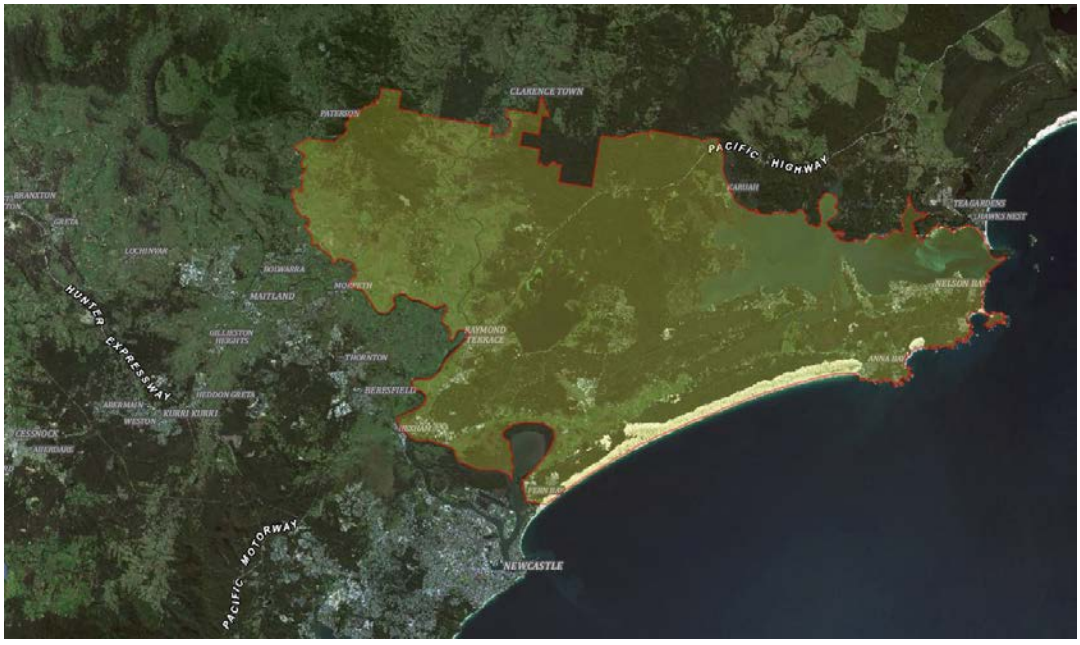


Figure 7 – Port Stephens LGA

5.2.2 Community

Community profile

Socio-economic data from the census provides a snapshot of the community profile in the local area. The data in Table 15 enables a comparison of the Fern Bay, Stockton – Fullerton Cove and NSW populations in respect to a range of socio-economic indicators.

Table 15 – Socio-economic indicators

Socio-economic indicator	Fern Bay	Stockton - Fullerton Cove (SA2)	NSW
Total population	2,763	566	7,467,527
Male	49.50%	49.90%	49.30%
Female	50.50%	50.10%	50.70%
Median age	53	51	38
Average children per family for families with children	1.8	1.7	1.9
Average people per household	2.2	2.3	2.6
Median weekly household income	$1,049	$1,164	$1,486
Median monthly mortgage repayments	$2,167	$2,000	$1,986
Median weekly rent	$430	$330	$380
Average motor vehicles per dwelling	1.6	1.6	1.7

The populations do not differ markedly in terms of gender. It is clear that an older population resides in both Fern Bay and the Stockton – Fullerton Cove areas, in comparison to broader NSW. In the study area, the average number of children per household, people per household, incomes, and motor vehicles per dwelling are smaller when compared to NSW averages.

The median age of 53 for Fern Bay, and 51 for Fullerton Cove suggests that the two are aging suburbs catering to established members of the workforce or retirees. This position is corroborated by the fact that 55% of community members in Fern Bay and 45.8% of community members in Fullerton Cove own their homes outright, and only 23% of homes in Fern Bay and 27.2% of homes in Fullerton Cove are owned with a mortgage. Accordingly, the family structure of Fern Bay favours families without children (58.1%) over families with children (32.1%). This is echoed in Fullerton Cove with the composition of families comprising 50.2% of couples without children compared to 34.0% of couples with children. The aging status of the community is further substantiated by the fact that 41.6% of couple families in Fern Bay and 34.7% in Fullerton Cove are not working.

Population projections

During 2016, the Port Stephens LGA population was 74,100. It is forecast to grow to 92,650 by 2036. Total households and implied dwellings[5] will follow the growth trajectory predicted for the

[5] The projection of implied dwelling demand shows how many dwellings are likely to be needed to accommodate the projected population and the households likely to form. It is a demand-driven estimate (NSW Department of Planning and Environment, 2019).

population. The rate of growth in each case is predicted to plateau slightly from 2031. Figure 8 illustrates these projections.

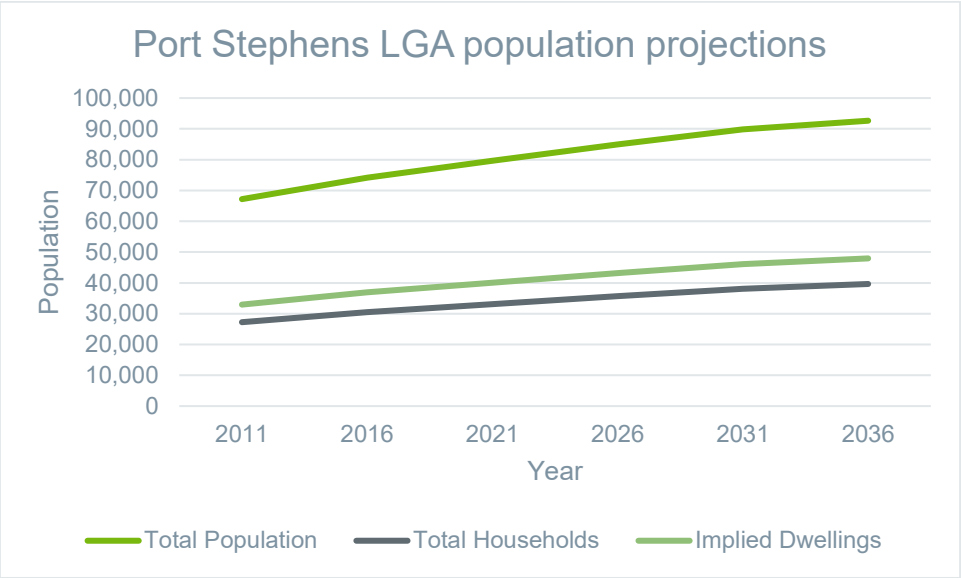


Figure 8 - Local Government Area Population and Household Projections, and Implied Dwelling Requirements (NSW Department of Planning and Environment, 2019)

Family composition

The composition of families in both Stockton – Fullerton Cove and Fern Bay is distinct in comparison to the NSW equivalent (see Table 16). Across NSW there are higher proportions of families (either couples or single parents) with children than in the geographies closest to the project. These statistics underscore the older demograhic and the relatively smaller number of dependent children in the local area.

Table 16 – Family composition

Family composition	Stockton - Fullerton Cove	%	Fern Bay	%	New South Wales	%
Couple family without children	1,010	50.2	465	58.1	709,524	36.6
Couple family with children	683	34	257	32.1	887,358	45.7
One parent family	292	14.5	74	9.2	310,906	16
Other family	25	1.2	4	0.5	32,438	1.7

Indigenous population

The Indigenous populations in the geographies nearest to the project are not drastically different to the proportion of Indigenous people residing in NSW as a whole (see Table 17). As with the non-Indigenous population locally, it is evident that the local geographies contain a comparatively older Indigenous population. This is demonstrated by the median ages in Stockton – Fullerton Cove (27) and Fern Bay (25) being larger than that of the NSW equivalent (22).

Indigenous people in the local populations are under-represented, a pattern which is common nationally. Of the 2,763 people in Fern Bay, Aboriginal and/or Torres Strait Islander people made up only 3.1% (86 people) of the population. Under-representation was also evident in Stockton - Fullerton Cove where only 4.0% (300 people) of the total population were Aboriginal and/or Torres Strait Islander people

Table 17 - Aboriginal and/or Torres Strait Islander peoples

Characteristic	Stockton - Fullerton Cove	%	Fern Bay	%	New South Wales	%
Male	154	51.3	39	47.0	107,368	49.7
Female	146	48.7	44	53.0	108,809	50.3
Median age	27	--	25	-	22	--

Place of birth

In terms of the birthplaces of residents in the communities surrounding the project, England, New Zealand, Scotland, USA, and Germany were reported most frequently at the Census. Excluding those residents born in Australia, the bulk of the local populations were born in Commonwealth nations. The data contained in Table 18 demonstrates there is not a major contrast between the proportions of residents born in these foreign locations, in Stockton - Fullerton Cove, Fern Bay, or NSW more broadly.

Table 18 – Birthplace of residents (excluding Australia)

Birthplace	Stockton - Fullerton Cove	%	Fern Bay	%	New South Wales	%
England	215	2.9	103	3.8	226,564	3
New Zealand	79	1.1	33	1.2	117,136	1.6
Scotland	36	0.5	25	0.9	28,579	0.4
United States of America	30	0.4	21	0.8	30,081	0.4
Germany	35	0.5	18	0.7	29,541	0.4

Multi-culturalism

Non-English languages spoken at home provide an indicator of multi-culturalism in communities. Contrasting language profiles were reported in the Stockton - Fullerton Cove and Fern Bay geographies as shown in Table 19 and Table 20. German and Spanish languages were reported by residents in both local areas as being among the popular non-English languages spoken at home. An obvious departure from the NSW non-English language profile is evident amongst the Stockton - Fullerton Cove population, where only 0.2% spoke Mandarin compared with 3.2% of the NSW population. Other language types were more consistent between the local geographies and NSW.

Table 19 – Language other than English, spoken at home (Stockton - Fullerton Cove)

Language	Stockton - Fullerton Cove	%	New South Wales	%
German	21	0.3	23,033	0.3

Language	Stockton - Fullerton Cove	%	New South Wales	%
Thai	14	0.2	24,839	0.3
Spanish	13	0.2	63,527	0.8
Mandarin	12	0.2	239,945	3.2
Tagalog	11	0.1	45,130	0.6

Table 20 - Language other than English, spoken at home (Fern Bay)

Language	Fern Bay	%	New South Wales	%
German	10	0.4	23,033	0.3
Spanish	9	0.3	63,527	0.8
Khmer	6	0.2	11,694	0.2
Dutch	4	0.1	8,686	0.1
Hindi	4	0.1	67,034	0.9

Employment

Employment status data derived from the Census and reproduced in Table 21, indicates that both Fern Bay and Stockton-Fullerton Cove residents maintain similar working patterns. The main inconsistency between the two resident groups is the proportion of residents that stated both parents in couple families were not working. A greater proportion (41.6%) of Fern Bay residents reported this status, compared to 34.7% of the population in Stockton-Fullerton Cove. Overall, the data illustrates that smaller proportions of the Fern Bay and Stockton-Fullerton Cove residents are working, relative to the collective NSW population. These employment figures reflect a small degree of vulnerability for Fern Bay and Stockton-Fullerton Cove residents and may suggest that limited opportunities are available for local employment.

Table 21 – Employment status

Employment Status of Parents in Couple Families	Fern Bay (%)	Fern Bay (No.)	Stockton-Fullerton Cove SA2 (%)	Stockton-Fullerton Cove SA2 (No.)	NSW (%)	NSW (No.)
Both Employed, Worked full-time	14.8	108	15.9	270	22.6	360,916
Both employed, worked part time	2.1	15	2.7	46	4.0	63,106
One employed full-time, one part time	15.3	112	18.6	315	20.6	329,567
One employed full time, other not working	10.7	78	10.7	181	15.0	240,084
One employed part time, other not working	4.1	30	4.9	84	6.1	96,933
Both not working	41.6	304	34.7	590	21.0	334,742
Other (includes away from work)	4.2	31	4.8	81	5.1	80,905
Labour force not stated (by one or both parents in a couple family)	7.3	53	7.7	131	5.7	90,630

Education

Educational attainment data associated with the local populations is contained in Table 22. It shows that data for the local populations is generally consistent. Conversely, it shows that larger proportions of the local populations attained a school qualification compared to the NSW population, up until the year 10 certificate. This scenario did not hold true for the post-year 10 qualifications however, including university qualifications. The strength of mining and agricultural industries historically in the Hunter region, is perhaps one explanation for this pattern. These industries would typically require a workforce with practical skills obtained through trade certificates and apprenticeships, rather than through university programs.

Table 22 – Educational attainment

Level of highest educational attainment (People aged 15 years and over)	Stockton - Fullerton Cove	%	Fern Bay	%	New South Wales	%
Bachelor Degree level and above	890	13.8	331	14.2	1,424,716	23.4
Advanced Diploma and Diploma level	506	7.9	187	8	543,142	8.9
Certificate level IV	233	3.6	82	3.5	167,947	2.8
Certificate level III	1,080	16.8	379	16.3	730,498	12
Year 12	589	9.2	215	9.2	930,654	15.3
Year 11	183	2.8	74	3.2	203,574	3.3
Year 10	936	14.6	382	16.4	702,178	11.5
Certificate level II	4	0.1	6	0.3	4,849	0.1
Certificate level I	0	0	0	0	625	0
Year 9 or below	707	11	332	14.2	513,209	8.4
No educational attainment	11	0.2	3	0.1	54,870	0.9
Not stated	1,069	16.6	252	10.8	627,465	10.3

5.2.3 Place

Status of industry

The industries that provide most employment opportunities for the Stockton - Fullerton Cove and Fern Bay workforces are identified in Table 23. It is not surprising that Defence is a strong employment industry for both local populations, given their proximity to the Williamtown RAAF base. The same might be said for State Government Administration data, presuming the base also provides administrative opportunities for the civilian population. The prominence of the Aged

Care Residential Services industry is consistent with the older demographic in the area, which promotes a demand for such services.

Table 23 – Employment by industry.

Industry of employment	Stockton - Fullerton Cove	%	Fern Bay	%	New South Wales	%
Defence	126	4.9	82	9.8	21,848	0.6
Aged Care Residential Services	83	3.2	30	3.6	67,209	2
State Government Administration	66	2.6	25	3	45,546	1.3
Hospitals (except Psychiatric Hospitals)	95	3.7	22	2.6	119,350	3.5

Income

In the Stockton - Fullerton Cove and Fern Bay areas median weekly incomes for people aged 15 years and older, are less than the equivalent NSW measurement. This pattern applies to personal, family and household incomes, as shown in Table 24.

Consistent with the above commentary about employment figures, these income measurements potentially highlight a small degree of economic vulnerability for the local populations. Moreover, when considering unemployment and income figures collectively, it would appear that additional income earning opportunities would potentially balance the disproportionate income relationship between the local and NSW populations.

Table 24 - Median weekly income for people aged 15 years and over

Income type	Stockton - Fullerton Cove	Fern Bay	New South Wales
Personal	590	544	664
Family	1,489	1,416	1,780
Household	1,164	1,049	1,486

Council services

Each year in April/May, PSC conducts a survey across the LGA. This survey seeks feedback from residents and visitors on their satisfaction with facilities and services provided by PSC. This annual survey is broadly representative of the population of Port Stephens. The results of the survey are reported to Councillors and staff to inform planning decisions and the allocation of resources.

Table 25 contains survey report (Port Stephens Council, 2018) results regarding the reported satisfaction with a range of Council services. The satisfaction levels can be interpreted as an indication of how attractive Port Stephens is as a ‘place’, to its residents. In each of the service categories listed, an increase in satisfaction occurred from the time of the first survey in 2012, to the latest survey in 2018, albeit with fluctuations measured during the inter-years. An exception to the trend is evident in children’s services which decreased over the sampling period.

Table 25 – Satisfaction with Council services in the Port Stephens LGA (Port Stephens Council, 2018)

All figures in the table below are percentages.

(n= 1287)	2018 Aggregate	2017 Aggregate	2016 Aggregate	2015 Aggregate	2014 Aggregate	2013 Aggregate	2012 Aggregate
Library Services	99.15	98.0	98.6	99.3.	72.4	N/A*	N/A*
Children's Services	99	87.5-100	98.3	98.0	99.6	99.8	N/A**
Ranger Services (e.g. Animal Management)	76.50	70.6	62.6	62.6	63.6	60.4	65.5
Rangers Services (Parking)	74.43	74.3	59.5	61.5	60.1	61.6	56.3
Garbage Collection Services	94.58	93.9	93.5	86.1	93.3	92.7	92.3
Access to waste depots and waste transfer stations	87.38	76.5	81.7	72.2	82.1	76.5	74.3

Safety

Perceptions of safety were also collected as part of the PSC survey. Results in Table 26 illustrate variable perceptions based on the LGA location and time of day. It is not surprising that daylight hours generated a sentiment of safety for a larger number of residents. Daylight hours were not deemed by all to generate feelings of safety however, with three residents indicating they feel unsafe at home and in their neighbourhoods during this time.

Table 26 – Perceptions of safety in the Port Stephens LGA (Port Stephens Council, 2018)

	Very safe	Safe	Moderately safe	Not very safe	Unsafe
At home during the day	672	477	119	13	3
At home at night	532	522	184	36	7
In your neighbourhood during the day	616	508	137	18	3
In your neighbourhood during the night	414	498	279	72	19

Crash and casualty statistics (see Figure 9) collected by Transport for NSW (2019) also provide an insight into safety across the LGA. These figures are also collected annually and will therefore be valuable to baseline monitoring. Between the two datasets presented in the figure, there is an obvious unexplained discrepancy in relation to the number of fatalities in 2016. Nevertheless, the data presents a spike in road deaths at this time.

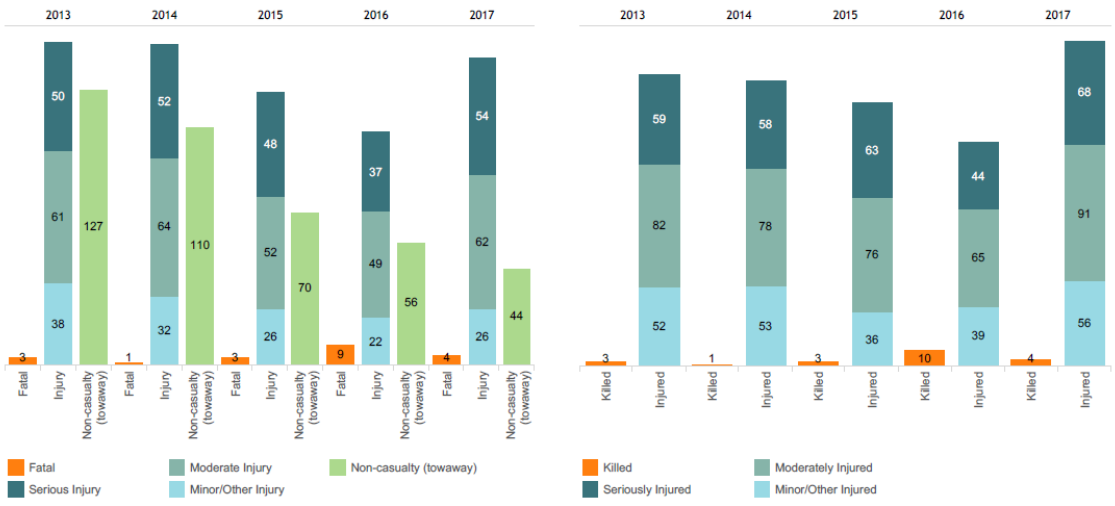


Figure 9 – Crash and casualty statistics, Port Stephens LGA (Transport for NSW, 2019)

Socio-economic index

Socio Economic Indexes for Areas (SEIFA) is a suite of indexes that have been created by the ABS from social and economic Census information.

Each index ranks geographic areas across Australia in terms of their relative socio-economic advantage and disadvantage. Figure 10 presents information from the Index of Relative Socio-economic Disadvantage (IRSD), a general socio-economic index that summarises a range of information about the economic and social conditions of people and households within the Port Stephens LGA. This index includes only measures of relative disadvantage (refer to Compelling Economics Pty Ltd., 2019, for those measures). A low SEIFA score indicates relatively greater disadvantage in general. For example, an area could have a low score if there are (among other things) many households with low income, many people with no qualifications, or many people in low skill occupations. Conversely, a high SEIFA score indicates a relative lack of disadvantage in general.

The SEIFA score for Port Stephens LGA in 2016 was 980. The scores for the smaller subset geographical areas are slightly higher, with Fern Bay achieving 984, and Fullerton Cove achieving 1035. These scores are relatively high in the range shown in Figure 10 (ie 188-1186).

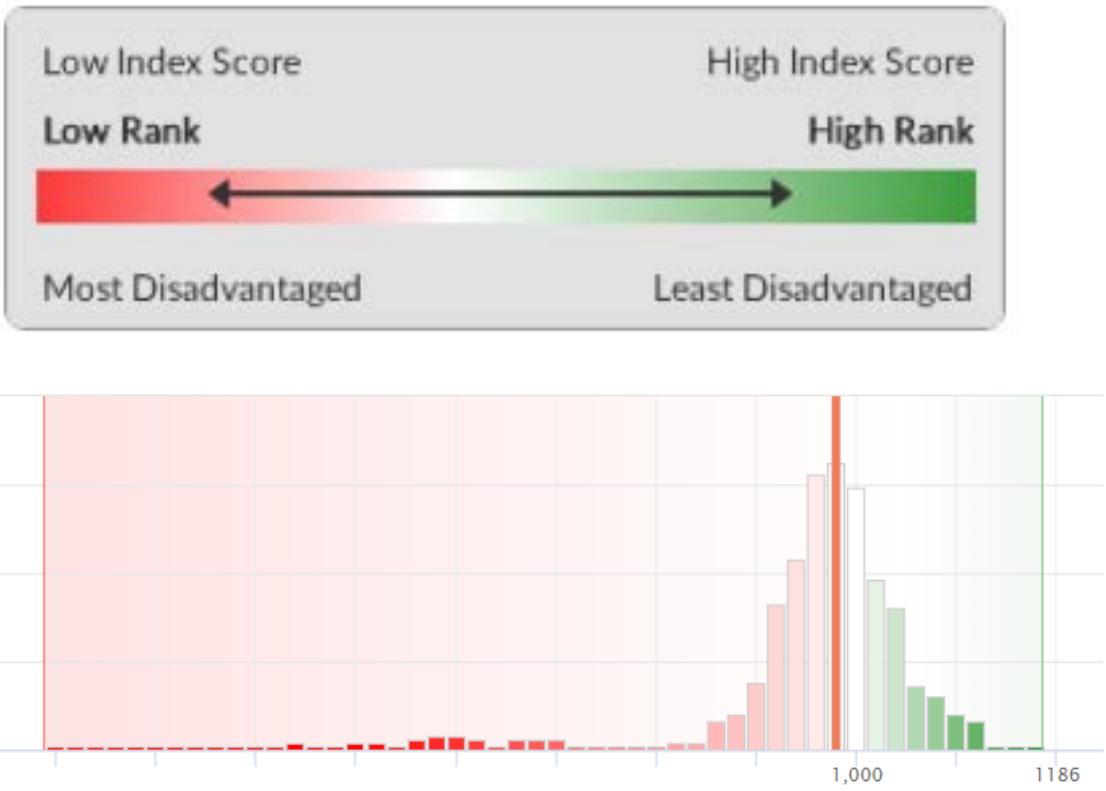


Figure 10 – SEIFA score for Port Stephens LGA (Compelling Economics Pty Ltd., 2019)

5.2.4 Governance

Management of local government resources

Interpreted as a measure of governance in the LGA, PSCs survey (refer Port Stephens Council, 2018) collected feedback about how well the authority manages its resources. The resources in

question are its workforce, its assets, and its finances. Figure 11 contains the survey results. In each case approximately 40% of survey respondents were somewhat confident that PSC was managing its resources well. Considering also the proportions of respondents that reported being confident and very confident that PSC was managing their resources well, it can be concluded that the majority of respondents are satisfied about resource management overall.

Figure 11 – Council's management of workforce, assets, and finance (Port Stephens Council, 2018)

5.3 Existing social infrastructure

Social infrastructure refers to facilities and services that enhance the social capacity of communities and may include infrastructure related to health, housing, youth, aged care, leisure, community safety facilities and road safety (Franks, 2012). As with the social indicators presented

above, the social infrastructure identified in areas surrounding the project prior to SSD approval will provide a reference point against which social impacts may be measured if the project proceeds. Such impacts can take the form of a decrease in the quantity, diversity, or capacity of the existing social infrastructure, courtesy of demand from an expanded workforce and their relatives relocating to an area. Conversely, an influx of staff and their families, or changes to the footprint of a project may stimulate new social attributes of the communities, bolster organisational capacities, and contribute to the supply of services.

The analysis conducted for this study identified a range of essential social infrastructure which underpin the social wellbeing of the population. Such infrastructure includes:

- education and child care facilities (five in total);
- community centres and town halls (four);
- art and cultural facilities (four);
- emergency and justice facilities (two);
- health facilities (four);
- aged care facilities (two);
- open space (six);
- sport and recreation facilities (seven); and
- places of worship (two).

The locations of all identified infrastructure are shown in Figure 12.

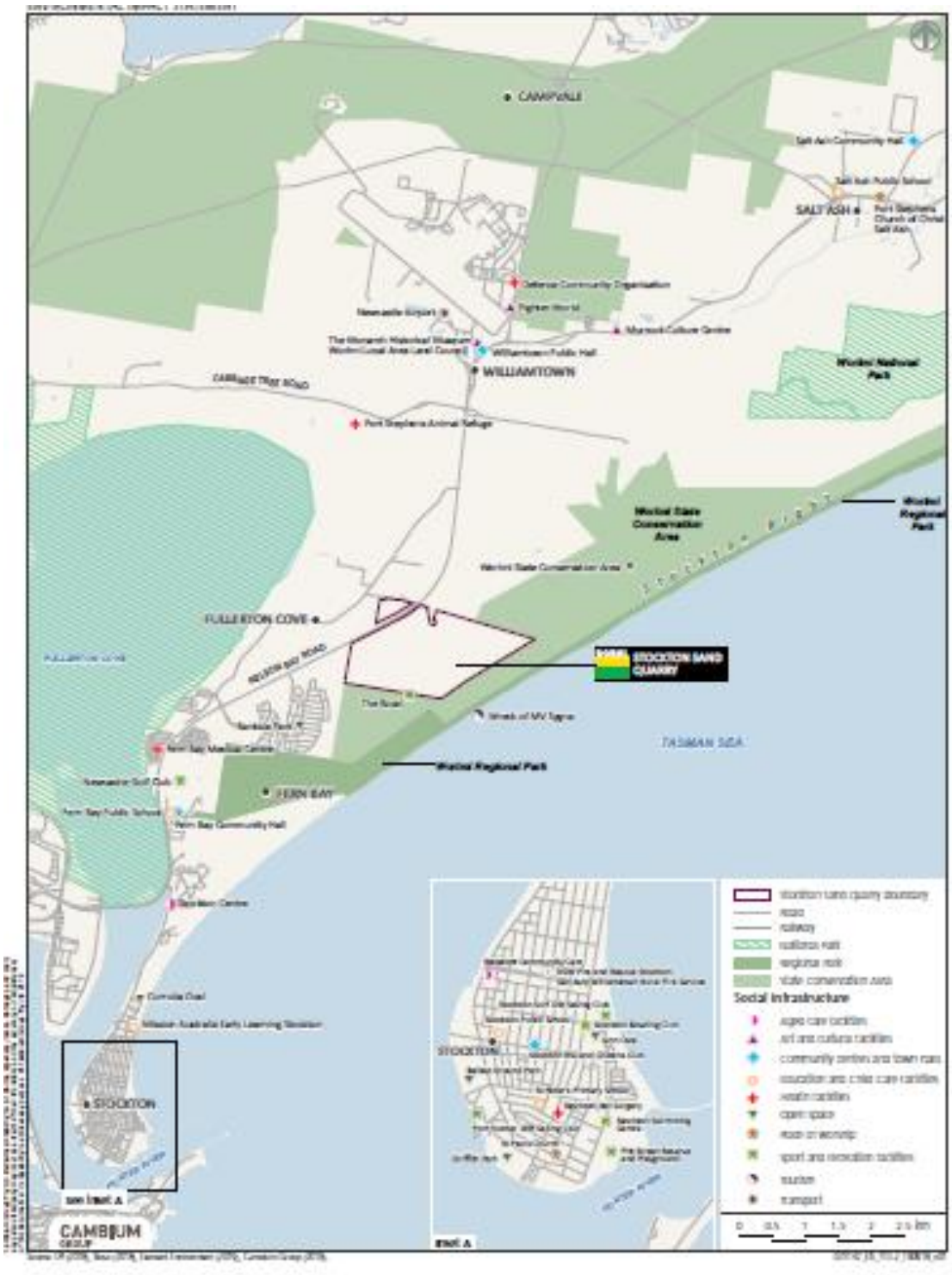
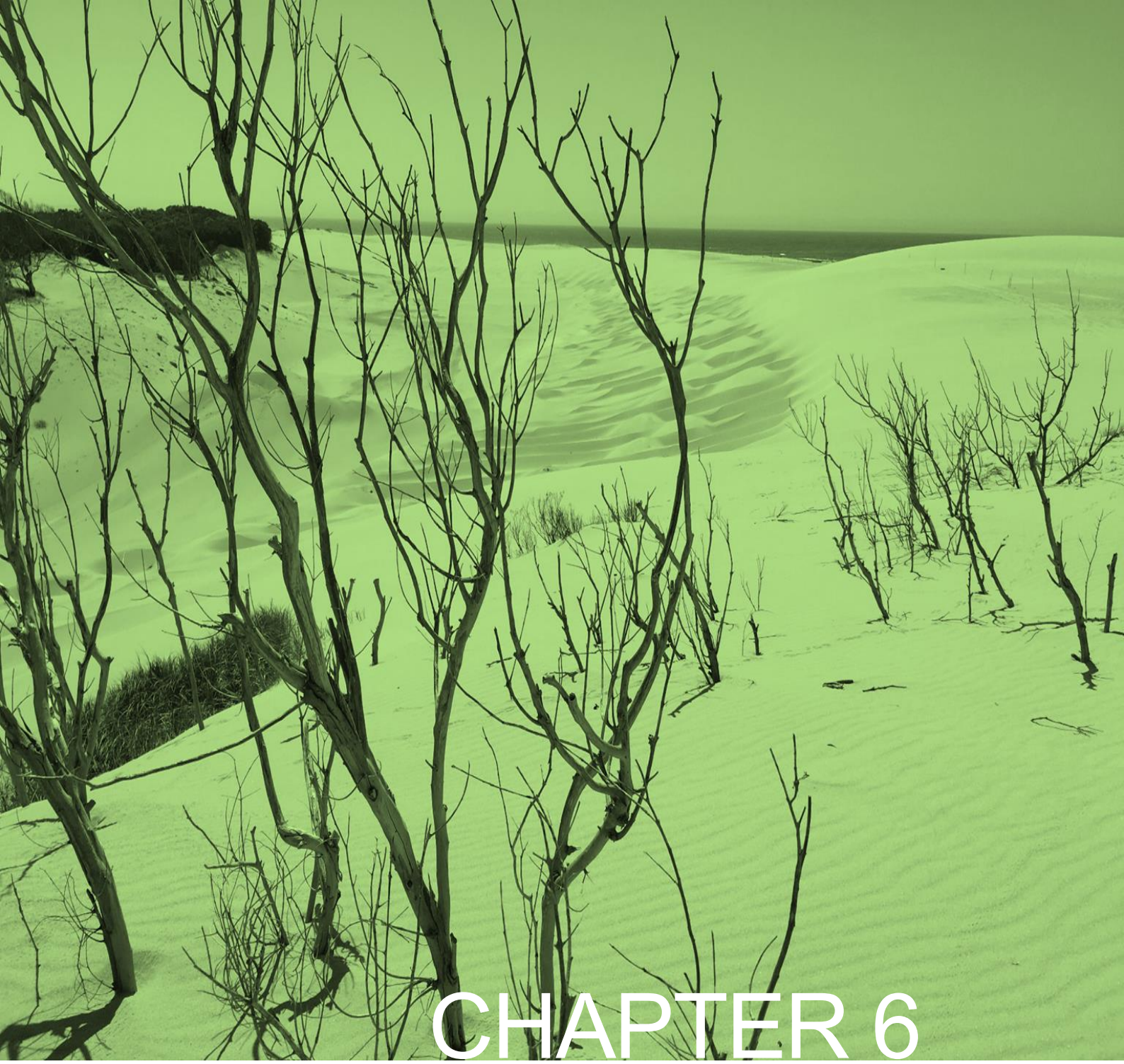


Figure 12 – Social infrastructure



CHAPTER 6

IMPACT ASSESSMENT

6 ASSESSMENT OF SOCIAL IMPACTS

In this chapter an assessment of the potential negative social impacts associated with the project has been completed on the assumption there is no mitigation. Predicted positive impacts associated with the project are also assessed below. Outcomes of the assessments are discussed according to the Social Risk Matrix contained in Appendix C3 of the Guideline (see Appendix E).

6.1 Way of life

'Way of life' was the first social impact category considered and assessed for the project. It was considered as part of the SIA scoping exercise and determined to be a category not influenced by the project. According to the Guideline, this applies to the influence of the project on how people live, work, play and interact with one another on a daily basis. It was subsequently disqualified from the SIA. Refer to the summary in Section 4.1.2 for an explanation regarding its disqualification from the SIA.

6.2 Community

Consistent with the Guideline, 'Community', including its composition, cohesion, character, how it functions, and sense of place, was considered in the SIA study. The matter was considered as part of the scoping exercise and determined to be a social impact category not affected by the project. Refer to the scoping tool results (the summary in section 4.1.2) for an explanation regarding its disqualification from the SIA.

In the absence of any contrary evidence gathered during the course of this SIA study, a range of explanations might be plausible as to why a community impact did not emerge. The size, scale and location of the project are potentially among the factors. It may be that the project is sufficiently 'hidden' from a visual and acoustic perspective (details about these findings are provided below), and that the small scale ASI does not influence public dialogue about the composition, cohesion, character, functions, or sense of place for neighbouring communities.

6.3 Access to and use of infrastructure, services and facilities

The social impact category related to access and use of infrastructure (per the Guideline), was identified in the SIA as being relevant to the project. The social matter subsets of this category that required assessment include impacts to the 1) Road and rail network and 2) Public infrastructure.

The EIS includes a comprehensive traffic impact assessment (refer Transport and urban Planning Pty Ltd, 2019). It is a specialist study which addresses the two matters above. To supplement the traffic assessment, the ECA methodology was applied for the purpose of the SIA.

6.3.1 Road and rail network

Although the scoping exercise determined that no SIA was required to assess this matter, the project team committed to an adaptive research approach at the completion of the exercise. By adopting this approach, if any EIS results (including those derived from the traffic impact assessment) isolated potential social issues regarding the road network, then detailed social assessments would have been conducted. The same adaptive approach would have been applied if negative feedback was received via further engagement activities during the EIS preparation phase.

No suggestion of social impacts related to the road network emerged from the EIS results. Furthermore, no feedback about these impacts (or sensitivity to them) was received via further engagement activities which included the community information sessions, requests for feedback made via emails to the project database, and the further engagement resident consultations made via the doorknock of residences closest to the quarry. Accordingly, the traffic impact assessment (Transport and Urban Planning Pty Ltd, 2019) was relied upon as the leading study into this matter, and further analysis via the implementation of a SIA methodology was not required.

The findings of the traffic impact assessment were favourable to the community in terms of the potential for social impacts to arise from the project, and its influence of the surrounding road network. With implications for the assessment of the likelihood, extent, duration and severity of the potential impacts, it found that:

- traffic impacts from the additional trucks associated with the project, on the adjacent road network including the principal intersections adjacent the quarry, will be satisfactory;
- future cumulative traffic impacts associated with the project, on the principal intersections until 2029, will also be satisfactory;
- construction traffic impacts are assessed as satisfactory;
- the project is not expected to have any negative impacts on other road users including pedestrians, cyclists and public transport vehicles (buses), and or on road safety; and
- after 2028, truck numbers generated by the quarry will reduce. When compared to the existing consent (DA 140-5-2006), the additional truck volumes will be 14 truck-loads (28 two-way truck movements) on an average day and 28 truck-loads (56 two way truck movements) on a maximum day. These truck movements will be spread over the road network.

Based on the above findings and submissions (NSW Department of Planning, Industry and Environment, 2020) from key agencies indicating there will be no impact on the road network, the project is predicted to have a **low social risk rating** at all stages of the project life-cycle.**.** It is considered to be immaterial and not requiring the implementation of a mitigation measure.

6.3.2 Public infrastructure

In the scoping phase, public infrastructure (or the condition of local roads) was not identified as a social matter relevant to the SIA. The condition of local roads was not raised by residents during the early or further engagement activities so feedback about this matter was extremely limited and no community sensitivity was identified. However, acknowledging the increased volume of heavy vehicles proposed for the project and the absence of a traffic impact assessment during the scoping phase, a precautionary approach was adopted. This approach involved the implementation of a standard SIA, via the ECA method. The ECA results supplement the traffic impact assessment which is now available.

Thirty-seven articles were obtained and analysed as part of the ECA (see Appendix F for the ECA protocol and list of articles), to assess the social impacts to public infrastructure. Of those articles, 27 were disqualified as they did not contain a public infrastructure discourse. The following seven discourses emerged from the ECA exercise, each conveying some negative sentiment (excluding item five) towards the social impacts of heavy vehicles using public infrastructure. The discourses listed at items 1,3, and 4 contained a reference to the condition of road pavements:

1. excessive number of quarry trucks using public infrastructure;
2. trucks have negative impacts on families and schools;
3. the introduction of additional truck movements (negative sentiment regarding road quality);
4. quarry operators should share road maintenance burden;
5. the introduction of additional truck movements (neutral sentiment regarding road quality);
6. negative impacts for community safety; and
7. sand haulage route debate.

Whilst heavy vehicles were a feature of each discourse, neither the project, the project location, Fullerton Cove more broadly, or the ASI were their exclusive focus. In other words, the discourses related to truck operations across the Port Stephens LGA, not specifically to truck operations associated with the project. These observations have implications for the assessment of social impacts under the 'access to and use of infrastructure' social impact category and the extent of the impact. They suggest that the social impacts in question are cumulative in nature. They are borne from the volume of heavy vehicles from across the region, using public infrastructure. That is, the collection of heavy vehicles sourced from multiple projects both within the ASI and beyond, are producing a negative social impact and sensitivity in relation to public infrastructure. Overall, the results of the ECA exercise illustrate a social unease in relation to the collective volume of heavy vehicles, the introduction of additional truck movements, and the road maintenance burden created by heavy vehicles for public infrastructure across an area much broader than the ASI.

ECA results aside, results of the traffic impact assessment (Transport and Urban Planning Pty Ltd, 2019) and the associated road safety audit are relevant to this matter. The audit examined the existing road pavement and the provision for heavy vehicles for the duration of the project. It assessed these against current road practice guidelines and standards, with the objective of identifying the likelihood of any real or potential road safety hazards. The audit identified a number of minor maintenance issues along the haulage route, but did not identify any specific road safety issues that required follow up. These results create a disconnect between the community dialogue about public infrastructure social impacts and the actual impacts predicted to arise from the project. They suggest these impacts are less severe, and more dominantly perceived or imagined, rather than being material.

Therefore, this social impact was assessed to have a **moderate social risk rating** during the operational project life-cycle stage. This rating was applied on the prediction that the additional heavy vehicle traffic would likely contribute to the cumulative social impact evident in media articles and the ECA results, even if that impact was one perceived by the community.

6.4 Culture

Consistent with the Guideline, 'Culture', including shared beliefs, customs, values and stories, and connections to land, places, and buildings (including Aboriginal culture and connection to country), was considered in the SIA study. The matter was considered as part of the scoping phase and determined to be a social impact category not affected by the project. Refer to the scoping tool results (the summary in Section 4.1.2) for an explanation regarding its disqualification from the SIA.

6.5 Health and wellbeing

The 'Health and Wellbeing' social impact category defined in the Guideline is relevant to the SIA in relation to two social matters. They are: 1) 'acoustic' amenity and 2) 'community safety'. For the acoustic impacts associated with the project, the scoping exercise determined that no SIA would be required alongside the noise impact assessment conducted by Wilkinson Murray (2019). In relation to community safety, the scoping exercise determined that a standard SIA would be required in the absence of any specialist study designed to investigate the matter. The PO method was applied for this purpose.

Assessment results for both social matters are provided below.

6.5.1 Acoustic amenity

The *Stockton Sand Quarry Noise Impact Assessment* (Wilkinson Murray, 2019) conducted for the project involved a detailed assessment of potential operational noise impacts. Acknowledging that

the project will generate heavy vehicle movements along Nelson Bay Road, Cabbage Tree Road and Medowie Road, it also involved an assessment road traffic noise (among other noise sources such as plant and equipment). Unattended noise monitoring was conducted to determine the existing ambient noise levels at the most potentially affected residential receivers in the area surrounding the project.

Results of the noise impact assessment describe that predicted noise levels for the project comply with the established project noise trigger levels and accordingly, no further noise mitigation measures or controls are required to be implemented. In relation to noise impacts derived from heavy vehicle movements on the surrounding road network, the predicted relative increase in noise levels are within the allowable limits, on all designate access routes. In summary, the predicted noise levels for the project are compliant with relevant legislation and standards.

From a social impact perspective, the project is predicted to have a **low social risk rating** in all stages of the project life-cycle. The risk is considered to immaterial and not requiring the implementation of a mitigation measure. This determination was made in consideration of the Wilkinson Murray (2019) findings which directly assessed characteristics of the potential noise impacts (ie extent, duration and severity), and also the fact that no noise concerns or issues were raised by stakeholders in the consultation and engagement activities conducted for the project or in submissions (refer NSW Department of Planning, Industry and Environment, 2020) from government agencies. The likelihood that an impact would emerge if the project is approved is considered to be low, and no receiver sensitivity was identified.

6.5.2 Community safety

Results of the PO exercise show that 17 participant events were observed by the quarry staff. Of these, two events involved actual instances of unauthorised access to the site during the observation period, from early January to late March 2019. For all other instances, members of the public did not enter the quarry and there is every possibility that the participants involved were merely using the public road[6] with no intention of accessing the quarry. They either turned away voluntarily at the quarry entry, some having read the signage (see Figure 13 and Figure 14) on display, or were prompted by quarry staff to turn away. A summary of the other characteristics of the recorded instances are provided in Table 27.

[6] During the PO exercise, quarry staff explained that Google maps currently provides directions to Stockton Bight beach and the Sygna via Cox's Lane. This is likely to draw members of the public to the quarry entrance. Boral have requested that Google correct this and remove the directions from their mapping software. The request was accepted, yet at the time of writing there was no change to this situation. Boral has advised that the matter is being actively followed up.

Figure 13 – Beach access signage

Figure 14 – Warning signage

An analysis of the data in Table 27 was made in respect to the three PO research questions. The questions and analysis results are below.

1. *Do the participants seem to be intentionally or unintentionally accessing site?*

During the observation period, PO results indicate that intentional or unintentional site access did occur, albeit for a small percentage (12%) of the recorded instances.

2. *What was the known or predicted purpose of those people attempting to access the project site?*

The purpose of the persons who accessed the site without authority is known for only one of the two recorded instances. Results indicate that the person involved on this occasion was intending to access the beach. Based on the conversation held with the member of the public, quarry weighbridge staff describe that the person was:

> "in a rush…[I] stopped the car as it was heading through the compound...[the] driver seemed to be late to pick people up from the beach. [I] advised him where the beach access was and he proceeded off site" (quarry weighbridge operator).

The purpose of the second person who accessed site is not known, as quarry staff were not able to have a conversation or determine with certainty what intention that person held.

As shown in Table 27, on five other occasions the travel mode of persons who were potentially interested in site access was travel by foot, horse, and bicycle. The implied purpose in each case was recreation, however there is no evidence to verify this.

3. *Was the safety of those who accessed the project site put at risk?*

In the two instances of unauthorised site access, there was no immediate safety risk to the members of the public. The weighbridge staff were able to alert the people to quarry operations, either by gesture or conversation, and advised them to leave the quarry in a safe manner. Members of the public then departed voluntarily. The cause of risk in these events rests entirely with members of the pubic who choose to undertake their recreational pursuits whilst ignoring the prominent warning signage and/or communications of quarry staff.

After considering and assessing the PO results, **a moderate social risk rating** is considered to be adequate for the project, applicable at all life-cycle stages of the project. This rating is nominated by recognising the characteristics of the impact:

- likelihood: without mitigation it is possible that a community safety incident (with moderate consequences) could occur if the project is approved;
- extent: if the project is approved, community safety impacts would not extend to a larger geographical area than the one associated with the project at present;
- duration: the timeframe in which the risk would exist would be extended if the project is approved;
- severity: the scale of community safety impacts would not increase if the project is approved; and
- sensitivity: susceptibility of people to community safety risks would not increase if the project is approved.

Table 27 – Summary of PO results

Event number	Date	Caucasian or other appearance	Age group (adult or youth)	Number of people	Travel mode	Route	Displayed awareness of site or recognition of warning signage?
1	14/01/2019	Caucasian	Adult	2	Horse	Coxs Lane only	No
2	17/01/2019	Unknown	Adult	1	Walking	Coxs Lane only	No
3	17/01/2019	Unknown	Adult	1	Bicycle	Coxs Lane only	No
4	18/01/2019	Unknown	Unknown	Unknown	Car	Coxs Lane only	Yes, read signage
5	18/01/2019	Not Caucasian	Unknown	Unknown	Car	Coxs Lane only	Yes, read signage
6	22/01/2019	Unknown	Adult	2	Car	Coxs Lane only	Yes
7	22/01/2019	Unknown	Adult	2	Car	Coxs Lane only	Yes, read signage
8	23/01/2019	Unknown	Adult	2	Car	Coxs Lane only	Yes
9	23/01/2019	Unknown	Adult	2	Car	Coxs Lane/Compound access road	Yes
10	24/01/2019	Unknown	Unknown	1	Bicycle	Coxs Lane only	Yes
11	24/01/2019	Unknown	Adult	2	Car	Coxs Lane/Compound access road	Yes, read signage
12	24/01/2019	Unknown	Adult	2	Car	Coxs Lane/Compound access road	Yes, read signage
13	25/01/2019	Unknown	Adult	1	Bicycle	Compound access road	No
14	29/01/2019	Unknown	Adult	2	Car	Coxs Lane/Compound access road	Yes
15	18/02/2019	Caucasian	Adult	1	Car	Through compound	Yes, after alert from staff
16	6/03/2019	Unknown	Unknown	2	Car	Coxs Lane/Compound access road	Yes
17	12/03/2019	Caucasian	Adult	1	Car	Coxs Lane only	Yes

6.6 Surroundings

As subsets of the 'Surroundings' social impact category, two social matters were determined to be relevant to the SIA. They are 1) 'visual amenity' for recreational dune users of Stockton Bight Beach and 2) 'heritage (natural features)'.

No specialist study was conducted as part of the EIS to investigate the potential visual amenity impacts of the project, and the scoping exercise determined a standard SIA was required. Accordingly, a semi-structured interview and the VIA method demonstrated by Andrews et. al. (2012) were applied. In relation to heritage (natural features), the interface between the Indigenous community and the dune areas adjacent the project which encompass the Worimi Conservation Lands, formed a focal point of the scoping exercise. For the purposes of the SIA, it was determined that further engagement with the Worimi WLALC was required in relation to the heritage matter. This was in addition to the Aboriginal cultural heritage assessment of the project.

Assessments of these matters are below.

6.6.1 Visual amenity

At the site visit conducted for the purpose of the VIA, the photograph displayed in Figure 15 was taken at a location within the quarry boundary that was above the highest point of the publicly accessible area of the dune system adjacent to the quarry. Given that recreational dune users are not authorised to breach the boundary rope and access the vantage point depicted in the photograph, there is no option for them to gain a better vantage point of the quarry and proposed project site, unless they access the site without authorisation.

In Figure 15 the project site is not visible. It exists in an area of the quarry that is a substantial distance behind the vegetation visible in the background of the photograph, and that area is characterised by a surface depression. As a result, the project site is completely obscured by the vegetation.

After the visual impact results described above were considered in relation to the receiver (ie the dune user), the Andrews et. al. (2012) visual assessment method was applied. The conclusion reached was that visual impact at the dune vantage point ranks as negligible. This decision was made on the basis that the rating for all criteria is low.

Figure 15 – Highest viewpoint on the dunes with a view towards the proposed dredge pond location

Aside from the VIA outcome, results of the semi-structured interview facilitated an assessment of potential visual amenity issues, and the associated social impacts for recreational dune users at

Stockton Bight. The following extracts from the interview overwhelmingly indicate that the potential for a visual impact to be created by the project is negligible:

> "The only thing we see is the danger tape and I wouldn't describe that as an eyesore".
>
> "To be honest we [quad bike riders] don't stop there…we're running past there and customers don't have a chance [to see the quarry]".
>
> "I don't even know why it's coming up on the radar as a visual impact…you'd need to talk to the pilots from Williamtown airport about that [laughter]".
>
> "We take twenty odd thousand [quad bike] customers along there, and I'm not aware of any concerned by the danger tape [causing] a visual impact" (owner, quad bike adventure company).

On the basis of the VIA, semi-structured interview, and engagement results, the SIA determined that a **low social risk rating** is most suitable for the potential visual amenity impacts predicted for the project. This rating would apply at each of the project life-cycle stages. Furthermore, the risk is considered to be immaterial and would not necessitate the implementation of a mitigation measure.

The social risk rating for this matter was nominated taking into account the characteristics of the potential impact:

- likelihood: if the project is approved, there would be a rare visual impact likelihood and the consequence would be minimal;
- extent: if the project is approved, visual impacts would not extend to a larger geographical area than the one associated with the project at present;
- duration: the timeframe in which the (immaterial) risk would exist would be extended if the project is approved;
- severity: the scale of visual impacts would not increase if the project is approved; and
- sensitivity: susceptibility of people to visual impacts would not increase if the project is approved.

6.6.2 Heritage (natural features)

Further engagement with Worimi LALC did not yield any specific feedback in relation to potential social impacts (considering extent, duration, severity and sensitivity impact characteristics) likely to be caused by the project. This applies broadly to Aboriginal heritage matters, and more specifically to natural heritage features being the sand dunes where the Worimi LALC operate quad bike tour business, Sand Dune Adventures. In conversation with the CEO Worimi LALC, Boral's Indigenous Affairs Manager agreed to the request to include nominated stakeholders in future communication campaigns. Consultation with Worimi LALC also occurred during Aboriginal cultural heritage assessment process. Consultation with the 19 registered Aboriginal stakeholders identified that the local area has cultural heritage value to the local Aboriginal community. The Aboriginal cultural heritage assessment report (Kelleher Nightingale Consulting, 2019) states that Aboriginal stakeholders expressed the cultural importance and significance of the vegetated hind dune landscape around the study area. Importantly, the report states that no specific Aboriginal cultural values were identified within the study area.

Noting the absence of concerns expressed by the Worimi LALC or other Aboriginal persons during the scoping and EIS preparation phases, and the Kelleher Nightingale Consulting (2019) findings, the SIA determined a **low social risk rating** was applicable to the heritage aspect of the project, at each of its life-cycle stages. The risk is sufficiently low to be immaterial and not requiring the implementation of a mitigation measure.

6.7 Personal and property rights

Two social matters related to the 'Personal and property rights' social impact category qualified for analysis for the SIA. They are 1) Economic (natural resource use) and 2) Economic (Livelihood). To investigate these two and other potential economic impacts of the Project for the EIS, Gillespie Economics (2019) conducted the *Stockton Sand Quarry Dredging Economic Assessment*. Subsequently, the scoping exercise determined that desktop research would be adequate to assess the above two social matters. Assessment results for each matter are provided below.

6.7.1 Economic (natural resource use)

There is a shortage of natural fine sand supply in the local and regional economy, and it is relevant to the SIA that the project will provide a partial remedy to this situation. Natural fine sand is an essential component to construction materials and consequently, to local and regional development projects. The project presents an opportunity to maintain supply at a cost-effective price.

Boral's existing operation supplies sand to at least seven concrete batching plants in the Hunter region. Products made in the batching plants in turn supply building materials to their surrounding local communities on a commercial basis. Boral also supplies sand to community groups on a voluntary non-commercial basis. In the past and over a long period, it has made valuable donations to community, school, and sport organisations in the local area (including in the ASI) for a range of civic purposes (see Appendix G for examples). Through these commercial and non-commercial supply chains there is a direct social benefit to local residents and this benefit would continue if the proposal is approved. The opposite scenario would arise if the proposal is not approved.

Gillespie Economics (2019) make further comments about the benefit of the project in relation to its contribution to find sand supply. The assessment states that:

> "demand for sand is dependent on there being a demand for some other product, such as concrete, cement, asphalt and construction materials, which in turn is dependent on demand for construction. With the significant increase in approved infrastructure projects in Sydney and other parts of NSW, the leading suppliers of sand are under pressure to meet this increased demand" (p.7).
>
> "Sand is a high bulk-low cost commodity and hence it is preferable for it to be located close to markets to minimise transport costs. A shortage in the supply of construction sand for the Sydney market has been predicted for many years as access to local onshore sources of construction sand has become increasingly difficult through resource depletion eg Penrith Lakes, and increasing land use constraints surrounding potential alternative sources. In the short term, demand for construction sand can be met by increasing production from existing sources, including Stockton sand quarry" (p.7).
>
> "A CBA [cost benefit analysis] of the Project indicated that it would have net social benefits to Australia of $41M, and net social benefits to NSW of $17M. Hence the Project is desirable and justified from an economic efficiency perspective" (p.7).

According to the analysis above, it is predicted that the project will yield a positive impact from an Economic (natural resource use) perspective. This prediction is made on the basis that the level of interest (ie local and regional sand customers, local beneficiaries of Boral donations), scale of benefit to both local and regional populations, equity in the distribution of the benefit to at least

seven batching plants across the Hunter region, and likelihood of the benefit is forecast to be **high.**

6.7.2 Economic (livelihood)

An obvious positive impact of the project would be the extension of local employment for the five current quarry employees, and the employment of four additional staff. Interviews with Boral management confirmed the current quarry employees are locally-based. Although this workforce is not large, it must be recognised that the maintenance of employment for a single staff member would enable an income for the household unit of that employee. In this scenario, the number of people benefitting from the project would be larger than the nine individuals employed by the project. Employment for the Project workforce will ensure income for the associated families (or housemates as the case may be).

In a deeper analysis of this matter, Gillespie Economics (2019) found that:

> "The project will provide continued quarry employment for approximately five (four full-time and one casual) employees currently on-site and another four (two full time and two casual). The project is also estimated to provide continued transport employment for 17 people from the local area, plus employment for an additional nine people from the local area.
>
> Economic activity analysis, using IO analysis, estimated that quarry production at 750,000 tonnes per annum (tpa) relative to 500,000 tpa is estimated to make up to the following incremental contribution to the regional economy: $5 M in annual direct and indirect regional output or business turnover, $3 M in annual direct and indirect regional value added, $1 M in annual direct and indirect household income, and nine direct and indirect jobs" (p.3).

The SIA baseline identified a potential small degree of economic vulnerability for Fern Bay and Stockton-Fullerton Cove residents in terms of income and employment, relative to the NSW population. If approved, it is forecast that the project would enable the realisation of positive employment and economic impacts described above. Noting the vulnerability of local populations illustrated by the baseline figures, this outcome would potentially balance the disproportionate income relationship between the local and NSW populations. There would likely be positive flow-on social implications from the new and ongoing employment opportunities, such as providing individuals and households associated with the project the opportunity to sustain themselves in a weaker-than-average economy.

Finally, notwithstanding the presence of the existing quarry in the local area its past contribution to local livelihoods for more than a quarter of a century, there is potential for the proposal to positively influence livelihoods and social cohesion in future. The minor increase in employment could encourage social cohesion in the community by expanding the number of local families connected to the project and strengthening social networks. Another positive impact would be the continuance of Boral's donations to local community groups. Fern Bay Primary School is the recipient of the latest donation which will be used to improve outdoor play equipment. If the proposal was refused, then positive livelihood impacts like these would not be realised. Considering the information obtained for this aspect of the SIA, a positive 'Economic (Livelihood)' social impact for the local population is predicted. The level of interest among current and prospective employees in an area of underemployment, scale of benefit, equity in the distribution of the benefit to a disadvantaged employment market, and likelihood of the benefit is forecast to be **moderate**.

6.8 Decision-making systems

‘Decision-making systems’ is the social impact category that relates to the influence that individuals have on decisions that affect their lives, and access to complaint, remedy and grievance mechanisms. This category did not emerge in the scoping exercise as one that was potentially affected by the project, or one that required attention in the SIA. It was subsequently disqualified from the SIA for the reasons outlined in the summary in Section 4.1.2.

6.9 Fears and aspirations

According to the Guideline, the final social impact category assessed during the SIA was ‘Fears and Aspirations’. The category relates to one or more of the social impact categories discussed previously, or fears about the future of the communities surrounding the project. As per the other social impact categories, ‘Fears and Aspirations’ of the community was a focus of the scoping exercise, but it did not emerge as a category likely to be influenced by the project. It was treated the same way as other social impact categories deemed to be irrelevant and was disqualified from the SIA. Again, the rationale for its disqualification is provided in Section 4.1.2.

CONCLUSION AND RECOMMENDATIONS

7 SIA CONCLUSION AND RECOMMENDATIONS

This chapter presents the conclusion and recommendations of the SIA. The conclusion identifies the predicted positive social impacts, and only those negative social impacts of the project deemed in the previous chapter to be material. Where material negative impacts are forecast, there are measures available to mitigate them which would improve the social risk ratings allocated in the impact assessment chapter. These measures are identified in the recommendations section below.

7.1 Conclusion

This SIA report outlines the process implemented to identify, predict, evaluate, and develop responses to the social impacts of the project. The report exists as a specialist study developed to support the overall EIS and SSD application.

Boral owns and operates the quarry, a long-standing operation that currently extracts sand from the windblown (transgressive) sand dunes of Stockton Bight, and transports up to 500,000 tonnes of sand product per year for use in the building, landscaping and construction markets. Due to current and predicted future demand for sand in the local Hunter and Sydney regions, Boral is seeking approval for continued and expanded operations at the site through a SSD application. The project involves the extraction of sand from the inland vegetated dunes by front-end loader/excavator in Stage 1 and subsequent dredging. The project would seek to permit a site wide increase on the dispatch limit to 750,000 tpa (ie the windblown sand extraction area and the project operations combined) up until 2028, after which the site wide limit would reduce to no more than 500,000 tpa. The project would be for a period of up to 25 years.

The project's ASI encompasses the nearest communities to the quarry including properties in Fern Bay and Fullerton Cove, and a small portion of the sand dune system adjacent to the project site. Coxs Lane and Nelson Bay Road (from its intersection with Seaside Boulevard to its intersection with Cabbage Tree Road) are the prominent roads associated with the project. Although the project is located in the Port Stephens LGA, Newcastle is the major city nearby. As the regional centre of the Hunter, Newcastle has strong historic links to extractive industries. However, during the last two decades, the region has experienced structural economic changes, diversifying from its traditional extractive industry base to other economies including defence, education and service industries. The Port of Newcastle, Newcastle Airport, and heavy rail links facilitate the transport of freight and passengers across this region of coastal and hinterland tourist destinations.

The social baseline for the project provides a socio-economic description of the Fern Bay and Stockton-Fullerton Cove populations in comparison to the NSW population. It is clear an older population resides in both Fern Bay and the Stockton – Fullerton Cove areas in comparison to broader NSW. In the study area, the average number of children per household, people per household, incomes, and motor vehicles per dwelling are smaller than the NSW averages. Across NSW there are more families (either couples or single parents) with children than in the geographies closest to the project. These statistics underscore the older demographic and relatively smaller number of dependent children in the local area. The Indigenous populations in the geographies nearest the project are not drastically different to the proportion of Indigenous people residing in NSW as a whole. The same cannot be said of a range of other socio-economic indicators however, including multi-culturalism (eg less Mandarin speaking individuals in the study area), employment (eg less people working), and income (less income).

A range of engagement and SIA methods were used to collect and analyse information to determine the potential for social impacts as a consequence of the project. Results of the SIA

analysis were considered according to the social impact categories defined in the Guideline. Of those categories, four were determined to be relevant to the project:

1. access to and use of infrastructure, services and facilities;
2. health and wellbeing;
3. surroundings; and
4. personal and property rights.

The project is predicted to yield limited positive and negative socio-economic impacts for the regional and local populations across these categories, as identified in Table 28. In terms of the predicted positive economic impacts associated with natural resource use, the project would likely have substantial effects (without any enhancement). Ensuring the supply of 'fine' sand will provide security to the building and construction industry both locally and regionally, and mitigate the potential shortage of an essential building product. Without enhancement, there are also positive impacts related to the economic livelihood of quarry employees. Although there are only a small number of employees associated with the project, employment benefits in the form of income will spread to other members of the respective households. Employment is weaker in the study area compared the NSW average, so small employment gains in the local area cannot be understated.

The predicted negative personal safety social impact is localised (ie at property). The other is both cumulative and perceptual in nature. Some mitigation measures are available to address these predicted negative project impacts. The measures are identified in the recommendations below.

Table 28 - Predicted positive and negative social impacts

Social impact type	Social impact category	Predicted social impact
Positive	Personal and property rights	Mitigation of a potential shortage of natural fine sand supply in the local and regional economy
		Employment benefits in the form of income for quarry employees and their households
Negative	Access to and use of infrastructure, services and facilities	Community perception of cumulative impacts to road quality caused by heavy vehicles, per the ECA results
	Health and wellbeing	Personal safety impact to members of the public that access site without authority

7.2 Recommendations

It is recommended that the measures nominated below are implemented to offset the predicted negative social impacts of the project.

7.2.1 Access to and use of infrastructure, services and facilities

An increase in the volume of heavy vehicles using local roads, and the perceived or actual negative influence of those vehicles on road pavement quality, are social risks identified by this SIA through the ECA only (as opposed to direct feedback during engagement activities). These social risks have been thoroughly considered and documented in this SIA, the EIS and associated technical studies. The EIS will be placed on public exhibition and all stakeholders will have the opportunity to view how these social risks have been assessed, and the proposed mitigation and management measures to address them. When the EIS is placed on public exhibition it is recommended that:

- Fullerton Cove residents are notified in writing about the availability of the EIS on exhibition, the increased truck volumes derived from the project, where these matters are addressed in the EIS, SIA and technical studies, how/where they can view the documentation, and an invitation to contact Boral to discuss any residual or additional concerns they may have; and
- Boral places a notice on the project webpage (and sends the web link to the notice via other media channels typically used throughout the SSD stakeholder engagement process) to notify stakeholders about the EIS exhibition process as outlined above.

In both of these EIS exhibition phase notification initiatives, Boral should refer to the increase in truck numbers proposed for roads used by project vehicles, and the high-level results of the road safety audit.

7.2.2 Health and wellbeing

The SIA concluded that potential personal safety risks remain in relation to unauthorised site access. Boral has taken all reasonable and necessary steps to ensure the security of the site and the safety of the public. All quarry staff are trained in operational safety requirements and are aware of their safety obligations in relation to staff and members of the public. This includes their role in protecting people who may inadvertently use the private access road that extends from Coxs lane or attempt to access the site without authority. This would continue if the Proposal is approved.

To maintain safety, staff efforts and quarry features include security fencing and lockable gates, high visibility line and signage, CCTV, safe batter requirements, trespass procedures, and operating hours, yet a small number of people continue to access site without authority.

With other options exhausted, this SIA recommends that the initial request made to Google be repeated with the objective of removing the Stockton Bight beach route (via the quarry) from Google maps. Achieving that objective would potentially dissuade members of the public from attempting to access the quarry without authority.

7.2.3 Summary of negative impacts and recommended mitigation measures

The negative social impacts predicted for the project, their description, and recommendations outlined to address them are summarised in Table 29. Should the recommendations be implemented, lower social risk ratings would be achieved. Some low residual risks would remain. Of these risks, the risk to personal safety would be immaterial.

Table 29 - Summary of negative impacts and recommended mitigation measures

Social Impact Category	Impact Description			Impact without mitigation		Impact with mitigation		
	Impact	Timing	Affected parties	Impact characteristic	Social risk rating	Mitigation	Social risk rating	Residual risk description
Access to and use of infrastructure, services and facilities	Impact to condition of public roads	Operational	Road users (roads surrounding the project)	Cumulative (perceived or actual) risk of additional heavy vehicle traffic affecting road quality	Moderate	Written notification about the availability of the EIS on exhibition, including the dissemination of EIS information about project heavy vehicles	Low	Low
Health and wellbeing	Impact to personal safety	Operational	Unauthorised community members	Personal safety risk from unauthorised site access	Moderate	The initial request made to Google is repeated with the objective of removing the Stockton Bight beach route (via the quarry) from Google maps	Low (if Google maps is corrected)	Low and immaterial (if Google maps is corrected)

7.3 Management and monitoring framework

The mitigation measures summarised in Table 29 should be implemented as part of a broader management and monitoring framework for the quarry. A range of management plans will be developed or updated as part of the project operations, and those addressing safety issues will assist with the management of the negative project impacts identified in Table 29. The management plans may include the:

- environmental management strategy;
- air quality management plan; and
- safety management plan.

Aside from the various management plans, performance measures applicable to the management framework are listed in Table 30, along with the measure type defined in the DPIE assessment and mitigation framework (NSW Department of Planning and Environment, 2017). Community sentiment derived from stakeholder feedback exists as a performance measure and is additional to those listed in Table 30.

Table 30 – Performance measures

Social impact category	Objectives	Affected parties	Actions	Performance measures	Measure type
Access to and use of infrastructure, services and facilities	Counter cumulative and perceptual risk of increased heavy vehicle volumes	Road users (roads surrounding the project)	Written EIS exhibition notification to Fullerton Cove residents	Distribution of notifications to stakeholders during EIS exhibition	Prescriptive[7]
			Provision of notification via web link, to disseminate EIS information about Project heavy vehicles		
Health and wellbeing	Mitigate personal safety risks for people attempting to access the quarry without authority	Unauthorised community members	Repeat the initial request to Google with the objective of removing the Stockton Bight beach route (via the quarry) from Google maps	Google maps is correct	Prescriptive

7.4 Monitoring

A social impact monitoring framework would apply to all phases of the project life-cycle. Monitoring results would be disclosed via the submission of an annual environmental management report (the principal reporting mechanism for the project). The report would be prepared and submitted to DPIE in accordance with conditions of the new SSD approval and would include reporting on all key matters assessed in the EIS.

Table 31 outlines the social issues which will be monitored to ensure compliance and meet the social objectives. In accordance with the Guideline, the table outlines the:

- key social issues to be monitored;
- how and when monitoring data will be collected; and
- community participation.

Although not included in Table 31, the project complaints register is an additional data source that applies to each social issue and provides value to the monitoring framework. The register will continue to operate and provide data in relation to each social issue should a complaint be submitted.

[7] Actions that need to be taken or things that must not be done, for example, adopt a known best-practice technology, design or management approach to mitigate the impact.

Table 31 – Monitoring framework

Social impact category	Social issue	Data source	Data availability / frequency
Access to and use of infrastructure, services and facilities	Road user satisfaction	Council feedback	As available
		Feedback received via Boral corporate communications channels or quarry staff	
Health and wellbeing	Community safety	Quarry staff and CCTV	Constantly during business hours (weighbridge staff) and after hours (CCTV)

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APPENDIX A

Social impact categories from section 1.1. of the Guideline (NSW Department of Planning, Industry and Environment, 2017)

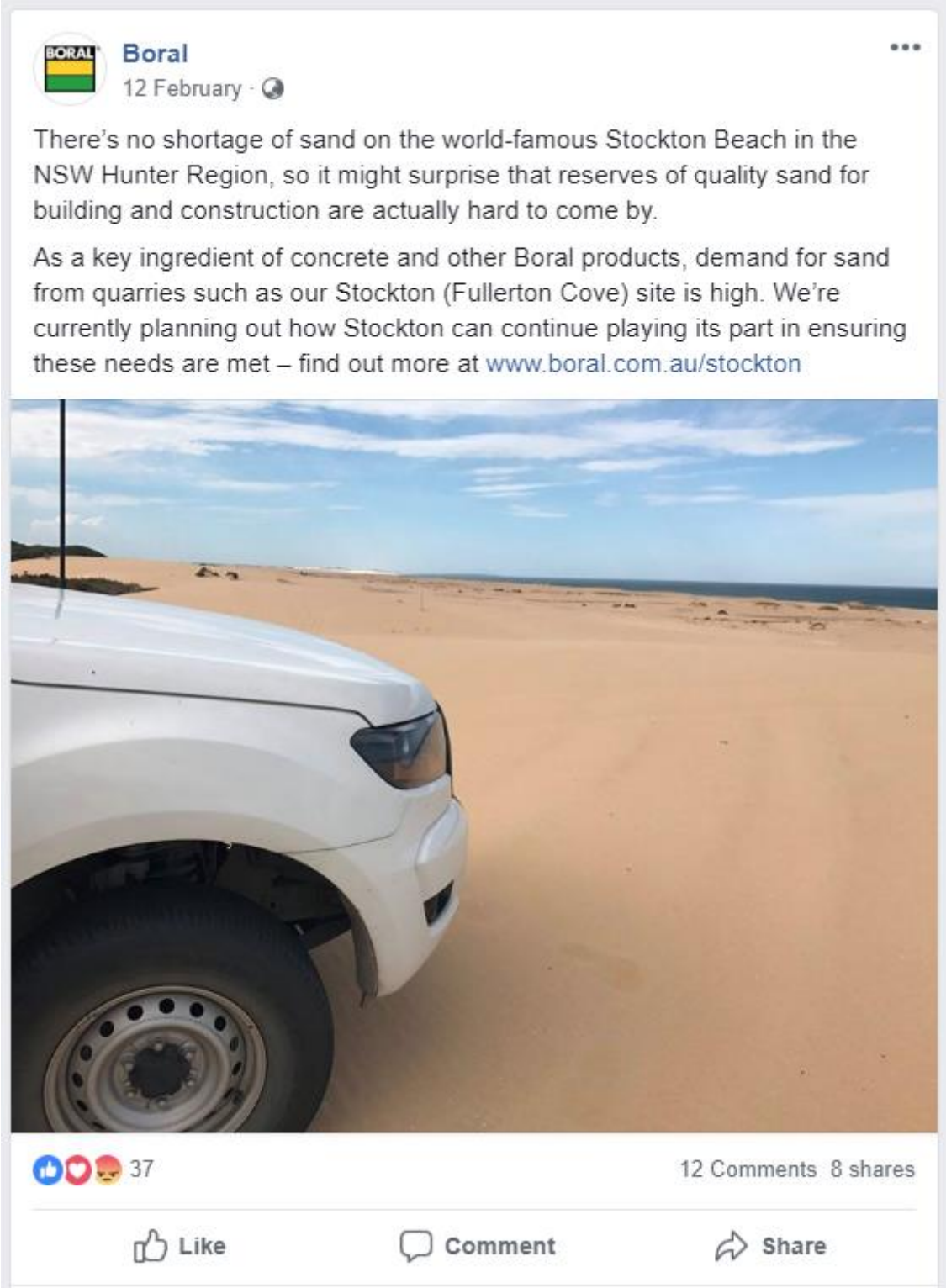
1.1 What are social impacts?

In the context of this guideline, a social impact is a consequence experienced by people[5] due to changes associated with a State significant resource project. As a guide[6], social impacts can involve changes to people's:

- **way of life**, including:
  - how people live, for example, how they get around, access to adequate housing
  - how people work, for example, access to adequate employment, working conditions and/or practices
  - how people play, for example, access to recreation activities
  - how people interact with one another on a daily basis
- **community**, including its composition, cohesion, character, how it functions and sense of place
- **access to and use of infrastructure, services and facilities**, whether provided by local, state, or federal governments, or by for-profit or not-for-profit organisations or volunteer groups
- **culture**, including shared beliefs, customs, values and stories, and connections to land, places, and buildings (including Aboriginal culture and connection to country)
- **health and wellbeing**, including physical and mental health[7]
- **surroundings**, including access to and use of ecosystem services[8], public safety and security, access to and use of the natural and built environment, and its aesthetic value and/or amenity[9]
- **personal and property rights**, including whether their economic livelihoods are affected, and whether they experience personal disadvantage or have their civil liberties affected
- **decision-making systems**, particularly the extent to which they can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms
- **fears and aspirations** related to one or a combination of the above, or about the future of their community.

APPENDIX B

Boral Facebook post



[redacted]
Been to Stockton to pick up a load before great place and nice people 👍

Like · Reply · 1 y

[redacted]
Does Boral have any plans to develop alternatives such as manufactured sand ?

Like · Reply · 1 y

[redacted]

1

Like · Reply · 1 y

Author

Boral

Hi [redacted] thanks for your question 🙂 Boral is one of the leading organisations in the production and development of Manufactured Sands in Australia. This development has significantly reduced Boral's reliance on 'natural' sand, however we cannot eliminate it completely due to the quality and performance requirements of our concrete products. Please let us know if you would like more info via PM and we'll have the relevant team contact you 🙂 Regards, Desiree.

1

Like · Reply · 1 y

Write a reply...

[redacted]
Leave Stockton beach alone ffs

8

Like · Reply · 1 y

[redacted]
We as a community should be prepared to work with all stakeholders for a mutually beneficial solution. One that would get my support would be if the Port Stephens council were to receive concrete at a super discounted rate to allow for paths, cycleways, gutters, etc.

Like · **Reply** · 1 y

2

[redacted] [redacted] worth a try I thought perhaps someone at Boral has a sense of adventure and becoming trendsetters 😉

Like · **Reply** · 1 y

Write a reply...

[redacted]
We make truexterior siding with fly ash, aka coal ash, a Boral siding and trim. I hear our waste is being used in other building products.

Like · **Reply** · 1 y

Author

Boral

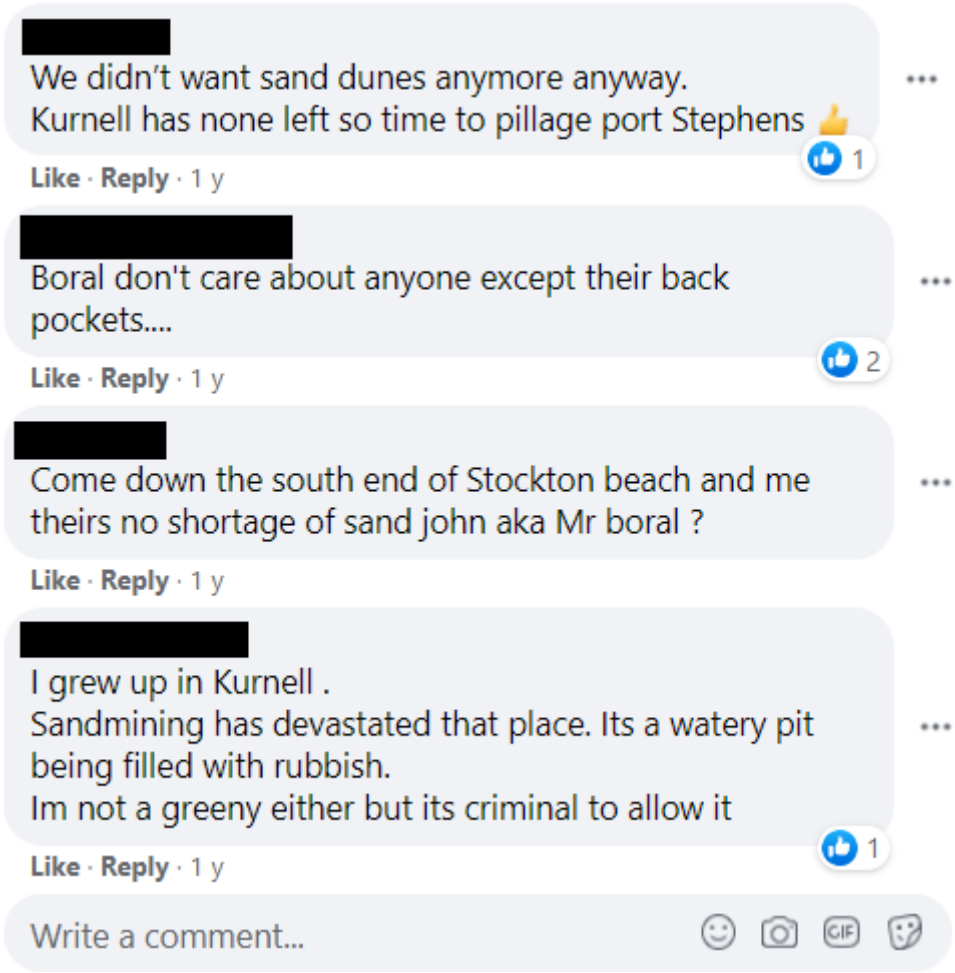
Hi [redacted] thanks for your comment 😀 There are a number of different Boral products which make secondary use of waste materials such as fly ash, including road bases, drainage aggregates, concrete products, pipe beddings and many more. See more here 👉https://bit.ly/2Eb9Drb Regards, Desiree

BORAL.COM.AU

Alternative fuels to power cement's future

1

Like · **Reply** · 1 y


[redacted]
We didn't want sand dunes anymore anyway.
Kurnell has none left so time to pillage port Stephens 👍
1
Like · Reply · 1 y
[redacted]
Boral don't care about anyone except their back pockets....
2
Like · Reply · 1 y
[redacted]
Come down the south end of Stockton beach and me theirs no shortage of sand john aka Mr boral ?
Like · Reply · 1 y
[redacted]
I grew up in Kurnell .
Sandmining has devastated that place. Its a watery pit being filled with rubbish.
Im not a greeny either but its criminal to allow it
1
Like · Reply · 1 y
Write a comment...
GIF

APPENDIX C

Community drop-in session summary

Residents question/comments (address: George Street, Fullerton Cove)	Boral project team response
What would be the proposed dredge depth - 1m?	No, 15m
So you complete the dredging and just walk away?	The site is proposed to be rehabilitated post-operation. Rehabilitation process was explained.
Rocla pit was not rehabilitated	Unlike the Rocla operation, the pit would definitely be rehabilitated. project conditions mandate rehabilitation
Where are the boundaries and what is the setback?	A map with boundaries was provided. It was explained that the buffer zone is 15m from the boundary in the windblown dune area
How close can Boral go to the boundary? You must put a batter down it?	The boundary was identified on the map and staff explained that the project would operate inside current boundary
What is the slope of the batters?	20 degrees, planted with native vegetation. It was explained that this environment would counter ripples from dredge operations
How long would the work be done for?	It is a 25-year plan
When will rehabilitation take place?	It would be done concurrently with the operations
How many trucks per day will be operating?	There would be no change to the current permission which allows 150 movements per day. There would be no trucks on local roads (note - this response was accurate at the time of the discussion)
Will the operations change the water table? We are concerned about the water (which we use for irrigation)	Current assessments don't show an impact to the water table
Is the project in the red (PFAS) zone?	No, the site is outside the published PFAS red zone
Will we be notified about the application and determination?	Yes, via letter box drop

APPENDIX D

Summary of consultation with residents via doorknock (August 2019)

Topics discussed	Conversation detail
Coxs Lane	
N/A - resident not at home	
Planning application	Resident asked about the duration of the planning approval being sought. project team advised that the approval would enable the operations to continue for another 25 years post the current consent.
Rehabilitation	Resident asked if there will there be an artificial lake post the dredge operations. Project team advised that the site would be rehabilitated (note - this response was accurate at the time of the discussion).
Positive feedback	Resident stated that Boral is a good corporate neighbour.
N/A - resident not at home	
Local employment	Continued operations at the quarry will be positive for local employment. Resident has no issues or concerns about the quarry.
Heavy vehicle on Coxs Lane	Resident observed heavy vehicles using Coxs Lane last week. Up to four heavy vehicles were observed on one day. Project team confirmed that the vehicles were working for the CQP quarry (21 Coxs Lane), and Boral had spoken to the quarry manager who in turn counselled the drivers responsible.
PFAS	The resident was curious about results from the PFAS monitoring program associated with the bore on the property adjacent to hers. The project team confirmed that Boral has been monitoring PFAS levels via the bore, and no PFAS had been detected from the samples.
Heavy vehicle on Coxs Lane	Resident observed heavy vehicles using Coxs Lane last week. project team confirmed that the vehicles were working for the CQP quarry (21 Coxs Lane), and Boral had spoken to the quarry manager who in turn counselled the drivers responsible.
Supply of product	Resident enquired about the purchase of sand for use on her property. project team explained product available and purchase process.
George Street	
N/A	Resident stated he had no problem with the quarry operations.
Positive feedback	Resident stated she had no problem with the quarry operations and suggested that the quarry was performing a positive role by preventing the westward movement of windblown sand, and therefore protecting private property.
N/A	Resident stated he had no problem with the quarry operations.
N/A - resident not at home	
N/A - resident not at home	
N/A - resident not at home	
Fullerton Cove Road	
N/A - resident not at home	
Local employment	Continued operations at the quarry will be positive for local employment. Resident has no issues or concerns about the quarry.
N/A	Local business requested an email with current quarry newsletter. Project team actioned the request.
N/A	Resident was rushing to an appointment and was too busy to discuss the project.

APPENDIX E

Social risk matrix

			Consequence Level				
			1	2	3	4	5
			Minimal	Minor	Moderate	Major	Catastrophic
Likelihood Level	A	Almost certain	A1	A2	A3	A4	A5
	B	Likely	B1	B2	B3	B4	B5
	C	Possible	C1	C2	C3	C4	C5
	D	Unlikely	D1	D2	D3	D4	D5
	E	Rare	E1	E2	E3	E4	E5
Social Risk Rating							
	Low		Moderate		High		Extreme

APPENDIX F

ECA protocol

TABLE A

Case No.	Search string	Publication	Date of article	Title	Frame	Theme	Discourse
1	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	23/01/2019	Different paths for Port Stephens state election candidates	1	1	1
2	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	3/01/2019	Whale carcass removed from One Mile Beach	DQ		
3	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	18/10/2018	No Sand Mining in Bobs Farm action group reformed after proposal resurfaces two years on	2	2	2
4	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	3/10/2018	Bobs Farm sand mine proposal is back on the table	2	2	3
5	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	20/09/2018	Residents turn out to meeting to hear proposal for Anna Bay sand mine	3	3	3
6	Sand trucks + stockton	Port Stephens Examiner	16/08/2018	Port Stephens Council and State Government urged to work together	DQ		
7	Sand trucks + stockton	Port Stephens Examiner	15/08/2018	Jimmys Beach sand transfer system to halt Myall River erosion woes.	DQ		
8	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	19/07/2018	Truck tax 'solution'	4	4	4
9	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	13/02/2018	Bruce MacKenzie's family company in court for alleged dumping trial	DQ		
10	Sand trucks + stockton	Port Stephens Examiner	13/01/2018	Bushfire burns within metres of homes at Cabbage Tree Road, Masonite Road and Barrie Close at Williamtown and Tomago	DQ		
11	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	12/01/2018	ATB Morton seeks to lift extraction limit on Redisand sand mine at Salt Ash	3	5	5
12	Sand trucks + stockton	Port Stephens Examiner	30/11/2018	Entries open for 2019 Hunter Photography Prize	DQ		
13	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	13/12/2017	Little Beach boat ramp woes prompt call for Port Stephens Council ...	DQ		
14	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	30/05/2016	Boat maintenance costs Clippers Anchorage $15,000 in EPA fine	DQ		
15	Sand trucks + Nelson bay Road	Port Stephens Examiner	16/01/2019	Money, promises flowing in Port Stephens as parties prepare for State election	DQ		
16	Sand trucks + Nelson bay Road	Port Stephens Examiner	22/11/2018	Campvale, Salt Ash bushfire: The RFS has downgraded the fire to 'advice' level	DQ		
17	Sand trucks + Nelson bay Road	Port Stephens Examiner	1/04/2018	Nelson Bay Road upgrade long overdue: Traffic expert Rob Caldwell	DQ		
18	Sand trucks + Nelson bay Road	Port Stephens Examiner	29/03/2018	Something Fishy | Mullet lead Easter charge	DQ		
19	Sand trucks + Nelson bay Road	Port Stephens Examiner	28/03/2018	Government denies broken election promise over Nelson Bay Road	DQ		
20	Sand trucks + stockton	Port Stephens Examiner	19/12/2016	Catching memories from the iconic Sygna wreck	DQ		
21	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	17/09/2013	Truck plan for Nelson Bay Road under fire	3	2	6
22	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	27/08/2013	New sand route favoured	3	2	7
23	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	11/03/2013	Beach sand boosted	DQ		
24	Sand trucks + stockton and Sand trucks + Nelson bay Road	Port Stephens Examiner	13/11/2012	New intersection proposed for sand project	3	1	1
25	Sand trucks + Nelson bay Road	Port Stephens Examiner	11/02/2018	Stockton fire: Crews shut Fullerton Street as wind shifts	DQ		
26	Sand trucks + Nelson bay Road	Port Stephens Examiner	12/12/2017	Department of Planning and Environment issues fine to Macka's Sand Quarry for breach of development consent	DQ		
27	Sand trucks + Nelson bay Road	Port Stephens Examiner	3/08/2017	Parliamentary Secretary for the Hunter Scot MacDonald announces start on Nelson Bay-Medowie Road roundabout upgrade but reveals more is needed for full duplication	DQ		
28	Sand trucks + Nelson bay Road	Port Stephens Examiner	21/12/2016	MacKenzies dispute role in clash over Ausgrid power poles	DQ		
29	Sand trucks + Nelson bay Road	Port Stephens Examiner	18/03/2016	Macka's Sand gains approval for additional 14 truck movements	1	1	5
30	Sand trucks + Nelson bay Road	Port Stephens Examiner	15/02/2016	Port Stephens mayor Bruce MacKenzie's family sand quarry stands alone in compliance audit	DQ		
31	Sand trucks + Nelson bay Road	Port Stephens Examiner	11/08/2015	Mackas Sand proposed modification to truck movements concerns residents	DQ		
32	Sand trucks + Nelson bay Road	Port Stephens Examiner	4/08/2015	Boat ramp needs work	DQ		
33	Sand trucks + Nelson bay Road	Port Stephens Examiner	3/03/2015	Greens weigh in to the Port's sand mining debate	DQ		
34	Sand trucks + Nelson bay Road	Port Stephens Examiner	2/12/2014	No sand mine in our backyard says Bobs Farm residents	DQ		
35	Sand trucks + Nelson bay Road	Port Stephens Examiner	27/08/2014	Sand buffer for Jimmys Beach 'urgent work'	DQ		
36	Sand trucks + Nelson bay Road	Port Stephens Examiner	1/10/2013	Sand access road okayed	DQ		
37	Sand trucks + Nelson bay Road	Port Stephens Examiner	9/07/2013	Fears over sand transit decision	DQ		

TABLE B

Frames		Themes		Discourses			
Political attention to quarries and road impacts	1	Political opposition to road impacts	1	Excessive quarry trucks using public infrastructure	1		
Community attention to quarries and road impacts	2	Community opposition to road impacts	2	Negative impacts on families and schools	2		
EIS and infrastructure/traffic planning	3	Infrastructure/traffic studies and planning	3	Additional truck movements (negative sentiment regarding road quality)	3		
Road maintenance funding	4	Quarry trucks damage roads	4	Quarry operators should share road maintenance burden	4		
		Quarry benefits outweight road impacts	5	Additional truck movements (neutral sentiment regarding road quality)	5		
				Negative impacts for community safety	6		
				Sand haulage route debate	7		

APPENDIX G

Examples of Boral's voluntary sand supply to community groups

- September 2009: sand donation to East Seaham Preschool
- November 2014: Port Hunter sailing club to repair erosion along the river bank
- November 2015 (approx.): Port Hunter sailing club to repair erosion along the river bank
- October 2016: sand donation to Stockton Little Athletics (long jump pit).
- March 2018: sand donation to Black Hill Public School playground (sandpit)

Boral's other in-kind donations to local organisations:

- From 1996-2014: sponsor of the annual Stockton Beach Clean-up
- June 2016: rehabilitation work with Conservation Volunteers Australia (CVA) on the Sandspit at Stockton.
- June 2018: World Environment Day Tree Planting Challenge (CVA) adjacent to Stockton Bridge at Kooragang.
- May 2019: Little Beach rehabilitation project with CVA.
- Latest donation: to be implemented in the new financial year, cash ($500) to support playground upgrade at Fern Bay Public School.

SYDNEY NEWCASTLE CENTRAL COAST TOWNSVILLE
elementenvironment.com.au


elementenvironment.com.au

APPENDIX C Revised Biodiversity Development Assessment Report

Excellence in your environment

niche Environment and Heritage

Stockton Sand Quarry Dredging

Revised Biodiversity Development Assessment Report

Prepared for Boral Resources (NSW) Pty Ltd 7 September 2020

niche-eh.com

Excellence in your environment

Project number	Client	Project manager	LGA
3706	Boral Resources NSW Pty Ltd	Luke Baker (Accreditation no. BAAS17033)	Port Stephens

Declaration

This Biodiversity Development Assessment Report has been approved for submission by Niche Environment and Heritage.
Niche Assessors and staff involved in this Project include:

Luke Baker - BAM Accredited Assessor (BAAS17033)

Rhidian Harrington – BAM Accredited Assessor (BAAS 17095)

Alex Christie - BAM Accredited Assessor (BAAS18131)

Amanda Griffiths - BAM Accredited Assessor (BAAS19016)

Radika Michniewicz - Senior Ecologist

Jodie Danvers - Ecologist

Version	Author	Review	Status	Date
D1	Baker, L; Christie, A	Dr Rhidian Harrington	Draft	20 July 2020
Rev0	Baker, L	Boral Resources (NSW)	Final	4 September 2020

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Executive summary

Context

Boral Resources (NSW) Pty Ltd (Boral) owns and operates the Stockton Sand Quarry (the Quarry), a long standing operation that currently extracts sand from the windblown (transgressive) sand dunes of Stockton Bight and transports up to 500,000 tonnes per annum (tpa) of sand products for use in the building, landscaping and construction markets.

Due to current and future demand for sand in the Hunter and Sydney markets, Boral is seeking approval for continued and expanded operations at the site through a State Significant Development (SSD) application.

The proposed development (hereafter referred to as the 'Project') involves the extraction of sand from within the former inland extraction area from the existing ground level to a depth of 15 m below sea level (-15 m AHD). As extraction will intercept the groundwater table (at approximately 1 m AHD) the primary method of sand extraction will involve dredging. To account for market fluctuations in demand, Boral are seeking a development consent period of 25 years for the SSD approval.

Boral is seeking approval for the Project under Part 4 of the NSW *Environmental Planning and Assessment Act 1997* (EP&A Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Boral to prepare a Biodiversity Development Assessment Report (BDAR) for the Stockton Sand Quarry expansion (the Project), which addresses the requirements of the NSW *Biodiversity Conservation Act 2016* (BC Act) and NSW Environmental Planning and Assessment Act 1979 (EP&A Act).

The BDAR was submitted as part of the Environmental Impact Assessment (EIS) to Department of Planning, Industry and Environment (DPIE) in December 2019. The BDAR was reviewed by the Biodiversity Conservation Division (BCD), DPIE and Port Stephens Council.

Comments regarding the BDAR from the Agencies were provided to Boral and Niche in March 2020. The Agency comments related primarily to the requirement for further targeted threatened fauna and flora survey, including a hollow-bearing tree survey. This Revised BDAR has been prepared to address the March 2020 Agency comments, and has been updated to reflect the changes that have been made to the Threatened Biodiversity Database Collection (TBDC) and additional survey guidelines and advice regarding the BAM, that were not available at the time of the original submission.

Survey overview

An ecological assessment in accordance with the BAM was undertaken for the Project and consisted of:

- Site survey to determine the extent and occurrence of native vegetation and determine habitat for threatened biodiversity.
- Collection of data from 16 BAM plots.
- Targeted surveys for threatened flora during the months of May to September.
- Targeted surveys for a range of threatened fauna species, including: Wallum Froglet, Bush-stone Curlew, Koala, Powerful Owl, Barking Owl, Masked Owl, Brush-tailed Phascogale, Gang-gang Cockatoo, Glossy-black Cockatoo, and threatened microbats (Little Bentwing-bat, Southern Myotis, Eastern Cave Bat, Greater Broad-nosed Bat, Eastern Bentwing Bat).
- Surveys for breeding resources associated with threatened fauna.

Results

The subject site for the Project contains all areas proposed for ground disturbance and is approximately 38.14 ha. The subject site is largely located within the footprint of former inland extraction areas that were cleared over the past two decades and have since been rehabilitated with native plantings.

Native Vegetation

Native vegetation on the Subject land was identified and mapped in accordance with the BAM and BioNet Vegetation Classification. In total the subject site includes:

- 35.66 ha of vegetation which meets the definition of 'native vegetation' as per the BAM
- 2.48 ha non-native vegetation.

Two Plant Community Types (PCTs) were mapped within the subject site:

- PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast: approximately 32.99 ha recorded in five different condition classes that are representative of the age of the former quarry pit rehabilitation.
- 1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast: approximately 2.67 ha recorded in one condition class which is representative of historic plantings.

None of the PCTs recorded align to Threatened Ecological Communities (TECs) listed on the BC Act or EPBC Acts.

Threatened Species

No threatened flora were recorded within the subject site during the field survey. However, our assessment notes that surveys for *Cryptostylis hunteriana* were not able to be carried out during the specified survey months listed in the Threatened Biodiversity Collection Database (TBCD), and as per the DPIE (2020) Plant Survey Guidelines (released in April 2020). Our assessment concludes that given the historic clearing of the subject site, approximately 23.19 ha is not likely to be suitable for the species. The remaining 12.47 ha of native vegetation may offer some potential habitat for *Cryptostylis hunteriana* and this area has been mapped as a species polygon for the species.

Three threatened fauna were recorded within the subject site during the field survey: Greater Broad-nosed Bat, Eastern Bentwing Bat and White-bellied Sea Eagle. All are regarded as 'ecosystem credit' species for this assessment given breeding habitat within the subject site was absent.

The assessment concluded that the Squirrel Glider (species credit) is likely to occur within the subject site due to a historic record within the subject site, known records throughout the locality, and the fact that the subject site contains foraging habitat for the species.

Two threatened fauna (species credits) with potential habitat within the subject site were not able to be surveyed during the recommended survey months and specific climate conditions as specified in the TBCD. These species include Gang-gang Cockatoo (breeding habitat) and Pale-headed Snake. As such, this assessment has assumed that potential habitat for each species is present in lieu of the site survey and assigned a species polygon for each.

All ecosystem credit species as generated by the BAM database searches and calculator outputs, were assumed to be present.

Impact

The impact of the Project on ecological values are summarised as follows:

- Direct removal of 35.66 ha of native vegetation, noting that 5.19 ha has a site integrity score below that requiring a credit offset.
- Indirect impacts to immediately surrounding vegetation/habitat will be prevented via a series of mitigation measures.
- Removal of fauna habitat, consisting of a mix of rehabilitation land and remnant vegetation.
- Removal of micro habitat features such as hollow-bearing trees and logs.

SEPP 44. Koala habitat

Our assessment has concluded that the subject site does not contain potential Koala habitat as defined under State Environment Planning Policy 44 because Schedule 2 tree species do not constitute at least 15% of the total number of trees within the subject site. Therefore, the site does not constitute Core Koala habitat.

Commonwealth Assessment

The Project is to be assessed under the EPBC Act pursuant to the assessment bilateral agreement with the NSW Government. Therefore, this BDAR provides an assessment of potential impacts to EPBC Act listed threatened species and communities, applying the Biodiversity Assessment Method (BAM).

Our assessment concluded that eight threatened biodiversity listed on the EPBC Act have a moderate to high likelihood to utilise the subject site, including *Cryptostylis hunteriana,* Black-faced Monarch, White-throated Needletail, Spotted-tail Quoll, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox. Many of these species were determined to potentially use the subject site occasionally given absence of detection during the field survey. Formal Assessment of Significance were completed for the Commonwealth listed threatened species, which concluded that that Project is unlikely to have a significant impact on any MNES.

Submission of an EPBC Act referral is not required.

Measures to Avoid, Minimise and Mitigate Impacts

As detailed in the Environmental Impact Statement (EIS), throughout the process of site planning Boral has considered alternative locations and processes. The current site utilises the former rehabilitated inland extraction area for most of the impact rather than remnant vegetation that occupies the remaining portion of the Boral site.

The Project has been designed to avoid or minimise impacts to vegetation and habitat and include:

- Undertaking vegetation clearing in accordance with the Vegetation Clearance Protocol described in section 5.1.4 (impacts arising from the construction will primarily relate to vegetation clearing).
- Fencing and signposting erected as close as possible to the edge of the subject site as described in section 5.1.4.
- Educating employees and/or contractors involved in the construction and operation of the Project.
- The preparation and implementation of a suitable Landscape and Rehabilitation Management Plan.
- Dust suppression.
- Procedures for the management of spills throughout the subject including the requirements for vehicles to carry spill kits.
- Management and removal of all rubbish from the subject site.

- Maintain current quarry speed limits to minimise the potential for fauna collision.

Offset Strategy

The result of running the Biodiversity Assessment Method Credit Calculator (BAM-C) is that the Project requires a total of 455 ecosystem credits and 1,567 species credits:

- Ecosystem credits:
    - PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast – 427 credits
    - 1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast – 28 credits.
- Species credits:
    - *Cryptostylis hunteriana* – 191 credits
    - Squirrel Glider - 558 credits
    - Pale-headed Snake - 226 credits
    - Gang-gang Cockatoo - 592 credits.

As detailed in section 7.2, Boral propose to survey for the *Cryptostylis hunteriana,* Pale-headed Snake and Gang-gang Cockatoo, during the correct survey months (planned to commence in November 2020). The survey would be used to inform if habitat occurs at the site, and where relevant, Boral will revise the associated species polygons and credit requirements. Boral propose to submit a modification BDAR detailing the survey and any credit variations once the seasonal surveys have been completed.

Boral commits to satisfying the credit requirements using offset mechanisms allowed by the NSW Biodiversity Offset Scheme (i.e. retirement of biodiversity credits and/or contribution to the Biodiversity Conservation Fund).

Boral propose to implement a staged offset approach to reflect the progressive dredging of the site. The staged-offset would involve the retirement of the required credits over a period of approximately 20 years to reflect progressing vegetation/habitat removal.

No Commonwealth biodiversity offset is required given that there is no significant impact to any EPBC Act listed threatened biodiversity.

Conclusion

The impact avoidance, mitigation and offset hierarchy has been applied to the Project resulting in some unavoidable impacts. The credit calculation has determined the offset requirement for clearance of native vegetation (ecosystem credit requirement) and the offset requirement for clearance of potential habitat for *Cryptostylis hunteriana*, Squirrel Glider, Pale-headed Snake, Gang-gang Cockatoo (species credit requirements). It is anticipated that these offset requirements would be met through retirement of biodiversity credits and/or contribution to the Biodiversity Conservation Fund.

The direct loss of habitat associated with the Project would be offset in accordance with the NSW Biodiversity Offset Scheme which would result in no net loss in biodiversity.

Glossary and list of abbreviations

Term or abbreviation	Definition
BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Credit Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BC Reg	NSW *Biodiversity Conservation Regulation 2017*
BCF	Biodiversity Conservation Fund
BDAR	Biodiversity Development Assessment Report
BMP	Biodiversity Management Plan
BOS	NSW Biodiversity Offsets Scheme
BSA	Biodiversity Stewardship Agreement
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically Endangered Ecological Community
cm	Centimetre/s
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DBH	Diameter at Breast Height
DCP	Development Control Plan
DPIE	NSW Department of Planning, Industry and Environment (formerly DECCW, DECC, DEC, OEH)
EEC	Endangered Ecological Community
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FM Act	NSW *Fisheries Management Act 1994*
ha	Hectare/s
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometre/s
LEP	Local Environment Plan
LGA	Local Government Area
Locality	The subject site and surrounds, nominally a 10 km radius from the subject site
m	Metre/s
MNES	Matters of National Environmental Significance (from the EPBC Act).
PCT	Plant Community Type
RDP	Rapid Data Point
SAII	Serious and Irreversible Impacts
SEARS	Secretary Environment Assessment Requirements
SSD	State Significant Development
TBDC	Threatened Biodiversity Database Collection
TEC	Threatened Ecological Community
VI	Vegetation Integrity as calculated by the BAM Calculator

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1. Introduction

1.1 Context

Boral Resources (NSW) Pty Ltd (Boral) owns and operates the Stockton Sand Quarry (the Quarry), a long standing operation that currently extracts sand from the windblown (transgressive) sand dunes of Stockton Bight and transports up to 500,000 tonnes per annum (tpa) of sand products for use in the building, landscaping and construction markets.

Due to current and future demand for sand in the Hunter and Sydney markets, Boral is seeking approval for continued operations at the site through a State Significant Development (SSD) application.

The proposed development (hereafter referred to as the 'Project') involves the extraction of sand from within the former inland extraction area from the existing ground level to a depth of 15 m below sea level (-15 m AHD). As extraction will intercept the groundwater table (at approximately 1 m AHD) the primary method of sand extraction will involve dredging. To account for market fluctuations in demand, Boral are seeking a development consent period of 25 years for the SSD approval.

Boral is seeking approval for the Project under Part 4 of the NSW *Environmental Planning and Assessment Act 1997* (EP&A Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Boral Resources (NSW) Pty Ltd (Boral) to prepare a Biodiversity Development Assessment Report (BDAR) for Stockton Sand Quarry expansion (the Project), which addresses the requirements of the NSW *Biodiversity Conservation Act 2016* (BC Act). The report was prepared in accordance with the Biodiversity Assessment Method (BAM) (OEH 2017a) and the Secretary Environmental Assessment Requirements (SEARs) for the Project, and also assesses the impacts of the Project on Matters of National Environmental Significance (MNES) under the EPBC Act.

The BDAR was submitted as part of the Environmental Impact Assessment (EIS) to Department of Planning, Industry and Environment (DPIE) in December 2019. The BDAR was reviewed by the Biodiversity Conservation Division (BCD), DPIE and Port Stephens Council.

Comments regarding the BDAR from the Agencies were provided to Boral and Niche in March 2020. The Agency comments related primarily to the requirement for further targeted threatened fauna and flora survey, including a hollow-bearing tree survey. This Revised BDAR has been prepared to address the March 2020 Agency comments, and has been updated to reflect the changes that have been made to the Threatened Biodiversity Database Collection (TBDC) and additional survey guidelines and advice regarding the BAM, that were not available at the time of the original submission.

1.2 The Project

The Stockton Sand Quarry is located in Fullerton Cove, approximately 9.8 kilometres (km) north-northeast of the Newcastle Central Business District (CBD), within the Port Stephens Local Government Area (LGA) (Figure 1 and Figure 2). Access to the site is via Nelson Bay Road and Coxs Lane.

The site is owned and operated by Boral and covers an approximate area of 246 hectares, comprising of:

- Lot 1 DP 1006399, comprising 234.0 hectares located on the eastern side of Nelson Bay Road.

- Lot 2 DP 1006399 comprising 10.4 hectares and located predominantly on the western side of Nelson Bay Road, with a small portion also positioned on the eastern side of Nelson Bay Road (formerly Part Lot 167, Part Portion 167).
- Lot 3 DP 664552 comprising 1.6 hectares and located wholly on the eastern side of Nelson Bay Road, within which the existing depot and weighbridge are located (formerly within Part Lot 3, Part Portion 3).

Boral previously quarried sand in the central area of Lot 1, to the east of Nelson Bay Road. This extraction commenced in 1996 and was completed in 2007 with the consent lapsing on 1 May 2009.

Following the exhaustion of the original extraction area in Lot 1 in 2007, Boral commenced extraction of windblown sand in the 2006 development consent area, which continues today.

The Project involves the extraction of sand from within the former inland extraction area (inclusive of pits 1 – 6) from the existing ground level to a depth of 15 m below sea level (-15 m AHD). As extraction will intercept the groundwater table (at approximately 1 m AHD) the primary method of sand extraction will involve dredging.

There is an estimated 9 million tonnes of sand resource within the Project extraction area. The Project would seek to permit a site-wide increase on the dispatch limit to 750,000 tpa (i.e. the windblown sand extraction area and the Project operations combined) up until 2028 when the site-wide limit would reduce to no more than 500,000 tpa. The increase in the site wide dispatch limit is sought to permit maximum flexibility across the two projects areas (located on the same site). A concurrent administrative amendment to DA 140-5-2006 to allow for the site-wide dispatch limit increase will be lodged with Department of Planning, Industry and Environment (DPIE).

Mobile plant and equipment utilised at the site would operate across both project areas and a docket system at the weighbridge would monitor outgoing product as a site total.

To account for market fluctuations in demand, Boral are seeking a development consent period of 25 years for the SSD approval.

1.3 The Subject Site

The subject site for the Project contains all areas proposed for ground disturbance and is approximately 38.14 ha (Figure 3). The subject site is largely located within the footprint of former inland extraction areas that were cleared over the past two decades and have since been rehabilitated with native plantings.

The extent of disturbance associated with the Project (subject site) will result in the clearing of:

- 35.66 ha of vegetation which meets the definition of 'native vegetation' as per the BAM; and
- 2.48 ha non-native vegetation.

Biodiversity values have been avoided as much as practical as detailed in section 5.1, and details of the mitigation measures proposed to reduce or prevent indirect impacts from the Project are detailed in section 5.1.4.

1.4 Approval and Assessment Process

The following legislation or planning instruments are relevant to the works associated with the Project.

1.4.1 State Approval and Assessment Process – Application of the BAM

For NSW State approval, the Project is to be assessed as State Significant Development (SSD) under Part 4 of the EP&A Act, which requires proponents to use the Biodiversity Offset Scheme (BOS) BAM to prepare a Biodiversity Development Assessment Report (BDAR) under the BC Act.

This BDAR describes the biodiversity values present within the subject site and identifies impacts from the Project on these values. This assessment has used the BAM Calculator (BAM-C) (version 1.2.7.2) to determine the biodiversity credits required to offset the Project.

1.4.2 Commonwealth Approval and Assessment Process

Matters of National Environmental Significance (MNES) are protected under the EPBC Act. The BAM requires proponents to identify and assess the impacts on all nationally listed threatened species and threatened ecological communities that may be present on or near the development site. Therefore, the BAM has partly been used to perform assessment of impacts under the EPBC Act. Further assessment of impacts under the EPBC Act has been undertaken via assessments of significance for EPBC Act listed species with the potential to be affected by the Project (Annex 8).

Under the EPBC Act, activities that have potential to result in significant impacts on MNES must be referred to the Commonwealth Minister for the Environment and Energy for assessment.

This report assesses the impact of the project on MNES.

1.4.3 Secretary Environmental Assessment Requirements (SEARs)

In addition to requirements under the BAM and Commonwealth environmental approvals process, this BDAR addresses specific requirements provided in the SEARs for the SSD application relating to biodiversity, issued in October 2018 by the DPIE. Table 1 below cross-references this report with the relevant SEARs.

Table 1. SEARs addressed in this BDAR

Requirement	Section addressed in report
Biodiversity – including: - accurate predictions of any vegetation to be cleared on site; - a detailed assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, undertaken in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report; and	This report follows the BAM. It provides an assessment of the impacts as per the BAM and assesses the Commonwealth EPBC Act Matters in relation to biodiversity.
- a strategy to offset any residual impacts of the development in accordance with the offset rules under the Biodiversity Offsets Scheme.	Section 7.
Office of Environment and Heritage	
1. Biodiversity impacts related to the proposed development (SSD 9490) are to be assessed in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the *Biodiversity Conservation Act 2016* (s6.12), *Biodiversity Conservation Regulation 2017* (s6.8) and Biodiversity Assessment Method.	This document is a BDAR and follows the BAM.

Requirement	Section addressed in report
2. The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.	Section 5.1 details avoidance and minimisation. Section 5.2 details impacts (direct, indirect, prescribed). Section 6 details offsets.
3. The BDAR must include details of the measures proposed to address the offset obligation as follows: The total number and classes of biodiversity credits required to be retired for the development/project The number and classes of like-for-like biodiversity credits proposed to be retired; The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules; Any proposal to fund a biodiversity conservation action; Any proposal to conduct ecological rehabilitation (if a mining project); Any proposal to make a payment to the Biodiversity Conservation Fund. If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.	The offset strategy is detailed in section 7. Rehabilitation of the site is discussed in detail in the EES (2019) Landscape and Rehabilitation Strategy.
4. The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the Biodiversity Conservation Act 2016.	This assessment and field survey has been completed by Accredited Assessors (section 1.7)

1.5 Consultation

As part of the project planning, Element Environment submitted correspondence to the Department of Planning, Industry and Environment (DPIE) - Biodiversity and Conservation Division (BCD) on the 17th July 2019 requesting to provide comments for the preparation of the Environmental Impact Statement.

A response was provided by DPIE on the 2nd August 2019, stating that the BCD has provided input into SEARs (reference DOC18/691590-1) which outline assessment requirements for Aboriginal cultural heritage, threatened biodiversity, impacts to National Parks and Wildlife Estate, soils and water, flooding, floodplain management and coastal erosion. BCD had no further assessment requirements at this stage of the project.

1.6 Assessment Objectives and Format

The primary objective of this assessment is to use the guidelines and methodology provided in the BAM to determine the impact the project would have on biodiversity, avoid and mitigate these impacts and then calculate the Project's biodiversity offset requirement.

This BDAR has two broad stages consistent with the BAM methodology:

Stage 1 – Biodiversity Assessment

- assessment of landscape features
- assessment of native vegetation

- assessment of threatened species and populations.

Stage 2 – Impact Assessment

- avoid and minimise impacts on biodiversity values
- consider impact and offset thresholds
- determine and calculate offset (credit) requirements.

1.7 Assessment Resources and Assessor Qualifications

This BDAR has been prepared by the accredited personnel and support staff identified in Table 2. Resources and survey guidelines used in the development of this BDAR are detailed in 3.1 and 4.1.

Table 2: Assessor qualifications and resources

Personnel	Qualifications	Tasks carried out
Luke Baker	Team Leader Ecology Accredited Biodiversity Assessor (BAAS 18088)	Flora and fauna field survey, data management, data entry, credit calculations, report preparation.
Rhidian Harrington	Ecologist and Director Accredited Biodiversity Assessor (BAAS 17095)	Quality assurance, report review, review of threatened bird and amphibian habitat.
Alex Christie	Ecologist Accredited Biodiversity Assessor (BAAS 18144)	Flora and fauna field survey and report preparation
Amanda Griffith	Senior Ecologist Accredited Biodiversity Assessor (BAAS 17066):	Flora and fauna field survey
Radika Michniewicz	Senior Ecologist Extensive fauna trapping experience, including project management and field assessment of long-term targeted Fauna Monitoring Projects for NSW Roads and Maritime Services.	Flora and fauna field survey, including trapping and spotlighting, and Wallum Toadlet transects after 20 mm of rain.
Jodie Danvers	Ecologist Extensive fauna trapping experience, including field assessment and reporting associated with long-term targeted Fauna Monitoring Projects for NSW Roads and Maritime Services.	Flora and fauna field survey, including trapping, spotlighting and Wallum Toadlet transects after 20 mm of rain.
Greg Tobin	GIS Specialist	Mapping

Table 3: Assessment resources and guidelines used

Assessment resources/guideline	
Resources	• Biodiversity Assessment Method (BAM) (OEH 2017a) • BAM Operational Manual – Stage 1 (OEH 2018b) • BAM Operational Manual – Stage 2 (DPIE 2019a) • BAM Calculator User Guide (OEH 2018c)
Survey guidelines	NSW • Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method (DPIE 2020c).

Assessment resources/guideline	
	• 'Species credit' threatened bats and their habitats, NSW survey guide for the Biodiversity Assessment Method (OEH 2018a). • Field survey methods for amphibians, Threatened species survey and assessment guidelines (DECC 2009). • 2004 Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (DECC 2004). • Lake Macquarie City Council (LMCC 2014a) Flora and Fauna Survey Guidelines Version 4.2. Commonwealth • Survey Guidelines for Australia's Threatened Frogs (DEWHA 2010a) • Survey Guidelines for Australia's Threatened Bats (DEWHA 2010b) • Survey Guidelines for Australia's Threatened Birds (DEWHA 2010c) • Draft Survey Guidelines for Australia's Threatened Orchids (Commonwealth of Australia 2013)

It should be noted that throughout the course of this Project (commenced in 2017) significant changes to the assessment approach have arisen due to the following:

- The habitat definitions for dual credit species, and survey effort for some species credit flora and fauna have changed in the BioNet Threatened Biodiversity Data Collection (TBDC) since the project commenced.
- *Surveying threatened plants and their habitats NSW survey guide for the Biodiversity Assessment Method (DPIE 2020c)* was released in April 2020, after the Environment Impact Statement (EIS) was submitted in December 2019.
- State Environmental Planning Policy (Koala Habitat Protection) 2019 (Koala SEPP), was released after the EIS was submitted to DPIE in December 2019.
- The Biodiversity Conservation Trust (BCT) released guidance material related to vegetation mapping and site stratification in March 2020. Whilst the guidance material was aimed as Biodiversity Stewardship Site Assessments, the content and interpretation of the BAM is relevant to BDARs.

At the time of this assessment the following is noted:

- Module 3 of the BAM has not yet been released.
- Some threatened biodiversity profiles in the TBDC have not yet been finalised (e.g. Mahony's Toadlet).
- Draft Guidelines for threatened birds has not yet been released. The BCD has advised that appropriate guidelines be used during the course of the project in lieu of formal bird survey guidelines.

2. Landscape Features

2.1 Methods

As detailed in Section 4 of the BAM (OEH 2017a), a landscape assessment for the Project is required, which was conducted within the BAM Calculator. Landscape value is an assessment of factors including:

- Native vegetation cover
- Rivers, streams and estuaries
- Areas of geological significance
- Habitat connectivity.

For each factor the current state of the landscape is assessed then compared with the state of the landscape if the Project were to proceed.

2.2 Landscape Features and Scoring

The inputs into the landscape features component of the BAM Calculator, along with the associated Figure reference, has been detailed in Table 4 below.

Table 4: Landscape features and scoring under the NSW BAM

Landscape features	Description	Figure reference
subject site size	38.14 ha	
IBRA bioregion/subregion	NSW North Coast IBRA region, and within Karuah Manning IBRA subregion.	Figure 4
NSW (Mitchell) Landscapes	One Mitchell landscape occurs across the subject site: Sydney - Newcastle Barrier and Beaches.	Figure 4
Rivers, streams and estuaries and Strahler stream order	No rivers, streams of estuaries occur within the subject site.	None occur within the subject site
Wetlands within and adjacent to development	No wetlands occur within or adjacent to the development. The closest mapped wetlands include Long Bight Swamp located approximately 2.3 km to the southwest of the subject site.	-
Cleared areas	The native vegetation proposed to be directly impacted for the Project has largely been subject to clearing due to historic quarrying operations. Rehabilitation of the former quarry pits have occurred over the past decade. The rehabilitation has been undertaken as per a series of rehabilitation management plans (section 3.1.2), which has entailed large-scale tubestock planting and seeding. Areas of 'cleared areas' (devoid of native vegetation) within the subject site, comprise portions of the former inland extraction area and associated infrastructure (Figure 6). These cleared areas total 2.48 ha.	'Cleared Areas' or 'non-native' areas is shown on Figure 6
Connectivity features	The subject site adjoins a native vegetation corridor which extends to the north and south along Stockton beach encompassing Worimi Regional Park and Worimi State Conservation Area. The corridor also adjoins the	Figure 1

Landscape features	Description	Figure reference
	wetlands (Long Bight Swamp) and riparian vegetation of Fullerton Cove approximately 2.3 km to the south-west.	
Buffer area (percent native vegetation cover)	A 1,500 m buffer was applied to the subject site resulting in an overall buffer area of 1,220 ha. Aerial interpretation was used to map the area of native vegetation, and non-native vegetation within the locality. In total 596 ha is non-native (consisting of quarry pit, existing emplacement, infrastructure, rural residential and roads/rail links) and 624 ha is native vegetation. ***Total native vegetation cover*** Combining the estimated native vegetation cover resulted in 51% of the buffer area supporting native vegetation. This falls into the 30-70% category within the BAM Calculator.	Figure 4
Site context	Site based assessment.	-
Geological significance	There are no karst, caves, crevices, cliffs or other areas of geological significance within the subject site. Such geographic significant features are located greater than 2 km away from the subject site, and thus none would be impacted by the Project.	-

3. Native Vegetation and Flora Assessment

3.1 Native Vegetation

3.1.1 Methods – Data Review

A review of relevant literature, databases and existing vegetation mapping was undertaken to identify vegetation, threatened flora and Threatened Ecological Communities (TECs) with potential to occur at the subject site. The literature review was undertaken prior to the field survey to inform field survey requirements. A likelihood of occurrence analysis (Annex 1) was then undertaken for each species/TEC, based on suitability of habitat present within the subject site.

Resources reviewed included the following:

- Database searches:
  - *NSW BioNet Atlas Database* (DPIE 2020d) for spatial records of threatened flora listed under the BC Act within a 10 kilometre (km) radius of the subject site.
  - *EPBC Act Protected Matters Search Tool* (PMST) (DAWE 2020) for list of flora and ecological communities identified as MNES known or with potential habitat within a 10 km radius of the subject site.
  - BAM Calculator candidate and predicted species list.
- Vegetation mapping: Greater Hunter Native Vegetation Mapping v4.0. VIS ID 3855 (OEH 2017b)
- Previous relevant studies including:
  - Eastcoast Flora Survey (2010) Vegetation of the Worimi Conservation Lands, Port Stephens, New South Wales: Worimi NP, Worimi SCA & Worimi RP - Final Report, November 2010, Stephen Bell & Colin Driscoll.
  - ERM (2005a) Fern Bay Estate, Species Impact Statement, Prepared for Winten Property Group and Continenal Venture Capital Limited.
  - ERM (2005b) Stockton Sandpit Windblown Sand Extraction, Environmental Impact Statement, Prepared for Boral Resources (Country) Pty Limited.

3.1.2 Methods – Vegetation Validation

Prior to field validation, the subject site was stratified using aerial photographic interpretation (API), and through reference of rehabilitation management zones specified in management plans of the former quarry pit (Plate 1). The series of relevant management plans and monitoring reports for the site include:

- ERM (2007) Boral Resources (Country) Pty Ltd, Stockton Transgressive Dune Quarry Rehabilitation and Landscape Management Plan December 2007.
- ERM (2010) Boral Resources (Country) Pty Ltd, Stockton Transgressive Dune Quarry Rehabilitation and Landscape Management Plan August 2010.
- Environmental Compliance Services (2017) Stockton Transgressive Dune Quarry Rehabilitation and Landscape Management Plan, Prepared for Boral Resources, March 2017.
- Hunter Land Management (2015) Rehabilitation Assessment Boral Fullerton Cove, Prepared for Boral Resources, August 2015.

Plate 1. Approximate former quarry pit locations subject to native vegetation rehabilitation

Through the API process some of the rehabilitation areas were clearly defined. BAM plot location and an approach to survey transects were then plotted on field maps to guide survey effort.

A field survey was carried out on the following dates to stratify the vegetation as per the BAM:

- 27-29th September 2017
- 20th August 2018
- 26th May 2020
- 30th July 2020
- 1st July 2020.

The surveys completed in 2020 involved a comprehensive hollow-bearing tree assessment which allowed Niche to refine the vegetation zones of the site to reflect similar plot condition scores within each PCT, and stratify the site based on relevant mapping guidelines provided by the BCT in March 2020.

In total, 16 BAM plots were completed within the subject site to meet the minimum plot requirement as per the BAM (Table 5 and Figure 5). A significant number of transects were also completed which assisted in vegetation zone delineation (Figure 5).

3.1.3 Results – Vegetation Validation

The field survey confirmed that the subject site consisted predominately of native vegetation. For the most part, the subject site consisted of large portions of planted tubestock at varying ages and in-fill planting within patches of remnant vegetation, which was conducted over the past two decades to rehabilitate the former quarry pits.

As detailed in the OEH (2018b) Biodiversity Assessment Method Operational Manual, '*Planted native vegetation is treated in the same way as native vegetation if it meets the definition of native vegetation in*

Section 5A of the Local Land Services Act 2013. Where the vegetation is a mix of local and non-local planted species the assessor should consider the best matching PCT based on the local species present'.

As such, the zones that have been rehabilitated have been attributed to two Plant Community Types (PCTs) which likely occurred within the subject site prior to clearing or contain a structure and composition similar to that of the rehabilitated land.

Different condition classes were assigned to vegetation where obvious differences in structure and quality occurred, resulting in two PCTs and six vegetation categories (zones) as shown in Table 5. The vegetation zones generally reflected the age of the rehabilitation and areas of remnant vegetation.

Descriptions for those communities which occur within the subject site are provided in Annex 2 and the distribution is shown in Figure 6.

Table 5: Plant Community Types present across the subject site

Vegetation zone	Plant Community Type (PCT)	Vegetation formation	Vegetation class	Threatened Ecological Community (TEC)*	PCT % cleared[1]	Condition identifier input used in Calculator	Total (ha)	Plots required	Plots completed
1	PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Dry Sclerophyll Forests (Shrubby sub-formation)	Coastal Dune Dry Sclerophyll Forests	-	45	Zone 1	14.13	3	4
2						Zone 2	3.87	2	2
4						Zone 4	5.19	3	3
5						Zone 5	1.71	1	1
6						Zone 6	8.09	3	4
3	1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	Dry Sclerophyll Forests (Shrubby sub-formation)	South Coast Sands Dry Sclerophyll Forests	-	86	Zone 3	2.67	2	2
-	Non-native	-	-	-	-	Non-native	2.48	-	-
	Total						**38.14**	**14**	**16**
	Total native vegetation						**35.66**		

3.1.4 Plant Community Descriptions

Refer to Annex 2 for plant community descriptions and diagnostic species for each plant community.

3.1.5 Site Values

Flora

Floristic data recorded from floristic plots performed throughout the identified vegetation zones is included within Annex 3.

Plot and transect values

The results of the plot data and species list obtained during the field assessment is provided in Annex 4.

[1] The BAM defines 'Percent Cleared Value' as the percentage of a PCT that has been cleared as a proportion of its pre-1750 extent, as identified in the BioNet Vegetation Classification

Site integrity scores

The site value assessment was carried out by entering plot data into the BAM Calculator. The data provides quantitative measures of composition, structure and function for each vegetation zone (Annex 4). The BAM Calculator compares the values recorded with the benchmark for the vegetation class to provide the site value score. This score represents the overall condition of the vegetation compared against the benchmark.

The vegetation scores for each zone in the subject site have been provided in Table 6. The score from these inputs, coupled with data in the following section of this report, is used to determine the number of ecosystem credits that are required for development.

Vegetation zones that have a site integrity score of less than 17 out of 100 for a non-threatened ecological community do not need to be offset.

As shown in Table 6, vegetation zone 'Zone 4' had a score of 4.8 and, as such, does not require to be offset. The remainder of the vegetation zones had a site integrity score greater than 17 and therefore require biodiversity offsetting (section 6.1.1).

Table 6. Vegetation zones and site integrity scores

Vegetation zone	Plant Community Type (PCT)	Condition identifier input used in Calculator	Total (ha)	Site integrity	Offset required
1	PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	Zone 1	14.13	43	Yes
2		Zone 2	3.87	19.8	Yes
4		Zone 4	5.19	4.8	No
5		Zone 5	1.71	39	Yes
6		Zone 6	8.09	47.7	Yes
3	1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	Zone 3	2.67	21	Yes

3.1.6 High Threat and Priority Weeds

The BCD has a list of 'High threat weeds' (HTW) which need to be taken into consideration in the BDAR.

During the field surveys, three high threat weeds were recorded within BAM plots: *Bidens pilosa* (Farmers Friend), *Ehrharta erecta* (Panic Veldtgrass) and *Eragrostis curvula* (Africa Lovegrass). Although the three high threat weeds were located across all vegetation zones, they were concentrated adjacent to existing disturbance areas. The cover of 'high threatened weeds' are considered in the site value scores for each BAM plot (Annex 4). Other HTW recorded outside of the BAM plots include *Chrysanthemoides monilifera* (Bitou bush), *Ageratina adenophora* (Crofton Weed) and *Senecio madagascariensis* (Fire weed).

3.1.7 Threatened Ecological Communities (TECs)

A list of TECs occurring or potentially occurring within the locality as generated from the database searches is detailed in section 3.1.1 and Annex 1. The database searches identified 25 TECs that have been identified as potentially occurring within the locality.

Based on the results of the detailed vegetation validation, and review of the Conservation Advice of the TECs, no TECs were recorded on the subject site or are considered likely to occur.

3.2 Threatened Flora

3.2.1 Methods - Threatened Flora

A total of 21 threatened flora with the potential to occur within the locality, or as generated by the BAM Calculator, are presented in Annex 1.

In total, approximately 84.5 hours of threatened flora survey was conducted across the site (Table 7 and Figure 5). Furthermore, the visibility of the landscape, particularly in the relatively younger rehabilitation areas (Zone 1, Zone 2, Zone 4), was relatively open resulting in limited observer obstruction during the transect walks.

A survey was also conducted in 2018 by Dr Amanda Griffiths during the recommended survey month (August) to determine the presence of *Diuris praecox*. The survey was considered necessary as *Diuris praecox* has been recorded within the locality and on total of 208 individual *Diuris praecox* were recorded within Boral's landholding in September 2003 (ERM 2005b).

The population recorded by ERM in 2003 was adjacent to walking tracks and roads where it was noted there was reduced competition for light (ERM 2005b). Follow up site visits in 2004 noted that half the population was not flowering, which may have been attributed to increased shrub density and competition for light (ERM 2005b). The August 2018 survey did not include transect lines as per the DPIE (2020c) plant survey guide as this guideline was only publicly available in April 2020 after the lodgement of the application in March 2020.

A follow-up targeted survey was therefore completed for *D. praecox* in August 2020 as per the DPIE (2020c) guidelines. The survey was completed after confirming with the BCD that the *Diuris praecox* was flowering in August. The survey entailed a series of transects as per the DPIE (2020c) guidelines, which was walked by ecologists Luke Baker and Jodie Danvers. Given the relatively open ground layer throughout much of the site, visibility to detect the species during the traverses was generally unimpeded.

Table 7. Threatened flora survey timing and effort

Dates of survey	Consultant	Hours completed (total)
26 – 27th September 2017	Luke Baker, Alex Christie	18 hours
20th August 2018	Dr Amanda Griffith	7 hours
26th May 2020	Luke Baker	3 hours
27th – 28th May 2020	Dr Radika Michniewicz, Jodie Danvers	8 hours
30th June 2020	Luke Baker, Jodie Danvers	10 hours
1st July 2020	Luke Baker, Jodie Danvers	9 hours
24th – 25th August 2020	Luke Baker, Jodie Danvers	29.5 hours
Total		**84.5 hours**

3.2.2 Threatened Flora Results (BC Act)

No threatened flora listed on the BC or EPBC Acts were recorded during the field surveys.

The historic clearing events have changed the resilience across large portions of the site, particularly for vegetation in Zone 1, Zone 2 and Zone 4. These vegetation zones had relatively low recruitment of native

species, and were relatively open in terms of ground cover (see - Plate 5 as an example from Zone 4). We therefore consider vegetation Zone 1, Zone 2 and Zone 4 to have a low habitat preference for threatened flora.

Vegetation Zone 3 is dominated by a *Leptospermum* shrub thicket. The soil is more compacted compared to the open areas of bare sand. The ground cover within this vegetation zone is sheltered from direct sunlight due to the thicket, contains high litter cover and a protection from wind (

Plate **3**). Zone 3 may offer some habitat for threatened flora.

Vegetation Zone 5 and Zone 6 offer greater resilience and native recruitment and would be more suited to threatened flora habitat for the associated subject species (Plate 4).

Plate 2. Sand cover across the former quarry pit (vegetation zone 4)

Plate 3. Ground cover within former quarry pit (vegetation zone 3)

Plate 4. Native regeneration and high resilience in vegetation zone 6

In accordance with Section 6.4 of the BAM, the list of potentially occurring threatened flora species may be further refined where:

- habitat constraints listed for the species in the TBDC are absent from the subject site (or particular vegetation zones), or
- habitat constraints or microhabitats on which the species depends are sufficiently degraded such that the species is unlikely to use the subject site, or
- the species is vagrant in the IBRA subregion, or
- an expert report is prepared (in accordance with Subsection 6.5.2 of the BAM) stating that the species is unlikely to be present on the subject site.

Table 8 lists the candidate threatened flora species provides comment on the survey effort completed, and justifies where a species has been removed from further consideration.

Table 8: Candidate flora species predicted by the BAM Calculator to occur

Scientific Name	Recommended survey time (BAM)												Survey completed?	Considered further
	J	F	M	A	M	J	J	A	S	O	N	D		
Allocasuarina simulans	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
Angophora inopina	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time - conspicuous species that is unlikely to remain undetected during field survey.	Not considered further.
Callistemon linearifolius	Y	Y	Y	Y					Y	Y	Y	Y	Survey was not completed during the recommended survey time, however given the relatively conspicuous nature of the species, it is highly likely the species would have been detected during the field surveys if present. The species is known to flower in spring and will not lose foliage over the winter months. As such, even without the flower present, *Callistemon* species within the current landscape would have been identified during the months that survey took place. We therefore regard our survey as suitable for detection of the species.	Not considered further.
Corybas dowlingii						Y	Y	Y					Survey was completed during recommended survey time. We did not detect the species during the field surveys. It should be noted that *Corybas dowlingii* forms clonal colonies and typically grows in gullies in tall open forest on well-drained gravelly soil at elevations of 10-200m (Jones 2004). Much of the subject site is below 10 m elevation, and the soil types across the site are not of a gravelly soil structure. As such, the habitat suitability at the site for this species is relatively low.	Not considered further.
Cryptostylis hunteriana	Y	Y									Y	Y	A survey was not completed during the recommended survey time. This species is associated with moist and sandy soils and is also known to grow in dry or peaty soils. *Cryptostylis hunteriana* is known from the Gan Gan Hill and Tomaree Headland. The species is a saprophyte and therefore reliant on a symbiotic relationship with mycorrhizal fungus. Based on the relatively low natural regeneration evident within much of the former quarry pit, the potential for the species to occur on the rehabilitated quarry areas (Zone 1, Zone 2 and Zone 4) seems highly unlikely based on the current natural regeneration at the site and historic disturbance. Some potential may occur within Zone 5 and Zone 6 given these zones have greater soil resilience and recruitment.	Considered further.
Diuris arenaria									Y				Surveys were completed during recommended survey periods. The species can utilise 'dune/sandy hills' which fits the habitat types present within the subject site. The species has been previously recorded within the Worimi Conservation Lands along a powerline easement (near Bob's Farm) (Eastcoast Flora Survey 2010). The species was not recorded at the subject	Not considered further.

Scientific Name	Recommended survey time (BAM)												Survey completed?	Considered further
	J	F	M	A	M	J	J	A	S	O	N	D		
													site by ERM in 2005 (ERM 2005b), nor was the species recorded at the Fern Bay Estate (approximately 1.1 km to the southwest) in 2005 despite targeted surveys by ERM (ERM 2005a). Within the subject site, some potential habitat occurs within vegetation Zone 5 and Zone 6 given these areas have a relatively intact soil profile. However, the species was not detected during targeted flora survey, nor historically at the subject site, and as such, is not required to be considered further as per the BAM.	
Diuris praecox							Y	Y					A survey was completed in August 2018 by Dr Amanda Griffiths, and again in August 2020 by Jodie Danvers and Luke Baker. The survey in August 2018 was not completed to the requirements of DPIE (2020b) survey guidelines, which were released in April 2020. The follow-up survey in accordance with DPIE (2020b) guidelines was completed in August 2020. The survey was carried out after confirming with the BCD that Diuris praecox within the Newcastle Region was flowering. The survey effort that was completed involved transects covering the entire areas as shown in Figure 5. Each transect was walked by two qualified ecologists. The survey did not record the *Diuris praecox*. Based on the relatively low natural regeneration evident within much of the former mine quarry pit, the potential for the species to occur on the rehabilitated quarry e pit encompassing areas (Zone 1, Zone 2, Zone 3 and Zone 4) seems highly unlikely. Some potential may occur within Zone 5 and Zone 6 given these areas have greater soil resilience and recruitment, however the survey confirmed that the species is not present.	Not considered further.
Eucalyptus camfieldii	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time and given it is a conspicuous species it is unlikely to remain undetected following field survey.	Not considered further.
Eucalyptus parramattensis subsp. decadens	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time and given it is a conspicuous species it is unlikely to remain undetected following field survey.	Not considered further.
Melaleuca groveana	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time and given it is a conspicuous species it is unlikely to remain undetected following field survey.	Not considered further.
Prostanthera densa	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time and given it is a conspicuous species it is unlikely to remain undetected following field survey.	Not considered further.

Scientific Name	Recommended survey time (BAM)												Survey completed?	Considered further
	J	F	M	A	M	J	J	A	S	O	N	D		
Rhizanthella slateri									Y	Y	Y		Survey completed during recommended survey period in September. We note that the species is relatively cryptic and as such the survey team looked for tips of bract breaking the surface of the sandy soil during surveys. Although the species was not detected during the surveys, we note that the LMCC (2014a) Flora and Fauna Survey Guidelines state that the species is *'difficult or impossible to detect even when flowering*'. As such, Niche has investigated the known and potential habitat associated with the species, and notes the following: - The subject site does not occur within the likely distribution range for the species as per DoE (2020a), but does occur within a 'known subregion' according to the TBCD given the known population at Bulledellah. - The population at Bulledellah is the closest known population to the subject site, approximately 50 km to the north, where the species occurs on the western slopes and base of Bulahdelah Mountain (known locally as Alum Mountain). - The species was not been recorded at the subject site by ERM, nor has the species been recorded during other investigations in the locality (e.g. ERM (2005a, 2005b); EastCoast Survey (2010)). Based on the above we therefore conclude that there is a low likelihood for the species to be present.	Not considered further.
Senecio spathulatus	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Survey completed during recommended survey time and given it is a conspicuous species it is unlikely to remain undetected following field survey. It should be noted that this species occurs on the frontal dune system, but the site does not occur on the frontal dune system complex.	Not considered further.
Tetratheca juncea							Y*	Y*	Y	Y	Y*	Y*	A targeted survey was completed during the recommended survey period in September, and also during August 2018. We note that this species has since been listed in the TBDC to have a survey period only in September/October. We did not detect the species during our survey. We note that the species is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. The site predominately did not have a grassy ground cover as evident in the plot cover scores provided in Annex 4. The Threatened Species Profile also states that the '*majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape*' (OEH 2018d). The Awaba soil landscape does not occur at the subject site. The Lake Macquarie Habitat suitability modelling using compiled species records shows core population densities around the Central Coast and North Coast Regions on Map 1 of LMCC (2014c). The closest record to the site is	Not considered further.

Scientific Name	Recommended survey time (BAM)												Survey completed?	Considered further
	J	F	M	A	M	J	J	A	S	O	N	D		
													approximately 8 km to the south in Newcastle. Other records throughout NSW are situated away from similar dune vegetation to the site. Map 2 provided in LMCC (2014c) contains the mapped *Tetratheca juncea* habitat and distribution of records. The site does not occur within areas mapped by LMCC as 'modelled suitable *T. juncea*' habitat. Based on the information gathered, we conclude that the species has a low likelihood to occur at the site given the following: - The species was not detected during field survey. - No modelled habitat by LMCC occurs within the subject site. - No records of the species have previously been recorded at the site, or during the current survey (we note however that the survey was completed during the correct survey times at the time of submission). - Records for the species indicates that the species may not coincide with the habitat present at the subject site. - Vegetation zones 1, Zone 2, Zone 3 and Zone 4 have low native recruitment, low resilience due to historic clearing and are unlikely to be suitable habitat for the species.	
Thesium australe	Y	Y							Y	Y	Y	Y	Survey completed during recommended survey period. It occurs on soils derived from sedimentary, igneous and metamorphic geology on a range of soils including black clay loams to yellow podzolics and peaty loams. The site contains sandy loams and as such is likely unsuitable regardless of survey.	Not considered further.

* survey time for the species as presented in the BAM calculator submitted January 2020.

3.2.3 Threatened Flora for Further Consideration

Our survey and analysis confirm that no threatened flora requiring species credits were recorded within the subject site. However, we note that transects have not been completed within the required survey period specified in DPIE (2020c) for *Cryptostylis hunteriana*.

As discussed in section 3.2.1, it seems unlikely that habitat for *Cryptostylis hunteriana* would occur within much of the former rehabilitated quarry pit (vegetation zones Zone 1, Zone 2 and Zone 4) for the reasons previously described. We have therefore assumed that in-lieu of targeted surveys, habitat for the species, if were present, may occur within the portions of the subject site that have greater resilience and recruitment. These areas are shown on Figure 7, and encompass vegetation zones Zone 3, Zone 5 and Zone 6, which totals 12.47 ha. This area is referred to in this assessment as the species polygon for *Cryptostylis hunteriana* ¸ which is considered further in section 5.2. It should be noted that Boral propose to undertake field surveys during the correct survey months as per the DPIE (2020c) guidelines in order to confirm the presence or absence of the species and amend the polygon, if required, through a modification assessment (section 7.2).

3.2.4 Threatened Flora Results (EPBC Act)

No threatened flora as listed on the EPBC Act were recorded during the field survey. Threatened flora listed on the EPBC Act have been addressed in Annex 1. For the reasons stated above wit is conclude that the subject site has potential habitat for one EPBC Act listed threatened flora *Cryptostylis hunteriana*. We have assumed based on the habitat present, the species has a moderate likelihood of occurrence within the species polygon shown on Figure 7 and, as a precautionary measure, have completed an EPBC Act Assessment of Significance the species.

4. Fauna and Fauna Habitat Assessment

4.1 Fauna assessment

Comments regarding the BDAR from the Agencies were provided to Boral and Niche in March 2020. The Agency comments related primarily to the requirement for further targeted threatened fauna using guidelines provided in the TBDC and the Lake Macquarie Survey Guidelines. In particular, both BCD and PSC recommended that targeted survey threatened owls (Barking Owl, Masked Owl and Powerful Owl), Brush-tailed Phascogale, and threatened amphibians (Wallum Toadlet, Green-thighed Frog and Mahony's Toadlet). This revised BDAR has involved extensive targeted threatened fauna survey and assessment of habitat features for each of the subject threatened fauna, which has been described throughout this chapter.

4.1.1 Methods – Data Review

As for the native vegetation and flora assessment, a review of relevant literature, databases and existing vegetation mapping was undertaken to identify vegetation (fauna habitat) and threatened fauna with the potential to occur on the subject site. Data reviewed included:

- Database searches:
  - *NSW BioNet Atlas Database* (DPIE 2020d) for spatial records of threatened flora listed under the BC Act within a 10 kilometre (km) radius of the subject site.
  - *EPBC Act Protected Matters Search Tool* (PMST) (DAWE 2020) for list of flora and ecological communities identified as MNES known or with potential habitat within a 10 km radius of the subject site.
  - BAM-Calculator candidate and predicted species list.
- Previous relevant studies including:
    - Ecotone (2008) Vertebrate Fauna Survey Worimi Conservation Lands prepared for the NSW Department of Environment and Climate Change.
    - ERM (2005a) Fern Bay Estate, Species Impact Statement, Prepared for Winten Property Group and Continental Venture Capital Limited.
    - ERM (2005b) Stockton Sandpit Windblown Sand Extraction, Environmental Impact Statement, Prepared for Boral Resources (Country) Pty Limited.

Results of the searches and reviews were undertaken prior to field survey to inform field survey requirements. A likelihood of occurrence analysis (Annex 1) was then undertaken for each species, based on suitability of habitat present within the subject site.

4.1.2 Methods – Field Survey

The likelihood of occurrence for threatened fauna, along with the candidate threatened fauna as per the BAM Calculator dictated the survey method approach. The fauna survey was primarily designed to target threatened fauna that are regarded as 'species credit' fauna, and those listed as threatened on the EPBC Act.

The following guidelines or documentation were consulted to assist with establishing the survey plan:

- TBDC (May & June 2020) reviewed prior to field survey
- TBDC (June 2017) reviewed prior to field survey
- Lake Macquarie City Council Flora and Fauna Survey Guidelines LMCC (2014a)
- Threatened Species – Field Survey Methods (OEH 2015)
- Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians (DECC 2009)
- Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities Working Draft (Department of Environment and Conservation, 2004)
- Survey Guidelines for Australia's Threatened Frogs (DEWHA 2010a)
- Survey Guidelines for Australia's Threatened Bats (DEWHA 2010b)
- Survey Guidelines for Australia's Threatened Birds (DEWHA 2010c)
- Survey Guidelines for Australia's Threatened Mammals (DEWHA 2011a)
- Survey Guidelines for Australia's Threatened Reptiles (DEWHA 2011b)
- Relevant Significant Impact Guidelines and Referral Guidelines for EPBC Act listed species.

Survey methods were selected to detect the target species identified during desktop research (i.e. threatened species with the potential to be impacted by the Project), as well as to employ a broad range of survey techniques that allowed for detection of the variety of fauna species groups.

Survey methods and effort is summarised in Table 10 with an overview of the survey dates provided in Table 9 below. Figure 8 shows the location of the fauna survey effort.

Table 9. An overview of fauna field survey dates

Dates of survey	Ecologist	Key fauna survey tasks completed during field campaign
26 – 27th September 2017	Luke Baker, Alex Christie	Habitat assessment, Bird survey, Anabat, SAT survey
20th August 2018	Dr Amanda Griffith	Opportunistic bird survey
26th – 28th May 2020	Luke Baker, Dr Radika Michniewicz, Jodie Danvers	Camera trapping, spotlighting, call playback, stag watching, hollow-bearing tree mapping, bird survey, amphibian survey
30th June 2020 - 1st July 2020	Luke Baker, Jodie Danvers	Camera trapping, spotlighting, call playback, stag watching, hollow-bearing tree mapping, bird survey, amphibian survey

The field survey program was designed to detect potentially occurring threatened species and allow for an inventory of species to be compiled for the subject site. Although singular sightings of individual species

were recorded during targeted surveys, repeat observations were not necessarily recorded. Incidental observations were recorded if the species had not been detected during targeted survey, was a threatened species, or was considered rare either within the subject site or more widely.

Details of the daily weather conditions have been provided in Annex 6. The mean weather conditions during the majority of the survey period (June 2020) consisted of day temperatures of 19 degrees, and at lowest temperature of approximately 12 degrees during night surveys.

Heavy rainfall (approximately 33.2 mm) occurred prior to the May 2020 field survey, which provided the recommended amphibian survey conditions (20 mm recommended) specified in the Amphibian Guidelines (DECC 2009) to maximise detection of the Wallum Toadlet.

During spotlighting, call-playback and stag watching, the wind conditions were relatively calm.

Table 10: Fauna survey effort

Fauna Group	Survey Technique	Survey effort	Details
All	Spotlighting	26/5/20 (start: 18.15) 27/5/20 (start: 18:30) 28/5/20 (start 18.20) 30/6/20 (start 18.00) 1/7/20 (start 18:15)	Spotlighting was undertaken by two ecologists within all habitat types of the subject site using LED torches. Each spotlighting session lasted for approximately one hour.
Mammals – arboreal	Camera trapping	59 camera traps Date established: 26/5/20 Date collected: 1/7/20 Total survey effort: 49,560 hours	A total of 59 baited camera traps (combination of Moultrie model MCG-12596, Scoutguard model SG562C, Reconyx model HC500) were set across the site. The cameras were placed in areas that were likely to yield the best results for target species (e.g. not within open bare sand areas). Each of the traps were mounted onto a tree at head height secured with the camera straps and a bait canister containing honey, oats and peanut butter was placed on an opposite tree at similar height. The bait cannister was secured with a nail and wire. The cameras remained in place for four weeks and the bait was changed at two weeks. Camera trap results were checked immediately after the field survey.
Mammals – ground	Camera trapping	21 camera traps Date established: 26/5/20 Date collected: 1/7/20 Total survey effort: 18,144 hours	A total of 21 baited camera traps (Scoutguard model SG562C) were set across the site. The cameras were set in all the vegetation zones. Each of the traps were mounted onto a tree at knee height secured with the camera straps and a bait canister containing honey, oats and peanut butter was placed on the ground and secured with a peg. The cameras remained in place for four weeks and the bait was changed at two weeks.
Mammals – Koala	SAT plot	3 x survey 26/07/2017 1 x survey 27/07/2017	SAT (Koala scat) surveys were conducted across the subject site at the locations shown in Figure 8. The bases (0 to 2 m from the trunk) of twenty such trees were searched for evidence of Koala scat by first circling around the tree looking for scats without disturbing the leaf litter (approximately 1 minute), then by raking through the leaf litter for scats (approximately 1 additional minute). In addition to SAT surveys, random tree inspections were carried out during traverses of the subject site at selected feed trees searching for scats and characteristic bark scratches.
Bird	Diurnal survey	1 x survey 26/07/2017, (2 hours) 15:30 into dusk 1 x survey 27/07/2017 (2 hours) 6:55	To date, the DPIE has not yet published the 'Bird Survey Guidelines' to provide guidance in relation to BDARs. We were advised by BCD in June 2020 that Niche should apply the most relevant guidelines available (ie. DECC 2004, LMCC 2014a).

Fauna Group	Survey Technique	Survey effort	Details
		1 x survey 26/5/2020 (30 mins) 16:45 1 x survey 30/6/20 (40 mins) 16:45 1 x survey 1/7/2020 (25 mins) 16.45	Two ecologists conducted 20 minute, two hectare bird surveys at the areas shown on Figure 8. These were generally lengthened in time due to relatively low bird activity in most areas and additional species being recorded after or at the end of the 20 minute period. Incidental bird sightings were made throughout surveys activities with species of note being recorded. Birds were identified with the use of 10 X 42 binoculars or from their calls.
Birds	Nocturnal survey – call playback	26/5/20 (start: 17.15) 27/5/20 (start: 17:40) 28/5/20 (start 17.30) 30/6/20 (start 5.16) 1/7/20 (start 17:20)	Calls of targeted species (Powerful Owl, Masked Owl, Barking Owl and Bush-stone Curlew) were broadcast using a loud hailer for up to five minutes followed by five minutes of listening time. This process was repeated several times for each species at each survey site. A total of seven survey sites (two additional locations for only the Bush-stone Curlew in more suitable habitat were included) were established across the subject site in locations that offered sufficient vantage points and habitat features that may suit each species. Given the volume of the loud hailer and size of the subject site, the broadcasted calls at each survey location could be heard from all areas of the subject site.
Birds	Nocturnal survey – stag watching	26/5/20 (start: 17.15) 27/5/20 (start: 17:40) 28/5/20 (start 17.30) 30/6/20 (start 5.16) 1/7/20 (start 17:20)	Stag watching commenced prior to and during call playback. Vantage points were established near potential roost trees. Stag watching commenced prior to call playback, at approximately to 17:00 pm (prior to dusk) and continued for approximately 30-40 minutes coinciding with the call playback surveys. Six stag survey sites were established, and each was surveyed once during the survey program.
Birds	General survey transects and tracks	Conducted in conjunction with all diurnal surveys	Opportunistic bird surveys were conducted in conjunction with all diurnal surveys. Many of the threatened fauna requiring targeted survey were relatively conspicuous (e.g. Glossy-black Cockatoo and Gang-gang Cockatoo) and therefore would likely have been heard/or observed during activities such as camera trap deployment and hollow-bearing tree mapping. Furthermore, the extensive survey tracks completed across the area were also subsequently used to survey for nests of the Bush-stone Curlew.
Microbats	Echolocation Call	2 x Anabat left for 2 x consecutive nights 26/09/2017 (5pm – 5am 10 hours);	Anabat II bat detector and Anabat CF recorder units were deployed at two sites over two nights along potential flyways.

Fauna Group	Survey Technique	Survey effort	Details
		27/09/2017(5pm – 5am 10 hours)	
Amphibians	Spotlighting transects	26/5/20 (start: 18.15, 1.75 hr pp) 27/5/20 (start: 18:30, 1.25 hr pp) 28/5/20 (start 18.20, 1.5 hr pp)	Three amphibian transects were completed in conjunction with the general spotlighting transects described above. The spotlighting transects were carried out immediately after 20 mm of rainfall (as recorded on Tuesday 26th May – 33 mm). The amount of rainfall did not result in any significant pool habitat or inundation areas being created within the subject site, nor within the patch of Swamp Sclerophyll Forest close to the subject site. The quarry manager confirmed that the site does not retain water following rainfall, with the exception being the Pasha Bulker storm in 2007 where a pool formed following days of heavy rainfall in the former quarry pit. The survey guidelines recommend '*a 200 m transect within watercourses or inundation areas*' (DECC 2009). Given the subject sites does not contain water features, our survey approach was to cover a greater distance than the 200 m transects specified in the guidelines and complete a series of transects within all habitat types within the subject site. This enabled the team to cover greater ground during ideal conditions, and not limit the team to only 200 m transects within non-watercourse habitats. Males of the Wallum Froglet also call at any time of the year, especially after heavy rain and, as such, calls of the Wallum Froglet were listened for during the spotlighting transects and diurnal surveys.
All	Survey tracks and transects		Opportunistic observations were made of fauna using binoculars and photography. Opportunistic survey included searches of micro habitat; under logs, waste piles (where limited areas of such habitat existed) or within heaped leaf litter, casual bird or mammal observations, or by listening for calls.

4.1.3 Fauna and Fauna Habitats

Fauna species recorded in the subject site are listed in Annex 5. A total 50 species were recorded during field surveys, comprising 38 birds, seven mammals, and five reptiles.

Of the species recorded, the Brush-tailed Possum and Ring-tail Possum were the most commonly encountered species, detection via infrared cameras and spotlighting. The Swamp Wallaby was the most encountered mammal during the day surveys.

Three threatened fauna were recorded with the subject site; Greater Broad-nosed Bat, Eastern Bent-wing Bat and White-bellied Sea Eagle. Both the threatened microbats were recorded via Anabat, whilst the White-bellied Sea Eagle was recorded flying over the subject site on most days of the field surveys. A feather of a Glossy-black Cockatoo, and evidence of foraging on planted Allocasuarina littoralis trees (chewed cones) was also recorded at the locations shown on Figure 9.

Our assessment stratified the subject site into different habitat types, which were generally reflective of the rehabilitation efforts. The habitat types are shown on Figure 9 and are described below.

Habitat – Dune

Ground cover across much of younger rehabilitation areas (vegetation Zone 4) were generally sparse consisting of bare sand cover. The sandy substrate may provide burrowing habitat for small to medium-sized mammals, however only three small borrows were encountered during transects. The three burrows were quite old and were not deep, and no tracks were recorded outside the entrances. Two rabbits were observed during the site survey and are likely to have habitat within the open rehabilitated areas.

Plate 5. Dune habitat within former quarry pit

Habitat – Forest

Forest habitat has been grouped into three categories representing stratums and condition:

- Young open forest habitat: represents the younger rehabilitation areas. The height of the trees were approximately 3 – 5 m. Shrub and ground layer was quite open. The area would be suitable for foraging habitat during spring when many of the shrubs are flowering.
- Open forest habitat: The large-scale planting of the former quarry pits have resulted in a forest habitat type, ranging in canopy heights of 5-10 metres. Tree species mainly comprised *Eucalyptus pilularis, Cormbia gummifera* and *A. costata.* Midstorey cover comprised plantings of *Allcasuarina littoralis, Acacia species* and Leptospermums.

  The *Allocasuarina littlorlis* tubestock have created a foraging resource for the Gang-gang Cockatoo. Evidence of foraging was present with chewed cones beneath trees at the locations shown on Figure 9.
- Forest habitat: consisted of remnant vegetation or the older rehabilitated areas where occasional trees where not cleared during historical mining operations. These areas had all stratum layers intact, and a higher diversity and coverage compared to the younger areas of forest habitat. Tree hollows were present throughout the forest habitat type. Such areas are likely to provide greater breeding and foraging resources compared to the younger forest habitat types.

Plate 6. Young open forest – habitat

Plate 7. Open Forest – habitat

Plate 8. Forest habitat

Habitat – Shrub Thicket

A relatively homogenous planting of *Leptospermum laevigatum and L. trinervium* occurs within vegetation zone 3. Some scattered trees of *Angophora costata* and *Eucalyptus pilularis* have been planted in the area, however the vegetation zone is predominately a shrub thicket. Ground cover throughout this area is very sparse, consisting of a few native grass species and very few forbs.

This area during times of flower may be suitable foraging habitat for a range of bird species, and the Squirrel Glider, which is known to occur within the Worimi National Park.

Plate 9. Shrub thicket

Habitat – Tree Hollows and stags

A hollow-bearing tree survey was carried out during the May-July 2020 field survey. The location of hollow-bearing trees and stags are provided in Annex 7 and shown on Figure 9. The hollow-bearing trees were

restricted to vegetation Zone 5 and Zone 6, being the vegetation zones that consisted of remnant vegetation or rehabilitated areas that contained scattered remnant trees. All planted trees within the other vegetation zones of the subject site are not at an age where hollows have developed.

The hollow-bearing trees were typically *Angophora costata, Eucalyptus pilularis* and *Banksia serrata*, and ranged in size from 30 cm to greater than 80cm diameter at breast height. The size of the hollows ranged in size from 5 cm to over 30cm. The base of a hollow-bearing tree inspected for the presence of owl pellets or prey, to which no evidence of usage was observed during the time of the survey.

Areas of hollow-bearing trees were also observed from vantage points during stag watch and call-playback survey. No fauna were observed leaving the hollows during the survey activity.

Many of the camera traps were also placed facing the hollow-bearing trees to increase detectability of hollow-dwelling species. As previously mentioned, only the Bush-tailed Possum and Ring-tail Possums were recorded on the cameras.

Aquatic habitat

There are no water features within the subject site such as creeks, swamps, dams or pools. The subject site does not contain Swamp Sclerophyll Forest or wetland/swamp habitat, which would retain pools or be inundated after heavy rains.

The May-July field surveys were conducted following 20 mm of rain to target threatened amphibians, including the Wallum Froglet, during the correct conditions. Despite the rain, the amount of rainfall did not result in any pool habitat or inundation areas forming within the subject site. The Quarry Manager confirmed that the site does not retain water following rainfall, with the exception being during the Pasha Bulker storm in 2007 where many days of heavy rainfall resulted in a pool forming in the former quarry pit.

The closest area that would retain pools or be inundated following heavy rainfall is immediately north of the subject site, near the quarry carpark. This area is shown on Figure 9 as Swamp Sclerophyll Forest. However, this area was not inundated following the 33 mm of rainfall. Following extended periods of heavier rainfall it is likely this area would become inundated and provide amphibian habitat.

4.1.4 Assessment of Threatened Fauna and Populations

Threatened species predicted or potentially occurring within the IBRA subregion as generated by the BAM Calculator were reviewed and refined post field survey on the basis of the vegetation types, condition and habitat features, as well as the results of field survey.

In accordance with Section 6.4 of the BAM the threatened fauna list of potentially occurring species may be further refined where:

- habitat constraints listed for the species in the TBDC are absent from the subject site (or particular vegetation zones), or
- habitat constraints or microhabitats on which the species depends are sufficiently degraded such that the species is unlikely to use the subject site, or
- the species is vagrant in the IBRA subregion, or
- an expert report is prepared (in accordance with Subsection 6.5.2 of the BAM) stating that the species is unlikely to be present on the subject site.

The list of predicted and candidate species generated via the BAM Calculator is presented in Table 11. A status for each species is provided which represents the basis for deciding whether a species was present or absent from the subject site. No ecosystem credit species were omitted from the BAM Calculator.

Table 11: List of Predicated and Candidate fauna species and assessment of credit requirement

Common Name	Scientific Name	Recommended survey time											Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D	
Candidate threatened species														
Regent Honeyeater (Breeding)	*Anthochaera Phrygia*									Y	Y	Y	Y	The subject site does not occur within the 'important Regent Honeyeater' map as per the BAM Important Areas Map. Therefore the 'species credit' component associated with Regent Honeyeater breeding habitat is not triggered. The Regent Honeyeater is therefore not considered further.	Not considered further
Bush Stone-curlew	*Burhinus grallarius*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	A targeted survey was completed using call playback, spotlighting and transects within the appropriate survey period. The species was not detected during targeted survey, and thus as per the BAM, the species is not required to be considered further.	Not considered further.
Gang-gang Cockatoo (Breeding)	*Callocephalon fimbriatum*	Y									Y	Y	Y	Breeding habitat as specified in TBCD (June 2020)[2] includes: *'(1) lone adult males have been identified at the site during the breeding season (October to January); or (2) an occupied nest has been found.'* As per the directions on the TBCD, hollow-bearing tree survey has been used to identify whether potential nest hollows are present (defined as hollows in forest and woodland eucalypts; (i) at least 9 m above the ground and, (ii) with hollow diameter of 10 cm or larger). Such features were recorded within the subject site and are common throughout the locality within *Eucalyptus pilularis* and *Angophora costata* trees. Given potential habitat exists, it is proposed that the species is monitored during the breeding season (October to January) to determine whether breeding is occurring on the site. DPIE is currently developing survey guidelines for threatened bird species. In the absence of guidelines, the BCD advised Niche in June 2020 to follow the best available guidelines for detecting breeding in this species, which will require surveys to be completed in October-January.	Considered further.
Glossy Black-Cockatoo (Breeding)	*Calyptorhynchus lathami*			Y	Y	Y	Y	Y	Y					Similar to the Gang-gang Cockatoo, the DPIE have not yet released survey guidelines for this species. Breeding habitat as specified in the TBCD (June 2020)[3] includes: *(1) begging birds of any age or sex have been identified at the site; or* *(2) lone adult males have been identified at the site during the breeding season (April to August); or* *(3) an occupied nest has been found.* As per the directions provided in the TBCD (June 2020) we have surveyed for all potential nest hollows (defined as *(i) at least 8 m above the ground and, (ii) in stems with a diameter of at least 30 cm and, (iii) hollow diameter is at least 15 cm and, (iv) stem angle is at least 45 degrees, and may be near-vertical or vertical)* (see Figure 9 for locations of potential nesting trees). The species was surveyed using targeted bird surveys during the correct survey season. It should be noted that the species is highly recognisable and would have been observed during all the other survey activities	Not considered further

[2] It should be noted that the definition of breeding habitat and hollow-bearing tree size/age have changed since the submission of the original BDAR.

[3] It should be noted that the definition of breeding habitat and hollow-bearing tree size/age have changed since the submission of the original BDAR.

Common Name	Scientific Name	Recommended survey time											Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D	
														had it been present. Evidence of the Glossy-black cockatoo was recorded at the site with a feather and chewed allocasuarina cones recorded (Figure 9). However, if the species was breeding in the subject site, it is likely we would have recorded the species during the survey. The species is relatively conspicuous, and given the amount of hours spent on-site during the correct breeding time, it is likely the species would have been detected if actively using hollow-bearing trees for breeding. Given it was not recorded during the field surveys, the habitat would not be regarded as known 'breeding habitat' as per the BAM guidelines.	
Eastern Pygmy-possum	*Cercartetus nanus*	Y	Y	Y						Y	Y	Y	Y	The subject site does not occur within a location that fits the distribution of the species as described in the Scientific Determination for the species - '*In New South Wales the species is found in coastal areas and at higher elevation in the south, but north of Newcastle at higher elevation only*'. This is supported by the closest record for the Eastern Pygmy Possum, occurring 20 km to the north of the subject site. The species has also not been recorded during previous surveys of the Boral landholding by ERM (2005b), or nearby fauna surveys associated with Worimi Conservation Lands (Ecotone 2008), Fern Bay (ERM 2005a). Despite the habitat not being ideal for the species, we deployed an extensive number of camera traps across the subject site and undertook spotlighting survey across all habitat types. Our survey did not record the species. Although the timing was outside of the recommended survey time provided in the TBCD, we note that the LMCC (2014a) guidelines state that at any time of the year a survey may 'still detect the species, though the months of September to June are optimal'. Given ours and previous survey results, and that the subject site is outside the know distribution of the species, the species is considered to have a low likelihood of occurrence.	Not considered further.
Large-eared Pied Bat	*Chalinolobus dwyeri*	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	The habitat descriptions provided in OEH (2018a) '*Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method'* note that the Large-eared Pied Bat breeding habitat occurs within 2 km of caves, scarps, cliffs, rock and disused quarries. The subject site does not occur within 2 km of such features. The species was also not recorded during the Anabat analysis. The use of bat call detector is the recommended method for recording this species LMCC (2014a). Given the absence of records and the distance from breeding resources, the subject site is unlikely to support habitat for the Large-eared Pied Bat.	Not considered further.
Wallum Froglet	*Crinia tinnula*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	There are no drainage lines, watercourses, dams or swamp-like vegetation within the subject site. The nearest swamp sclerophyll habitat that may become inundated following rainfall occurs immediately north of the subject site (as shown on Figure 9). Following over 30mm of rainfall, which is above the 20 mm specified as ideal survey conditions (LMCC 2014a), there pools or inundation within the Swamp sclerophyll Forest, nor within the subject site. Following 20 mm of rainfall, Dr Radika Michniewicz and Jodie Danvers completed three nights of spotlighting transects targeting the species. Given the subject sites does not contain water features, our survey approach was to cover a greater distance than the 200 m transects specified in the guidelines by completing a series of transects within all habitat types of the subject site. This enabled the team to cover greater ground during ideal conditions, and did not limit surveys to 200 m transects within non-water	Not considered further.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D		
														course habitats. Males of the Wallum Froglet call at any time of the year, especially after heavy rain and, as such, calls of the Wallum Froglet were listened for during the spotlighting transects. The surveys did not detect the Wallum Froglet within the subject site. The lack of water bodies within the subject site means habitat for the species is unlikely to be present.	
Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	*Dromaius novaehollandiae* - endangered population	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The Emu was not detected during the field surveys. No Emus were recorded on the camera traps, nor have they been previously recorded within the subject site by Boral staff.	Not considered further.
White-bellied Sea-Eagle (Breeding)	*Haliaeetus leucogaster*							Y	Y	Y	Y	Y	Y	The White-bellied Sea-Eagle is a dual credit species, with breeding habitat triggering species credits. The White-bellied Sea-Eagle was recorded flying over the subject site during the September and July surveys. The TBCD states that '*Breeding habitat is live large old trees within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines AND the presence of a large stick nest within tree canopy; or an adult with nest material; or adults observed duetting within breeding period.* Our survey effort has confirmed that no large stick nest are present within the subject site. Given we have covered the entire subject site intensively, it is highly unlikely that breeding habitat is present within the subject site.	Not considered further.
Little Eagle (Breeding)	*Hieraaetus morphnoides*								Y	Y	Y			The Little Eagle is a dual credit species, with breeding habitat triggering species credits. Little Eagle Breeding habitat is defined in the TBCD as '*live (occasionally dead) large old trees within suitable vegetation AND the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy*'. The survey did not record the presence of the Little Eagle, nor did it record any large stick nests. Therefore, it is conclude that the subject site does not contain breeding habitat for the Little Eagle.	Not considered further.
Pale-headed Snake	*Hoplocephalus bitorquatus*	Y	Y	Y								Y	Y	The TBDC (as at June 2020) notes that the Pale-headed Snake can be found '*within 500m of moderate to good vegetation*', and further describes habitat as '*found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest*'. Both definitions of habitat, but particularly '*moderate to good vegetation*', are very broad and encompass most vegetation types, including derived native grasslands. The TBDC also states that the species utilise hollows. The LMCC (2014a) survey guidelines describe habitat for the species as '*Loose bark, tree hollows in riparian habitat in dry eucalypt forest / woodland*'. The species is also described as preferring Callitris woodlands	Considered further.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D		
														(Scientific Committee Determination). The main prey is tree frogs although lizards and small mammals are also taken. The subject site does not contain riparian habitat, and the closest record to the subject site is 30 km to the immediate west. Within the immediate locality, habitat for this species is likely to be within Swamp Sclerophyll Forest where there are tree hollows. Riparian habitat does not occur within the subject site. The areas containing tree hollows (Zone 5 and Zone 6) are not located in riparian habitat, nor do they contain Callitris woodlands. Based on the habitat descriptions in the LMCC (2014a) guidelines, the species is unlikely to occur, but if the broader definition of the TBCD is used, potential habitat is present.	
Swift Parrot (Breeding)	*Lathamus discolor*					Y	Y	Y	Y					The species is a dual credit species, with the species credit component mapped as an important area. These mapped areas do not require survey as it is presumed that the species is present. The subject site does not occur within an important area.	Not considered further.
Green and Golden Bell Frog	*Litoria aurea*	Y	Y	Y							Y	Y	Y	The BAM calculator lists the following habitat constraints in reference to potential habitat for the Green and Golden Bell Frog: *- 'Semi-permanent/ephemeral wet areas* *- Within 1km of wet areas/Swamps* *- Within 1km of swamp/Waterbodies* *- Within 1km of waterbody'* The above terms are very broad definitions (e.g. what constitutes a 'wet area'?) with little guidance provided. When referenced in relation to the specific habitat requirements for the species as detailed in BioNet, habitat for the Green and Golden Bell Frog includes: *- 'marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (Eleocharis spp.).* *- water-bodies that are unshaded, free of predatory fish such as Plague Minnow.'* The subject site does not contain any of the above features. The closest dam to the subject site is approximately 350 m north of the subject site. This dam is separated from the subject site by Nelson Bay Road. The Project will not impact upon this water feature, nor any other known areas of potential habitat. Given such habitat requirements are absent for the species, it is unlikely that the Green and Golden Bell Frog would be present at the subject site.	Not considered further.
Green-thighed Frog	*Litoria brevipalmata*	Y	Y	Y								Y	Y	As stated in the TBDC, the Green-thighed Frogs '*occurs in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain*' and ' *Breeding occurs following heavy rainfall from spring to autumn, with larger temporary pools and flooded areas preferred*'. The TBDC recommends that survey be undertaken after rainfall events of >75 mm in 24 hrs or 150 mm over 72 hrs as the most probable time to survey and detect the species.	Not considered further.

Common Name	Scientific Name	Recommended survey time											Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D	
														In relation to the LMCC (2014a) Guidelines: preferred breeding/sheltering habitat is in ephemeral pools in creeklines and soaks in flood prone vegetation. As previously discussed, the subject site does not contain watercourses or riparian habitat, is not flood prone. Although the subject site was not visited after 75 mm of rainfall, the quarry manager has confirmed that the subject site does not hold water with the exception being following the Pasha Bulker storm in 2007 where a pool formed in the former quarry pit following days of heavy rainfall. In the context of other records for the species, the subject site is within 35 km of the closest record. The species has also not been detected during a fauna surveys of the site by ERM (2005b), at the Fern Bay development (ERM 2005a) nor within the Worimi Conservation lands (Ecotone 2008). There is no suitable habitat for this species present within the subject site.	
Square-tailed Kite (Breeding)	*Lophoictinia isura*	Y								Y	Y	Y	Y	Breeding habitat is living large old trees within suitable vegetation AND the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy. Our hollow-bearing tree survey confirmed the absent of large stick nests. Therefore, it is unlikely that breeding habitat of the species occurs within the subject site.	Not considered further
Little Bentwing-bat (Breeding)	*Miniopterus australis*	Y	Y										Y	The species is regarded as a dual credit species with breeding habitat triggering species credits. Breeding habitat includes: -Caves - Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave' observation type code 'E nest-roost' with numbers of individuals >500 or from the scientific literature. None of these features occur at the subject site or immediately adjacent.	Not considered further.
Large Bentwing-bat (Breeding)	*Miniopterus schreibersii oceanensis*	Y	Y									Y	Y	The species is regarded as a dual credit species with breeding habitat triggering species credits. habitat includes: --Caves - Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave' observation type code 'E nest-roost' with numbers of individuals >500 or from the scientific literature. None of these features occur at the subject site or immediately adjacent.	Not considered further.
Southern Myotis (Breeding)	Myotis macropus	Y	Y	Y							Y	Y	Y	The species is regarded as a dual credit species with breeding habitat triggering species credits. Breeding habitat as described in the TBDC includes: - *'Hollow bearing trees* - *Within 200 m of riparian zone|Other* - *Bridges, caves or artificial structures within 200 m of riparian zone|Waterbodies* - *This include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site'*	Not considered further.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D		
														The Bat survey guidelines (OEH 2018a) also state that habitat for the species is '*land within 200m of a waterbody with pools/ stretches 3m or wider including rivers, creeks, billabongs, lagoons, dams and other waterbodies on the subject site'.* The subject site contains hollow-bearing trees, but is over 200 m from waterbodies. As such, no breeding habitat would be impacted.	
Barking Owl (Breeding)	*Ninox connivens*					Y	Y	Y	Y	Y	Y	Y	Y	The species is regarded as a dual credit species with breeding habitat triggering species credits. As at June (2020), breeding can be identified by "suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified". The subject site contains approximately 9.8 ha of suitable habitat. This is made up of the following vegetation zones: Zone 5 and Zone 6 which contain hollow-bearing trees. In order to determine the presence of breeding habitat, we completed the following survey (as detailed in section 4.1.2): - Spotlighting - Call playback - Stag watching from key vantage points. Our field survey did not record the Barking Owl on the subject site, nor any nests during the hollow-bearing tree surveys. Thus, despite the presence of potential habitat, under the BAM and available survey guidance material, breeding habitat is unlikely to be impacted.	Not considered further.
Powerful Owl (Breeding)	*Ninox strenua*					Y	Y	Y	Y					The species is regarded as a dual credit species with breeding habitat triggering species credits. As at June (2020), breeding can be identified by 'suitable habitat AND 1. presence of male and female or 2. calling to each other (duetting) or 3. find nest or 4. existing breeding habitat identified'. The subject site contains approximately 9.8 ha of suitable habitat. This is made up of the following vegetation zones: Zone 5 and Zone 6 which contain hollow-bearing trees. In order to determine the presence of breeding habitat, we completed the following survey (as detailed in section 4.1.2): - Spotlighting - Call playback - Stag watching from key vantage points. Our field survey did not record the Barking Owl on the subject site, nor any nests during the hollow-bearing tree surveys. Thus, despite the presence of potential habitat, under the BAM and available survey guidance material, breeding habitat is unlikely to be impacted.	Not considered further.
Eastern Osprey (Breeding)	*Pandion cristatus*				Y	Y	Y	Y	Y	Y	Y	Y		The species is regarded as a dual credit species with breeding habitat triggering species credits. As at June (2020) breeding is 'Presence of stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting)'. The field survey confirmed the absence of stick nests. The species was also not recorded during the field survey. As such, breeding habitat for the Eastern Osprey is unlikely to be impacted.	Not considered further.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D		
Squirrel Glider	*Petaurus norfolcensis*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The species was detected during previous surveys within the subject site in 2003 (ERM 2005) and is known to occur in the Worimi Conservation Lands (Ecotone 2008).	Considered further.
Brush-tailed Rock-wallaby	*Petrogale penicillata*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	According to the TBDC, habitat for the species is associated '*Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines'*. There are no such features within 1km of the subject site, and thus no potential habitat is present.	Not considered further.
Brush-tailed Phascogale	*Phascogale tapoatafa*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	A targeted survey was completed using camera trapping following the TBDC guidelines (section 4.1.2). The survey involved extensive camera trapping (totalling 49,560 hours). The species was not detected during the targeted trapping.	Not considered further.
Koala (important habitat)	*Phascolarctos cinereus*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The Koala was not detected during targeted field survey (spotlighting, SAT surveys) (section 4.1.2). The Koala has also not been recorded by Boral staff working at the quarry. The Koala has been recorded throughout the locality, with the closest records according to Bionet being along Nelson Bay Road approximately 100 metres to the north of the subject site. The Koala has also been recorded throughout the stretch of the vegetation corridor which encompasses Worimi Regional Park and Worimi State Conservation Area. One of the most important factors influencing the distribution and numbers of Koalas in any area is the presence and density of their food tree species (OEH 2018e). Koalas feed almost exclusively on a few preferred tree species which are of primary and secondary importance. If primary tree food species are not present or occur in low density, Koalas must rely on secondary food tree species, but the number of animals per hectare is lower. *Eucalyptus robusta* is regarded as a primary feed tree, but it is not present in the subject site in large numbers, nor was it a prominent species in the tubestock plantings. The dominant canopy species over most of the subsite site include *Eucalyptus pilularis, Corymbia gummifera* and *Angophora costata*, none of which are regarded as primary or secondary feed trees. The subject site does not contain a large proportion of important feed trees and is unlikely to be utilised by Koalas. This is supported by the absence of scratches and Koala scats observed during the field survey. This is further supported by the Recovery Plan for the Koala (DECC 2008) which notes that *arguably the most important factor influencing koala occurrence is the suite of tree species available. In any one area, koalas rely primarily on regionally specific primary and/or secondary food tree species. If primary food tree species are not present or occur in low density, koalas will rely on secondary food tree species, but the carrying capacity of the habitat (i.e. number of animals per hectare) is inevitably lower. Adequate floristic diversity is also important. Although primary and secondary food trees provide the bulk of a koala's diet, leaves from other species, including non-eucalypts, may provide a seasonal or supplementary dietary resource (Smith 1992). The quality of habitat is also influenced by the presence of suitable shelter trees, particularly in harsh climates.* Based on the absence of suitable food trees it has been determined that important habitat for the Koala does not occur within the subject site, and therefore the Koala should be regarded as an ecosystem credit species.	Not considered further as a species credit fauna.

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D		
Koala, Hawks Nest and Tea Gardens population	*Phascolarctos cinereus* - endangered population	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	As above.	Not considered further.
Common Planigale	*Planigale maculata*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	The TBDC states that the Common Planigale *'inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water'*. The subject site contains surface cover in vegetation Zone 3, Zone 5 and Zone 6, compared to the other vegetation zones which typically had low litter coverage. However, the site is located away from freshwater waterbodies. Targeted surveys for the species were conducted using baited camera traps placed at ground level to maximise the survey period for the species. A total of 18,144 hours of camera trapping was conducted. The camera traps did not record the species nor any other antechinus or mouse species. Based on the trapping results, the species has been considered unlikely to be present within the subject site.	Not considered further.
Grey-headed Flying-fox (Breeding)	*Pteropus poliocephalus*										Y	Y	Y	The species is regarded as a dual credit species with breeding habitat triggering species credits. Breeding habitat is considered present if a camp site is known to occur. The field traverses confirmed that the subject site does not contain a camp site.	Not considered further.
Masked Owl (Breeding)	*Tyto novaehollandiae*					Y	Y	Y	Y					The species is regarded as a dual credit species with breeding habitat triggering species credits. Potential breeding habitat for the species as at June 2017 on BioNet is '*Living or dead trees with hollows greater than 20cm diameter*'. Whilst the BioNet does not specify a process for confirming breeding habitat, we have assumed this it is similar to the other threatened owl species and is determined based on field survey. We have therefore completed a targeted survey for the Masked Owl during appropriate periods using a combination of call playback, spotlighting, stag watching and hollow-bearing tree mapping as detailed in section 4.1.2. Our field survey did not record the Masked Owl at the site, nor was it heard calling from a distance. Based on the result of the field survey the species is considered unlikely to breed within the subject site.	Not considered further.
Mahony's Toadlet	*Uperoleia mahonyi*	Y	Y	Y							Y	Y	Y	As at June 2020, the TBDC profile for the Mahony's Toadlet is incomplete. The BioNet describes that the '*potential for the species to be more abundant/broadly distributed than currently thought, this combined with the location of this species (coastal fringe) and lots of PCT associations means it may frequently trigger SAII. As such, it will need regular review of status/data'*. The habitat description provided in the TBDC includes: - *'Inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range.* - *Known records occur in heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. Commonly associated with acid paperbark swamps,* - *Mahony's Toadlet also is known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland.*	Not considered further.

Common Name	Scientific Name	Recommended survey time											Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D	
														- *Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species.* - *Known records are associated with shallow ephemeral/semi-permanent water bodies with limited flow of water.* - *Aquatic vegetation at breeding sites includes sedges (Shoenoplectus spp., Baumea spp. and Lepironia articulata) and Broadleaf Cumbungi (Typha orientalis).* - *Females have been recorded up to 400m from water-bodies indicating moderate dispersal distances and use of multiple habitat types.* - *Tadpoles have been observed using leaf litter in the shallow verges of water bodies on sandy substrate. Rocks, logs and leaf litter may also be used for shelter and provide important foraging areas for invertebrate prey items.'* The subject site does not contain a water body. Survey was completed after 20 mm of rain which confirmed that the subject site does not retain pools of water following heavy rainfall. As such the subject site does not contain aquatic vegetation as described above, shallow pools, or drainage lines with limited flow. We note that the species may occur within 400 m of water and has been associated with Paperbark Forest. Paperbark Forest occurs outside of the subject site near the front entrance to the quarry from Nelson Bay Road. It did not hold water following 20 mm or rain and would likely require days of heavy rain to maintain potential habitat for the species. Given the absence of ephemeral, semi-permanent or permanent waterbodies in the subject site and within 400 m, and the absence of vegetation types that are known habitat for the species, the species is considered unlikely to occur.	
Eastern Cave Bat	*Vespadelus troughtoni*	Y										Y	Y	Habitat as per the TBDC that needs to be considered for this species includes: - *'Caves* - *Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds'.* The subject site does not occur within 2 km of such features. As such, the subject site does not contain habitat for this species. Furthermore, the species was not detected during Anabat surveys	Not considered further.
Predicted threatened species														
Regent Honeyeater	*Anthochaera phrygia*	No requirement to survey as assumed to be present based on habitat present												
Gang-gang Cockatoo	*Callocephalon fimbriatum*													
Glossy Black-Cockatoo	*Calyptorhynchus lathami*													

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D		
Speckled Warbler	*Chthonicola sagittata*														
Spotted Harrier	*Circus assimilis*														
Varied Sittella	*Daphoenositta chrysoptera*														
Spotted-tailed Quoll	*Dasyurus maculatus*														
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*														
Little Lorikeet	*Glossopsitta pusilla*														
White-bellied Sea-Eagle	*Haliaeetus leucogaster*														
Little Eagle	*Hieraaetus morphnoides*														
Golden-tipped Bat	*Kerivoula papuensis*														
Swift Parrot	*Lathamus discolor*														
Square-tailed Kite	*Lophoictinia isura*														
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*														
Little Bentwing-bat	*Miniopterus australis*														
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*														

Common Name	Scientific Name	Recommended survey time												Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D		
Eastern Freetail-bat	*Mormopterus norfolkensis*														
Turquoise Parrot	*Neophema pulchella*														
Barking Owl	*Ninox connivens*														
Powerful Owl	*Ninox strenua*														
Eastern Osprey	*Pandion cristatus*														
Yellow-bellied Glider	*Petaurus australis*														
Koala	*Phascolarctos cinereus*														
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*														
Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*														
Grey-headed Flying-fox	*Pteropus poliocephalus*														
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*														
Greater Broad-nosed Bat	*Scoteanax rueppellii*														
Diamond Firetail	*Stagonopleura guttata*														
Common Blossom-bat	*Syconycteris australis*														

Common Name	Scientific Name	Recommended survey time											Approach to survey	Considered further
		J	F	M	A	M	J	J	A	S	O	N	D	
Masked Owl	*Tyto novaehollandiae*													

4.1.5 Threatened Fauna for Further Consideration

Through consideration of the candidate species list, three threatened fauna were determined for further consideration based on:

- Assumed presence (Squirrel Glider) given previous records within the subject site, surrounds and presence of habitat.
- Survey not completed during survey period as per TBDC (June 2020), or suitable climate conditions recommended for survey (e.g. humid nights) have not been met (Gang-gang Cockatoo, Pale-headed Snake).

In order to determine the offset requirement, species polygons (areas of occupied/potential habitat for the species) must be completed. We have detailed the species polygons in Table 12. The biodiversity credits associated with each species polygon is detailed further in section 6.

Table 12. Threatened Fauna Species Polygon

<table>
<tr><th>Threatened Fauna</th><th>Consideration</th><th>Details</th></tr>
<tr><td>Gang-gang Cockatoo</td><td>Potential breeding habitat in the form of Hollow-bearing trees present.
Further survey during October to January required to confirm breeding habitat.</td><td>As detailed in section 4.1.4 the Gang-gang cockatoo has a specific breeding survey time that must be undertaken using the DPIE bird survey guidelines (not yet released). Given the completed survey was outside the ideal survey months for breeding habitat, we have assumed that 30.08 ha of potential breeding habitat occurs at the site. This has been made up from a polygon buffered by 200 m around each hollow-bearing tree that is greater than 9 m in height and has a hollow of 10 cm (Figure 10).

<table>
<tr><th>Species Polygon</th><th>Vegetation zone</th><th>Area (ha)</th></tr>
<tr><td>PCT1644 - Coast Tea Tree/ Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast</td><td>Zone 3</td><td>2.67</td></tr>
<tr><td rowspan="4">PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast</td><td>Zone 1</td><td>14.13</td></tr>
<tr><td>Zone 2</td><td>3.48</td></tr>
<tr><td>Zone 5</td><td>1.71</td></tr>
<tr><td>Zone 6</td><td>8.09</td></tr>
<tr><td>Total</td><td></td><td>30.08</td></tr>
</table>

We note that this is a conservative approach to determining the species polygon, given a polygon would normally only consist of a 200 m buffer around each nest tree, not every hollow-bearing trees.

The biodiversity credit obligation for this species using the conservative approach is provided in section 6, noting that Boral intend to survey for the species during the correct survey month (planned for November 2020) and provide a modification assessment to:
- Confirm the presence of breeding habitat and amend the species polygon shown in Figure 10.
- If breeding habitat is not present, remove the species polygon for the Gang-gang Cockatoo.
- Provide a modified BDAR to reflect the survey results and any change to offset requirement.</td></tr>
</table>

<table>
<tr><th>Threatened Fauna</th><th>Consideration</th><th>Details</th></tr>
<tr><td>Squirrel Glider</td><td>Assumed to be present given previous records</td><td>The Squirrel Glider has been previously recorded at the site by ERM (2005b) and is known to occur widely throughout Worimi Conservation Lands (Ecotone 2008).
The TBCD does not provide any guidance on the methods used to determine a species polygon for the Squirrel Glider. We have assumed that the area for the polygon relates to potential roosting and foraging habitat. Foraging habitat consists of eucalyptus sap, Acacias and nectar from a wide range of native flora. We have therefore assigned the vegetation zones provided in the table below to a species polygon. Foraging habitat is present within these vegetation zones. The total area is 26.60 ha as shown on Figure 10Figure 11.
<table>
<tr><th>Species Polygon</th><th>Vegetation zone</th><th>Total (ha)</th></tr>
<tr><td rowspan="3">PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast</td><td>Zone 1</td><td>14.13</td></tr>
<tr><td>Zone 5</td><td>1.71</td></tr>
<tr><td>Zone 6</td><td>8.09</td></tr>
<tr><td>1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast</td><td>Zone 3</td><td>2.67</td></tr>
<tr><td colspan="2">Total</td><td>26.60</td></tr>
</table></td></tr>
<tr><td>Pale-headed Snake</td><td>Survey required in correct survey period (November to March)</td><td>As discussed in section 4.1.3 there is no riparian vegetation or Callitris woodlands within the subject site. However, we note that the definition of habitat for the species in the TBDC is very broad (‘within 500 m of moderate to good vegetation’) and therefore based on this the species cannot be ruled out. The species would need to surveyed during humid months (November – March), in order to confirm absence/presence.
In the interim, we have assumed that a suitable species polygon encompasses the vegetation zones that contain hollow-bearing trees (Zone 5 and Zone 6) (Figure 12).
<table>
<tr><th>Species Polygon</th><th>Vegetation zone</th><th>Total (ha)</th></tr>
<tr><td rowspan="2">PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast</td><td>Zone 5</td><td>1.71</td></tr>
<tr><td>Zone 6</td><td>8.09</td></tr>
<tr><td>Total</td><td></td><td>9.8</td></tr>
</table>
The total area assigned as the species polygon is 9.80 ha.
The biodiversity credit obligation associated with this species is provided in section 6, noting that Boral intend to survey for the species during the correct survey month (planned for November 2020) and provide a modification assessment to:

Confirm the presence of habitat and amend the species polygon shown in Figure 12.
If survey confirms the species is not present, remove the species polygon for the Pale-headed Snake.
Provide a modified BDAR to reflect the survey results and any change to offset requirement.
</td></tr>
</table>

4.1.6 Threatened Fauna (EPBC Act)

A total of 63 EPBC Act-listed fauna were considered in the assessment based on the database reviews detailed in section 4.1.1, with most species being Marine or Migratory bird species. Of the species considered, foraging habitat for seven were considered to have a moderate to high likelihood of occurring:

Black-faced Monarch, White-throated Needletail, Spotted-tail Quoll, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox.

The Grey-headed Flying-fox is only likely to utilise the subject site on occasion for foraging. No roosting camp sites were observed in the subject site or immediately adjacent. The species has been recorded throughout the Worimi conservation lands (Ecotone 2008).

The Long-nosed Potoroo, Koala, Spotted-tail Quoll and New Holland Mouse have been attributed a moderate likelihood of occurrence as all species have been recorded within Worimi Regional Park and Worimi State Conservation Area and may utilise the subject site for foraging. However, none of these species were recorded during the field survey so any use of the subject site is likely be to be low.

None of the above species were detected during the field surveys and based on specific habitat requirements for each species (Appendix 1), it is likely that subject site would only be used on an intermittent basis for foraging, if at all based on the surveyed habitat features. The extensive native vegetation that occurs throughout the land to the north and south within Worimi Regional Park and Worimi State Conservation Area are likely to offer greater habitat suitability for each of these species.

Given the likelihood of occurrence and potential use of the subject site, each of the threatened species have been considered in an EPBC Act Assessment of Significance (Annex 9).

5. Impact Assessment

The Impact Assessment forms Stage 2 of the BDAR as detailed in Section 8 of the BAM.

5.1 Avoid and Minimise Impacts

In accordance with the BAM, proponents must demonstrate the measures employed to avoid, mitigate and offset impacts of a Project on biodiversity values. This section of the report outlines the details from the Environment Impact Statement (Element Environment 2019) associated with avoidance planning, management and mitigation measures that Boral has incorporated into the Project design or will employ during construction, operation or completion of the Project to reduce impacts on biodiversity values.

5.1.1 Justification for the Project

As detailed in the Environmental Impact Statement (Element Environment 2019), Boral is a leading producer and supplier of building and construction materials in the country. Accordingly, a significant amount of development in NSW, including many of NSW's best known structures, are underpinned by Boral-supplied concrete, cement, asphalt and construction materials such as natural sand.

With the significant increase in approved infrastructure Projects in Sydney and other parts of NSW, the leading suppliers of natural sand are under pressure to meet this increased demand as natural sand has unique structural characteristics to manufactured sand and is essential to meet design specifications on many infrastructure and associated development Projects.

As Stockton Sand Quarry is one of Boral's few remaining natural sand quarries, Boral propose to meet part of this increased demand in natural sand by extracting the remaining sand from the same inland extraction area previously approved under the former 1996 development consent.

As detailed in the Environmental Impact Statement (Element Environment 2019), the expanded operations at Stockton Sand Quarry will provide:

- supply of essential natural sand to major infrastructure and associated development Projects;
- continued employment of four full time employees, one casual employee and truck/transportation drivers, with an additional two full time positions and two casual positions also created along with further employment benefits created through flow-on effects;
- optimal use of a regionally-significant resource; and
- economic benefits to the local community through the purchase of goods and services and local expenditure both directly and indirectly through employee wages.

Boral's operations provide substantial economic benefits at Federal, State and local levels while being committed to maintaining a good working relationship with the local community and implementing best practice environmental management across the site.

5.1.2 Justification for the Subject Site

Resource quality

Sand suitable for use in the construction and foundry industries occurs in the Stockton Bight dunes. Although the entire sand unit possesses some potential for a particular use, there are optimum areas from which these materials can be obtained. The sand within Boral's land holding comprises a fine to medium grained sand suitable for use as a fine aggregate in concrete.

Sand suitable for concrete use must comply with Australian Standard 2758.1-1998 "Aggregates and Rock for Engineering Purposes - Concrete Aggregates". Factors such as grain shape, composition and grading of the sand must be considered. The sand must be clean, fine to medium grained, and free of deleterious materials including friable particles, organic impurities, structurally weak substances, and alkali reactive materials. The sand in Boral's land holding meets these requirements and the main use proposed for the sand is concrete production within Boral's own concrete plants in the region.

Foundry sand suitable for the use and manufacture of cores and moulds in the casting of metal products must have chemical and physical properties that allow them to withstand the high temperatures of molten metal. The sand should be a fine silica sand, even grained, and low in deleterious matter such as shell, silica and limonite, as is the case with the dune sands at Anna Bay at the northern end of Stockton Bight. Sand in the Boral land holding does not generally meet foundry requirements due to unsuitable grading, given it is too coarse grained. Conversely, the very fine grained windblown dune sands along the northern end of Stockton Bight are generally not optimal for use in concrete, being too fine grained.

Leaching of the upper layers of vegetated dune sands, by organic acids, produces white, low iron sand below the organically enriched sandy topsoil layer. The leached white sand layer on Boral's property is of variable thickness but is generally thin. Below this thin white sandy capping there is a zone of iron enrichment, the sandy material within this zone being commonly termed ‘coffee rock’ or ‘waterloo rock’. This material varies in character from a thin crusty layer of loosely bound iron coated sand grains to a thick layer of moderately iron stained amber-brown sand. ‘Coffee rock’ or ‘waterloo rock’ is unsuitable for concrete production and (where it occurs) is blended with the thin white sand layer above (where it occurs) to produce a fill sand.

Fill sand is used in numerous construction applications, including use as a support filler under house slabs, as a filter material for pipe bedding and as a drainage layer under roads. Sand used for this purpose does not have to conform to the rigid specifications outlined for specialised sands. The sand, however, needs to be reasonably 'clean' (some impurities such as charcoal, shell material, and iron-staining can be tolerated) and not too fine grained.

Sand suitable for use in glass manufacture must comply with rigid specifications. It should consist of almost pure quartz (i.e. minimum silica content of 99.5 percent), and be fine in grain size and low in shell, iron, and organic materials. Very few sand deposits, including sand on Boral's holding, meet these stringent requirements.

In the manufacture of Concrete, the fine aggregate component is achieved by blending Fine Sand with a Course Sand. In Boral’s case, the Course sand is Manufactured Sand which is a made from further processing of Quarry Dust which is a by-product of the crushing process.

Stockton Fine Sand is ideally matched to Boral’s Peppertree Manufactured Sand which supplies most of Boral’s Concrete production requirements in the Sydney and Hunter market. This means that Stockton Sand allows the greatest utilisation of manufactured sand in the Concrete blend, and therefore better utilises this scarce resource over a greater volume of total production that would otherwise have been produce with a less superior grading.

In this regard, Boral’s Stockton fine sand reduces the natural fine sand usage, and avoids the need to find and develop a more resource intensive source of fine sand.

Locational factors

In terms of weight and volume, more sand products have to be quarried and transported to construction sites than any other type of resource material. It is for these reasons that extractive sand sources need to be located as close as possible to the point of usage. The value to weight ratio is very low, making transport costs to the market highly sensitive.

Establishing sand extraction operations close to the construction market represents considerable savings in terms of construction and associated transport costs for Projects undertaken in the region that are to be serviced by the quarry. Over the life of the quarry this represents a significant benefit to the local community and the state in terms of reduced transport and associated infrastructure maintenance costs.

Adjoining operations

Existing operations providing fine to medium grained sand suitable as fine concrete aggregate in the Lower Hunter Region are principally located in the barrier dune systems between Stockton and the Port Stephens peninsula. In addition to Boral's sand extraction operation at Fullerton Cove, operations in the Stockton Bight area are located at Salt Ash, Williamtown, Bobs Farm, Anna Bay and Raymond Terrace.

Minor quantities of manufactured sand are derived from quarrying and processing of hard rock (quarry dust). Manufactured sand is assisting to prolong the life of the natural sand reserves, however manufactured sand is generally not suitable for use in concrete on its own and is typically either used in road base or blended with natural sand to produce an acceptable grade concrete sand.

As transport distance adds significantly to the delivered price of sand into the Hunter Region, very little sand is imported into the region from outside.

Future demand

The demand for construction materials in major infrastructure and construction Projects in the Lower Hunter Region and Sydney has been high in recent years and is expected to be strong for the foreseeable future.

Fine grained construction sand is a major component of concrete, particularly for domestic applications. For example, an average three bedroom brick veneer home on a concrete slab foundation, with concrete paths and driveways, consumes in the order of 50 cubic metres of concrete, which contains 17.5 tonnes of fine grained construction sand.

Boral uses sand extracted from the site as the fine sand component in concrete production. The future demand for construction sand will correlate with anticipated growth in residential development, commercial development, and major infrastructure and construction Projects in the Lower Hunter Region and Sydney during the next 15 to 20 years.

Life of operation

The Project proposes to extract approximately 9 million tonnes of sand resource over a potential 25 year period.

Taking into account the sites existing operation, extracting sand from the transgressive dunes, the project is seeking to allow for maximum site transport limit of 750,000 tonnes per annum (tpa) (over the two projects) up until 2028 when the extraction on the transgressive dunes is due to cease. At this time the transport limit will reduce to 500,000 tpa.

To allow for flexibility between the two projects, the project has been assessed on the basis of a site wide maximum extraction and transport rate of 750,000 tpa.

5.1.3 Project Alternatives

Do nothing

Sand extracted from the Stockton Sand Quarry is used within the Hunter and Sydney regions. At present, due to sustained demand across the building and construction industry, Boral's sand resource across all assets have been substantially depleted.

If the proposed extraction of additional sand is not approved, the quarry will cease to operate in approximately three years' time due to current demand trends for natural sand products. This would result in loss of employment, reduced revenue to local service providers, reduced regional expenditure in the Port Stephens and Newcastle Local Government Areas (LGA), sterilisation of a valuable resource and shortages of raw materials for essential NSW infrastructure and associated development Projects.

The sand deposit at the site is highly suitable for use in concrete, is close to markets, and environmental impacts are less than for other alternatives on Boral's land and possibly less than for other sites in the region.

As detailed in the Environmental Impact Statement (Element Environment 2019), given that local demand for natural construction sand is unlikely to diminish, and given that the site is ideally located at the southern end of Stockton Bight to supply the Lower Hunter and Sydney market, it is most likely that other Stockton Bight sand suppliers further to the north would take up a shortfall in Boral's production. As such, there is a possibility that sand would be purchased from elsewhere, likely further away from the end use. In this case, it is likely that road transport impacts would be compounded, and would increase the cost of sand and concrete. Additionally, Boral would be required to purchase sand from other approved or yet to be approved Stockton Bight quarries. While it is not possible to clearly compare environmental impacts in this case, the Project has a limited environmental effect as it is confined to an area which has been disturbed by quarrying operations in the past. Because of the likelihood of alternate supply being a different grading there is a greater likelihood that more fine sand will be required for extraction and transport in order to produce one cubic metre of Concrete, when compared to the combination for Stockton Sand Grading with Boral's Manufactured Sand source.

In summary, should the Project not proceed, Boral would close the quarry in due course and have to rely on other sand sources locally or further afield, depleting those resources sooner. Importantly, not proceeding would mean that the community would lose the opportunity to allow the further development of an existing quarry operation. Conversely, alternative developments may require the disturbance of greenfield land parcels with more inherent environmental risks.

Alternative locations

As outlined earlier, Stockton Sand Quarry is one of Boral's few remaining natural sand quarries. With the significant increase in demand for natural sand, all of Boral's natural sand quarries are operating at full capacity.

As the quarry has a substantial remaining natural sand resource and is relatively close to Boral's existing Hunter and Sydney supply contracts, it is an ideal site to meet current and predicted future market demand for natural sand.

Other sand resources on Stockton Bight lie within the Worimi Conservation Lands, Crown lands and, to a lesser extent, on freehold lands. Most sand deposits on freehold lands are already owned or being extracted by the construction sand industry. A few isolated sand bearing properties remain but the size of the sand deposits are generally too small for economic development.

Many millions of tonnes of sand lie within the Worimi Conservation Lands or Crown lands on Stockton Bight but are currently unavailable for extraction by virtue of environmental protection zoning. Sand on Crown lands closer to Anna Bay which have appropriate zoning for extraction is generally too fine grained for concrete, being more suited to foundry applications and glass manufacture.

The dune sands on Stockton Bight need little or no processing to produce a grain size grading suitable for concrete manufacture. The only other source of sand in the region is the processing of soft rock. Friable sandstones at Blackhill, matrix sand from conglomerates at Teralba and overburden sediments in coal mines are examples, but in each of these cases, the cost of extraction and processing to produce suitably graded sand would be considerably higher than extracting the loose, naturally graded sands of Stockton Bight.

There are millions of tonnes of remaining sand suitable for production of concrete at the site. A number of alternative development scenarios were explored for the development of this remaining sand, culminating in the conclusion that the Project represents the most environmentally, socially and economically sensible option.

The proposed extraction area has been previously disturbed and as such the recommencement of sand extraction is considered to have a reduced direct environmental impact. The location of the site is separated from sensitive receptors, with Boral's current operations largely going unnoticed by the surrounding community and visually unobtrusive due to the presence of the dune system that surrounds the extraction area.

Alternative materials

There are few alternative materials to replace natural sand in the production of concrete. Alternative materials are emerging, which represent viable supplements to natural sands, but not as replacements to natural sands. In recognition of the value of such alternatives, Boral is becoming increasingly more active in recycling and in the production of manufactured sand.

Manufactured sand is a sand product created from quarry dust generated by the crushing of hard rock. Quarry dust is mainly blended into road bases, but many quarries process some of the dust to produce coarse sand for blending with finer grained natural sands to produce acceptable grade concrete sand.

To a significant extent, therefore, the alternative manufactured sand option is already being used to extend the life of natural fine grained sand sources. The inability of manufactured sand to be a complete replacement for natural sands is due to a number of factors. Quarry dust generally has a particle shape that is angular and often elongated, making concrete flow and concrete workability very difficult. Quarry dust also tends to be deficient in the fine end of the particle range and the addition of fine grained natural sand is required to fill out the grading. The addition of fine grained natural sand also helps concrete workability as the natural sands are often rounded.

Barmac crushing can be used to produce a dust with a better particle shape, but this in turn produces greater volumes of dust. A compromise is usually made, which invariably requires the use of natural sand to even out grain shape and particle size deficiencies.

Boral is engaged in ongoing research and development into the production of manufactured sand to supplement the natural sand market. In the immediate term Boral are investigating options to utilise glass sand or recovered sand from virgin excavated natural material (VENM). However, these sources are yet to receive approvals. In the case of glass sand, commercial production levels are low (as a new recovered resource and burgeoning industry) and the planning approvals necessary to permit the importation and blending of these materials to create building products is not widely accepted by consent authorities. Additionally, recovered sand product from processing VENM does not typically yield the same high quality product as that proposed to be extracted from the Stockton Sand Quarry. Cumulatively this would impact on the production of key building materials, in particular the production of concrete which would have wider implications for the building and construction industry within the Hunter and Sydney regions.

Alternative non-naturally occurring materials exist which can substitute to some extent for the naturally occurring construction sand sources. Examples are recycled building and demolition waste, granulated blast furnace slag and fly ash from coal fired power stations. However, these alternatives generally have high handling, transport and processing costs, although they are commonly used for roadbase and other applications.

Boral is actively involved in construction and demolition recycling with a major plant at Wetherill Park in Sydney and approved operations at Somersby on the Central Coast and Kooragang Island. The products from these operations supplement the natural sand market.

Whilst new innovation in alternative materials is emerging, the need for constant supply of natural sands for concrete production remains integral.

Alternative Project Design

Various options were considered when formulating the preferred concept of the Project. Such options included:

- extension of the extraction footprint beyond the 1996 development consent boundary, and subsequent extraction and dredging of this footprint. It was determined that this option would maximise access to sand resource, however would increase the clearing of remnant vegetation and habitat compared to the current proposal, and subsequently increase the projects offsetting requirement, and as such was not investigated further from a biodiversity perspective; and
- extension of the extraction footprint beyond the 1996 development consent boundary, inclusive of sand extraction to 4 m AHD with no dredging operations. It was determined that this option would reduce the degree of ground disturbance as is experienced with dredging, however would also increase the area of environmental impact (vegetation clearing, noise, and dust emissions) and fail to maximise use of the sand resource beneath 4m AHD.

With the above considered, confinement of the Project to the previously disturbed 1996 development consent boundary was considered to result in the most favourable environmental and social impacts.

Several configurations of infrastructure for the Project were considered to minimise the potential for adverse noise and air impacts to the closest sensitive receivers. Such options included positioning the wash plant in the southern extremity of the extraction area in order to maximise separation distance to these receivers.

5.1.4 Mitigation Measures (Construction and Post Construction)

A project specific Landscape and Rehabilitation Management Plan (will be prepared to reflect biodiversity management measures associated with the Project in order to protect and manage important biodiversity values. It is envisaged that the project specific plan would be similar to the existing Landscape and Rehabilitation Management (Boral, 2010) adopted in relation to the existing Windblown Sand Project. This existing Plan discusses key commitments relating to threatened species management, pest and weed management, fire management and site hygiene practices.

Mitigation measures to be undertaken during construction and post construction include:

Fencing and signposting

Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the proposed extraction area.

Signposting will be used to inform Project personnel and site visitors of areas of conservation value to restrict entry or inform behaviour that will reduce incidental interactions with threatened species - e.g. speed limits along access roads to reduce potential for fauna vehicle strikes.

Employee Education and General Environmental Controls

Employees and contractors would be educated on and required to implement the following controls, to avoid or at least minimise potential environmental impacts associated with the Project:

- Minimise dust generation by minimising the extent and time that bare sand is exposed and by appropriate sand suppression.
- Procedures for the management of hydrocarbon and/or chemical spills throughout the Project site including the requirements for vehicles to carry spill kits.
- Ensuring vehicles remain on designated roads and tracks and abide by site speed limits, through use of signposting and driver education during the induction process and in on-going Project discussions.
- Management and removal of all rubbish from the Project site.

Vegetation Clearance Protocol

Boral has an established vegetation clearing protocol provided in the existing Windblown Project Landscape and Rehabilitation Management Plan (ERM 2010). This protocol would be adopted under a project specific Management Plan. This will include the following key protocols:

- Prior to clearing of native vegetation, ecologists are to survey for ground dwelling fauna and to remove any fauna/ fauna habitats to adjacent areas that would not be further disturbed.
- Prior to clearing of remnant hollow-bearing trees or habitat trees, ecologists are to be engaged to supervise felling. All hollow-bearing trees that are accessible safely from the ground are to be checked and identified fauna relocated. Hollows higher up and not accessible from the ground are to be identified and trees felled gently by an excavator or dozer and left overnight to allow fauna to relocate.
- Any fauna displaced during clearing are to be captured where possible and relocated to pre-planned areas (fauna to be captured and handled only by personnel trained to do so).
- In an event that fauna are injured during clearing, the NSW Wildlife Information, Rescue and Education Service (WIRES) will be contacted to handle and collect for appropriate care and rehabilitation.

5.1.5 Rehabilitation

The disturbance would be rehabilitated in accordance with the projects Rehabilitation Management Strategy (EES 2019a). As described in the Plan, a pond would be established with stable banks that would be rehabilitated with native vegetation, which would enhance fauna habitat surrounding the water body.

5.1.6 Pest and Weed Management

A project specific pest and weed management plan would be developed and implemented. It is envisaged that this plan would adopted protocols and strategies similar to those implemented under the existing management plan adopted for the Windblown Project (ERM 2010) with the following additional matters also included::

- Management protocols for feral animals such as dogs, rabbits and foxes within the rehabilitation area, and
- Management protocols for the identification of noxious or important environmental weeds within areas to be cleared (in order to avoid transporting the weeds to rehabilitation areas or other parts of the site).

5.1.7 Fire Management

Boral currently have a Bushfire Management Plan included in the Boral (2010) Stockton Transgressive Dune Quarry Environmental Management Strategy. Fire prevention and suppression are detailed within the Plan including emergency protocols should a fire occur. This Plan would be updated where required to reflect the findings and recommendations provided in the Bushfire Hazard Assessment for the Project (BPAD 2019).

5.2 Impact summary

An assessment of the potential impact of the Project on biodiversity is provided below. It considers direct and indirect impacts as defined in OEH (2018), which states:

> *"**Direct impacts** are those that directly affect habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. When applying each factor, consideration must be given to all of the likely direct impacts of the proposed activity or development.*
>
> ***Indirect impacts** occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. As with direct impacts, consideration must be given, when applying each factor, to all of the likely indirect impacts of the proposed activity or development."*

The Project would affect biodiversity, including threatened biodiversity through both direct and indirect impacts. The areas subject to direct and indirect impact are shown in Figure 13 and discussed below.

5.2.1 Direct Impacts

The Project would result in the unavoidable clearing of 35.66 ha of vegetation regarded as 'native vegetation,' as defined in the BAM, which comprises of:

- 32.99 ha of PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland
- 2.67 ha of PCT1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes.

The Project would result a direct impact to 26.60 ha of Squirrel Glider habitat.

As discussed in section 4.1.4, given the absence of a targeted threatened fauna survey, the following threatened fauna may have potential habitat at the site: Gang-gang Cockatoo, and Pale-headed Snake. If present, the species may be directly impacted by the Project.

These direct impacts cannot be further avoided or mitigated. As per the BAM, Section 6 details the biodiversity credits required to offset the unavoidable impacts of the Project.

5.2.2 Indirect Impacts

Indirect impacts associated with the Project will largely occur during the construction and operation of the Project, resulting in a short-term impact (i.e. the construction and rehabilitation phases of the Project) and will be minimised where possible through management procedures. A range of indirect impacts are likely to or could occur as a result of the Project, including:

- Increased noise and dust
- Changes to ground-water levels and flow patterns
- Increased spreading of weed propagules.

The indirect impacts described above are variable in terms of the distance they may extend from the subject site, and in many cases, due to mitigation measures, indirect impacts will be completely contained within the subject site. The area of indirect impact without mitigation measures has been attributed to a 50 m area around the boundary of the site.

Indirect impacts on the biodiversity values of areas surrounding the subject site, along with recommended mitigation measures to minimise identified impacts, are discussed in Table 13. Boral would be responsible for carrying out the mitigation measures.

Table 13: Indirect impacts

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation measure	Mitigation measure	Expected success of mitigation measure
Edge effects	The establishment of the new extraction area would result in the creation of new edges adjacent to areas of existing native vegetation immediately adjacent to the extraction area. The new edges could facilitate the establishment and spread of introduced plant species and increase light levels, however, appropriate monitoring and control measures would be implemented during and after construction to counteract the potential for weed occurrences. The extraction area would be progressively rehabilitated creating a pond structure, with stable vegetated banks.	Varying distance from subject site. Potentially occurring within 30 metres from the disturbance area throughout the active life of the Project.	Fencing and/or the use of highly visible rope or tape boundaries will be used to delineate the boundary of vegetation clearing at the edge of the extraction area. Signposting and education will be also be used to inform Project personnel of no-go areas. Weed management and monitoring to be included in the project specific Landscape & Rehabilitation Management Plan.	Active weed, and pest management are anticipated to be successful at managing edge effects from the Project.
Weeds	Weeds have the opportunity to establish themselves in areas of disturbed vegetation. The greatest establishment of weeds are in areas already disturbed. The Project has the potential to increase or lead to the establishment of weed species where they do not currently exist through the operation of machinery during construction phases. New weed species can potentially be introduced as a result of the movement of construction vehicles and materials into the subject site. Areas more likely to be exposed to weed increases are areas of native vegetation that occur to the south of the subject site. However, weeds will be controlled during and after construction in accordance with the Landscape and Rehabilitation Management Plan and thus indirect impacts from weeds is likely to be negligible within the adjacent woodland areas.	Variable depending on topography. However, typically would occur within close proximity to the disturbance area.	Weed management and monitoring to be implemented in accordance with the project specific Landscape and Rehabilitation Management Plan.	Active weed control methods are likely to be successful in managing the spread of weeds within adjacent areas.
Erosion and sedimentation	Erosion of sand and associated sedimentation associated with the Project may involve the following: • Alteration of sand structure beneath haul roads; and • The deposition of soil particulates in drainage lines and remnant vegetation surrounding the subject site.	Variable depending on topography and operation.	Sediment management measures will be implemented in accordance with project specific Erosion and Sedimentation Control Plan that will adopt mitigation and strategies similar to the existing recommendations in the Stockton Transgressive Dune Quarry(ERM 2010).	Sedimentation control are known to reduce sedimentation spills.

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation measure	Mitigation measure	Expected success of mitigation measure
Dust	Although dust will be generated from the construction and operation of the Project, it will be mitigated with dust suppression from a water truck, which is the practice with the current operations. Where feasible Boral utilise available water allocations.	Variable depending on wind conditions. Potential for dust emissions likely throughout life of Project.	Dust impacts will be mitigated through the onsite use of water suppression. Further, vegetation clearing protocols for the Project will seek to minimise exposed areas with the potential to generate dust by completing vegetation clearing as close to mining operations as practical.	Successful implementation of dust control would minimise dust. Current dust suppression mitigation works are ongoing at the Stockton Sand Quarry.
Fire	Historically, bushfires tend to be associated with a proficient growth of native grasses following large rain events. During summer, following rain events, dry swards of grasses pose a bushfire hazard when placed near a source of ignition. Vehicles driven through long grass with hot exhausts may cause a fire particularly during the hotter months of the year.	Potential to be widespread in locality, though unlikely.	A bushfire hazard assessment has been completed by BPAD (2019) as part of the Project. Boral also currently have a Bushfire Management Plan included in the Boral (2010) Stockton Transgressive Dune Quarry Environmental Management Strategy. Fire prevention and suppression are detailed within the Plan including emergency protocols should a fire occur. This Plan would be updated to reflect the recommendations of BPAD (2019) where required to reflect the Project.	Given the existing quarry operations have not resulted in any significant fires, the continued implementation of the Stockton Transgressive Dune Quarry Environmental Management Strategy and any project specific requirements would likely result in fire prevention.
Groundwater changes resulting in impacts to vegetation	Groundwater impacts as a result of the dredging are detailed in the Hydrogeological Impact Assessment (EES 2019b). A separate project specific groundwater management plan would also be prepared. The ESS (2019b) assessment concludes that the groundwater movement accounts for less than 0.5% of catchment drainage even in the driest recorded years, excavation of the aquifer sediments should have no discernible effect on catchment hydrology other than increasing the area available for water storage and direct recharge to the Stockton Sandbeds Aquifer in the subject site. The report concludes that the Project is unlikely to have an impact on vegetation surrounding the subject site.	EES (2019b) concludes that the Project it is unlikely to result in any impact to surrounding vegetation.	Groundwater monitoring and mitigation requirements will be included in an update to the existing Groundwater Monitoring and Management Plan (GMMP) (Jacobs, 2017). The GMMP describes the objectives of the groundwater management and monitoring and details the proposed types and locations of monitoring. It also describes the monitoring observations which would trigger actions, and the	Implementation of the Groundwater Monitoring and Management Plan wold assist in minimising impacts to vegetation from groundwater changes.

Indirect impact	Likely impact from the Project	Potential extent of the indirect impact prior to mitigation measure	Mitigation measure	Expected success of mitigation measure
			proposed action and/or mitigation should triggers be exceeded. In summary, water levels and pH will need to be monitored in the field weekly during excavation and rehabilitation, and quarterly thereafter. Further laboratory analysis of collected samples will be required monthly throughout the Project duration and quarterly following completion of rehabilitation.	
Fauna vehicle strike	No fauna have been hit via a vehicle over the past decade. This is likely attributed to enforced speed limits whilst on-site, and contractor awareness. Boral will continue to maintain the slow speed limits during the operation of the Project.	Likely to be successful given no fauna have been impacted by vehicle movement at the site to date.	Continue current slow speed limits around the quarry site. Continue current contractor awareness training regarding fauna operations.	Currently successful.

5.2.3 Impacts to Commonwealth Threatened Biodiversity

Formal Assessments of Significance have been provided in Annex 9 for the following EPBC Act listed threatened species: *Cryptostylis hunteriana*Black-faced Monarch, White-throated Needletail, Spotted-tail Quoll, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox.

The Assessments conclude that a significant impact to Commonwealth listed threatened biodiversity is unlikely.

5.2.4 Potential Serious and Irreversible Impacts (SAII)

The BC Act and the *Local Land Services Act 2013* (LLS Act) imposes various obligations on decision-makers in relation to impacts on biodiversity values that are at risk of Serious and Irreversible Impacts (SAII). These obligations generally require a decision-maker to determine whether the residual impacts of a proposed development on biodiversity values (that is, the impacts that would remain after any proposed avoid or mitigate measures have been implemented) are serious and irreversible (DPIE 2019b).

No threatened biodiversity at risk of SAII (as assigned in the TBDC at June 2020) are known in the subject site or are considered to potentially be impacted by the Project.

5.2.5 Connectivity of Habitat

The subject site adjoins a large native vegetation corridor which extends along Stockton Beach to Anna Bay in the north and Stockton in the south (Figure 1). The stretch of the vegetation corridor encompasses Worimi Regional Park and Worimi State Conservation Area. The corridor also adjoins the wetlands (Long Bight Swamp) and riparian vegetation of Fullerton Cove approximately 2.3 kilometres to the southwest.

The removal of habitat within the subject site is unlikely to reduce the amount of important habitat features within the corridor to an extent that fauna roosting and foraging habitat would be significantly impacted. The removal of the vegetation from within the subject site is unlikely to restrict fauna movement along the Stockton Beach to Anna Bay corridor given the following:

- The area to be disturbed is centred on the former quarrypit which was predominately cleared over a decade ago.
- Vegetation would be retained along Nelson Bay Road and towards Stockton Beach allowing fauna movement along the corridor (as can be seen from Figure 9).
- The haul road that is currently in operation for the quarry operations would not be widened as part of the current proposal, thus no changes to fauna movement are likely.

5.2.6 SEPP 44 - Koala Habitat

At the time of EIS submission (December 2019), the State Environment Planning Policy 44 – Koala Habitat (SEPP 44) was in effect. SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:

(a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and

(b) by encouraging the identification of areas of core koala habitat, and

(c) by encouraging the inclusion of areas of core koala habitat in environment protection zones.

SEPP 44 applies to Local Government Areas (LGAs) listed in Schedule 1, and where a development has an area of more than 1 ha.

The subject site exceeds 1 ha and is located within the Port Stephens LGA which is listed in Schedule 1 of SEPP 44, and as such, the SEPP applies to the subject site.

Under SEPP 44, 'potential Koala habitat' is defined as -

'*areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component'.*

Of the tree species listed in Schedule 2, only *Eucalyptus robusta* was recorded within and near the subject site. *E. robusta* comprised less than 15 per cent of the total number of trees present in the subject site, and therefore, as per the definition of SEPP 44, the habitat present is not regarded as 'potential Koala habitat'.

'Core Koala habitat' is defined in the SEPP as -

'an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population'.

The Koala was not recorded on the subject site during the surveys and there are no historical records of the species in the subject site. As discussed in Table 11, the Koala has been recorded within the locality, with the closest records being along Nelson Bay Road approximately 100 metres to the north of the subject site.

If a resident population of the Koala was present within the subject site, it is highly likely that there would be extensive sightings by Boral staff and rehabilitation contractors whilst working within the subject site. Given the lack of recent sightings and/or historical records in the subject site, the site is not considered to constitute 'core Koala habitat'.

It should be noted that the SEPP 44 Koala Habitat was replaced with SEPP Koala Habitat Protection 2019 (SEPP KHP), which took effect on 1 March 2020. Under clause 15 of the SEPP KHP, the transitional arrangement apply, and as such the former Koala SEPP applies to the Project given the EIS was submitted prior to commencement of SEPP KHP:

'Savings provision relating to development applications - A development application made, but not finally determined, before the commencement of this Policy in relation to land to which this Policy applies must be determined as if this Policy had not commenced. '

5.2.7 Port Stephens Council Comprehensive Koala Plan of Management

The Port Stephens Council Comprehensive Koala Plan of Management (CKPoM) has been prepared by Port Stephens Council and the Australian Koala Foundation (AKF) for the Port Stephens LGA. The CKPoM has an aim to 'encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline'.

The CKPoM includes a Koala habitat map for the Port Stephens LGA (Port Stephens Council 2007), which classifies Koala habitat into different categories based off a range of attributes and survey results. The subject site has been mapped as 'Supplementary" Koala habitat, which is defined as habitat where Marginal Koala Habitat Middle-ranking Community overlap' (Port Stephens Council 2002). This habitat is regarded in the CKPoM as 'important to the long-term conservation of Koalas in Port Stephens and thus also requires protection, albeit with less restrictions on development than Preferred Koala Habitat'.

The CKPoM also includes performance criteria to assist development applications in the Port Stephens LGA demonstrate that developments are consistent with the objectives associated with the CKPoM. Given this BDAR is associated with an SSD rather than a local government development application, the performance criteria are not relevant to this Project, however Boral has considered the aims and objectives of the performance criteria to minimise potential impact to the Koala as detailed in Table 14 and Table 15.

Given the Project will largely impact upon a rehabilitated former quarry pit, and will avoid decreasing the width of a wildlife corridor along Nelson Bay Road, it is highly unlikely that the Project would result in an impact to a Koala population in the Port Stephens LGA. The Project will also implement a series of mitigation measures (section 5.1.4) to avoid any potential indirect impacts to surrounding habitat.

Table 14. Consideration of aim and objectives of CKPoM

General Aims and Objectives of CKPoM Performance Criteria for Developments	Consideration in the Project
i) To ensure that the koala population in the Port Stephens LGA is sustainable over the long-term.	The area to be impacted is not known to contain a resident Koala population. The area to be disturbed consists predominately of native rehabilitated land, which occurs within and immediately adjacent to a former quarry pit. The Project is highly unlikely to result in any decrease in the Koala population of the Port Stephens LGA.
ii) To protect koala habitat areas from any development which would compromise habitat quality or integrity.	The vegetation disturbance associated with the Project does not occur within areas of 'important' or 'core Koala' habitat as discussed in section 4.7.1. The Project would predominately involve the clearing of rehabilitated native vegetation within a former quarry pit. As such, impacts to large tracts of native vegetation and habitat have largely been avoided. The Project will not result in an impact to a Koala corridor, core habitat, important habitat or extensive koala habitat that would decrease a population of the Koala.
iii) To ensure that any development within or adjacent to koala habitat areas occurs in an environmentally sensitive manner.	Boral will implement the mitigation measures detailed in section 5.1.4 to minimise all potential indirect impacts.
iv) To ensure that acceptable levels of investigation are undertaken, considered and accepted prior to any development in or adjacent to koala habitat areas.	This assessment has utilised the methodology of the BAM and associated threatened survey guidelines to survey for Koalas.
v) To encourage koala habitat rehabilitation and restoration.	The Project would result in the clearing of native vegetation, conservatively estimated to be 35.66 ha, of which most is predominately rehabilitated land. Given the Project is located predominately within a former quarry pit and historically impacted areas, impacts to remnant vegetation is largely avoided. Mitigation measure to reduce potential habitat impacts are detailed in section 5.1.4.
vi) Maintain interconnection between areas of Preferred and Supplementary Koala Habitat and minimise threats to safe koala movements between such areas.	The Project will impact areas mapped as 'supplementary Koala habitat' as per the CKPoM. Much of the areas to be impacted occur within the former quarry pit, and immediately adjacent areas. The removal of the vegetation would not restrict Koala movement

General Aims and Objectives of CKPoM Performance Criteria for Developments	Consideration in the Project
	throughout the landscape and mitigation measures (speed limits) would prevent Koala collisions, should they venture into the site during operation.
vii) To ensure that development does not further fragment habitat areas either through the removal of habitat or habitat links or through the imposition of significant threats to koalas.	As discussed in section the Project would not reduce Koala connectivity and movement through the landscape.
viii) To provide guidelines and standards to minimise impacts on koalas during and after development, including any monitoring requirements.	Boral will implement the mitigation measures detailed in section 5.1.4 to minimise all potential indirect impacts.
ix) To provide readily understandable advice to proponents preparing development applications and for Council officers involved in the assessment of those applications.	Not relevant

Table 15. Performance Criteria

Performance criteria	Response
a) Minimise the removal or degradation of native vegetation within Preferred Koala Habitat or Habitat Buffers;	The Project justification is provided in section 5.1. The subject site contains limited primary or secondary preferred feed trees. The Project minimises impacts to remnant native vegetation/habitat by focusing the e majority of the subject site on the former quarry pit.
b) Maximise retention and minimise degradation of native vegetation within Supplementary Koala Habitat and Habitat Linking Areas;	As above, impacts to potential Koala habitat has been minimised as much as practical. The project is largely contained to an area of the site that was cleared in accordance with 1994 development consent to extract sand. Any existing vegetation is rehabilitation in various stages of growth that was planted by Boral. The project site contains few mature primary or secondary species preferred by Koalas. Moreover, Boral has occupied the site for almost 40 years during which time no Koalas have been observed to use the site. In this regard, despite the mapping identification, the project area does not provide Koala Habitat. The Project will not result in fragmentation or reduce Koala connectivity throughout the wider landscape. Land outside of the subject site will not be impacted by the Project.
c) Minimise the removal of any individuals of preferred koala food trees, wherever they occur on a development site. In the Port Stephens LGA these tree species are Swamp Mahogany (*Eucalyptus robusta*), Parramatta Red Gum (*Eucalyptus parramattensis*), and Forest Red Gum (*Eucalyptus tereticornis*), and hybrids of	*Eucalyptus robusta* was quite rare in the subject site, with only a few noted within vegetation zone 2. These individuals were either planted as tubestock or been in the native seed mix.

Performance criteria	Response
any of these species. An additional list of tree species that may be important to koalas based on anecdotal evidence is included in Appendix 8	The dominant eucalypts on the subject site include *E. pilularis, Corymbia gummifera* and *Angophora costata.* The Project will therefore not impact on the important trees or hybrids. *Corymbia gummifera* and *E. pilularis* are listed in Appendix 8 of the KPoM as 'tree species that may be important'. These species will be impacted as they are dominant species within PC1646. The Project has minimised impacts by predominately using a former quarry pit and impacting largely upon planted trees.
d) Make provision, where appropriate, for restoration or rehabilitation of areas identified as Koala Habitat including Habitat Buffers and Habitat Linking Areas over Mainly Cleared Land. In instances where Council approves the removal of koala habitat (in accordance with dot points 1-4 of the above waive clause), and where circumstances permit, this is to include measures which result in a "net gain" of koala habitat on the site and/or adjacent land;	The Koala is regarded as an 'ecosystem credit' species as part of this BDAR (section 4.1.4, Table 11) that would be subsequently offset through PCT1646 and PCT1644. Both these PCTs contain 'trees that may be important' and would result in a net gain of Koala habitat.
e) Make provision for long term management and protection of koala habitat including both existing and restored habitat;	An overarching management plan will specify the mitigation measures and controls during construction and operation of the Project (see details provided in section 5.1.4). Long-term management and restoration of Koala habitat be through the provision of biodiversity credits for PCT1646 and PCT1644.
f) Not compromise the potential for safe movement of koalas across the site. This should include maximising tree retention generally and minimising the likelihood that the proposal would result in the creation of barriers to koala movement, such as would be imposed by certain types of fencing. The preferred option for minimising restrictions to safe koala movement is that there be no fencing (of a sort that would preclude koalas) associated with dog free developments within or adjacent to Preferred or Supplementary Koala Habitat, Habitat Buffers or Habitat Linking Areas.	The Project will not impeded Koala movement across the landscape. The Project will not introduce or enhance populations of feral and domestic dogs.
g) Be restricted to identified envelopes which contain all buildings and infrastructure and fire fuel reduction zone. Generally there will be no clearing on the site outside these envelopes. In the case of applications for subdivision, such envelopes should be registered as a	Not applicable.

Performance criteria	Response
restriction on the title, pursuant to the Conveyancing Act 1919; and	
h) Include measures to effectively minimise the threat posed to koalas by dogs, motor vehicles and swimming pools by adopting the following minimum standards. i) The development must include measures that effectively abate the threat posed to koalas by dogs through prohibitions or restrictions on dog ownership. Restrictions on title may be appropriate. ii) The development must include measures that effectively minimise the threat posed to koalas from traffic by restricting motor vehicle speeds, where appropriate, to 40 kph or less. iii) The development must reduce the risk of koala mortality by drowning in backyard swimming pools. Appropriate measures could include: trailing a length of stout rope (minimum diameter of 50mm), which is secured to a stable poolside fixture, in the swimming pool at all times; designing the pool in such a way that koalas can readily escape; or enclosing the pool with a fence that precludes koalas. This last option should include locating the fence away from any trees which koalas could use to cross the fence.	The Project will not introduce or enhance populations of feral and domestic dogs. Existing vehicle speeds within the quarry site would be adhered to and staff and contractors educated about Koala interactions to prevent Koala collisions. Final land use of the subject area will be detailed in a project specific Landscape and Rehabilitation Management Plan. This plan will consider measures to protect Koalas during Project decommissioning and rehabilitation.

5.2.8 Cumulative Impacts

In relation to the Project, the cumulative impacts are considered to be the total impact on the environment that would result from the current proposal plus any additional impacts likely to occur due to subsequent Projects that are of a similar nature or that are partly or wholly contingent on the Project.

Identifiable cumulative impacts to be considered in the locality include the following quarry operations:

- Salt Ash Sand Project (Nelson Bay Road), which has approval to operate until 2030
- Cabbage Tree Road Sand Quarry, which has approval to operation until 2033
- Mackas Sand Project, Nelson Bay Road.

Each of the above quarry operations have a range of approved biodiversity impacts, and it is likely that over the next few decades, modification to existing operations may entail clearing of native vegetation and habitat. Niche is not able to quantify this as part of this BDAR, however it is likely that such impact would be within the existing operations leases. Residential, commercial and industrial development is also identified as a continuous cumulative biodiversity pressure associated with the wider Port Stephens and Newcastle LGAs. Whilst the Project will result in removal of native vegetation from within the North Coast IBRA region, the Project primarily will result in an impact to planted rehabilitation. The Project also involve an offset that will contribute to in-perpetuity managed conservation areas within the Bioregion.

6. Quantifying Offset Requirements

The BAM identifies the BAM Calculator as the appropriate tool for quantifying the offsets required, which is expressed as numbers of ecosystem and species credits. A calculation of the nature and extent of biodiversity credits required due to ecological impacts associated with the Project has been undertaken using the BAM Calculator.

No threatened biodiversity listed on the EPBC Act are required to be offset for the project, as the project does not result in a significant impact to any threatened biodiversity listed on the EPBC Act.

6.1.1 Summary of Ecosystem Credits Required

The results of the BAM Calculator, ecosystem offset credit requirements, including current, future and change in vegetation integrity scores are shown in Table 16.

Impacts to native vegetation communities within the development site generate a requirement for 455 ecosystem credits. These 455 ecosystem credits also cover the credit requirement for ecosystem credit species. The full BAM Calculator biodiversity credit report is provided in Annex 8.

Table 16. Ecosystem credit requirement

PCT	Vegetation zone	Impact area (ha)	Current Vegetation Integrity score	Future Vegetation Integrity score	Change in Vegetation Integrity Score	Biodiversity risk weighting	Required credits
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	1	14.13	43	0	-43	1.5	228
	2	3.87	19.8	0	-19.8	1.5	29
	4	5.19	4.8	0	-4.8	1.5	0*
	5	1.71	39	0	-39	1.5	25
	6	8.09	47.7	0	-47.7	1.5	145
1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	3	2.67	21	0	-21	2	28
Total							455

*Credits not required as vegetation integrity score below 17

6.1.2 Summary of Species Credits Required

The results of the BAM-C species offset credit requirements are shown in Table 17. Threatened species identified or assumed to be present within the development site and likely to be impacted by the Project generate a requirement for a total of 1,567 species credits. The full BAM Calculator biodiversity credit report is provided in Annex 8.

It should be noted that Boral propose to survey for the Gang-gang Cockatoo, Pale-headed Snake, and *Cryptostylis hunteriana* during the appropriate survey period (planned for November 2020) and provide an updated BDAR to:

- Confirm the presence of breeding habitat and amend the conservative species polygons
- Provide a modified BDAR report to reflect the survey results and any change to the offset requirement for the species.

Table 17. Species credits required

Threatened species	Habitat impacted (ha)	Required credits
Cryptostylis hunteriana	12.47	191
Squirrel Glider	26.60	558
Pale-headed Snake	9.80	226
Gang-gang Cockatoo	30.08	592
Total		**1,567**

7. Offset Strategy

Under the BAM, an offset strategy is not required to be submitted with the BDAR as the credits are to be formally retired with the establishment of a Biodiversity Stewardship Site, or purchasing of credits from the market, or payment into the Biodiversity Conservation Fund (BCF). However, as noted in the SEARs for the Project, a biodiversity offset strategy is required to be included in the Biodiversity Assessment.

7.1 Offset Requirements

Under the BAM, the biodiversity offsets must provide benefits to biodiversity to compensate for the adverse impacts of an action. Biodiversity offsets assist in achieving long-term conservation outcomes while providing development proponents with the ability to undertake actions that have unavoidable impacts on biodiversity.

Unavoidable impacts to biodiversity are those impacts that are residual (i.e. impacts that remain after impact avoidance, management and mitigation measures are employed to reduce the type or magnitude of biodiversity impacts). Section 5.1 of this report outlines the planning and consideration of alternative emplacement options that Boral has considered. Section 5.1.4 to section 5.1.7 of this report outline the management and mitigation actions that Boral will employ to further reduce direct and indirect impacts to biodiversity values as a result of this Project.

This section of the report describes the approach to biodiversity offsetting proposed for the Project in order to satisfy the BAM offsetting requirements.

Based on the results of the MNES Assessments of Significance contained in this report, the Project would not result in a significant impact to any threatened biodiversity listed on the EPBC Act, and thus would not require offsets for any Commonwealth MNES.

7.2 Offset Refinement

As detailed in section 3.2.3 and 4.1.5, a survey during the months specified in the TBCD and DPIE (2020) Plant Survey Guidelines were released in April 2020. The release date occurred while the subject Development Application was on exhibition and the BDAR completed accordingly it was not feasible for these guidelines to have been considered in the BDAR preparation. Notwithstanding this, Boral is prepared to undertake further surveys for the following threatened species during the relevant survey period: *Cryptostylis hunteriana,* Pale-headed Snake and Gang-gang Cockatoo. At the time of preparing the revised BDAR (May – July 2020) DPIE Bird Survey Guidelines have also not yet been released. Therefore these threatened species have been assumed to be present and have been allowed for in the offset calculations and strategy.. We have provided a credit estimate in section 6 based on a conservative estimate of the species polygons (section 3.2.3 and 4.1.5).

Boral propose to survey for the *Cryptostylis hunteriana,* Pale-headed Snake and Gang-gang Cockatoo, during the correct survey months (planned to commence in November 2020). The survey would be used to inform if habitat occurs at the site, and where relevant, Boral will revise the associated species polygons and credit requirements. Boral propose to submit an updated BDAR detailing the survey and any credit variations.

7.3 Offset Strategy Options

To satisfy the offset requirement, Boral has identified a range of options to meet the required offsets for the Project (Table 18). As demonstrated in the table and given Boral has the option to pay into the Biodiversity

Conservation Fund (BCF) to satisfy the offset requirement, there is minimal risk for Boral not to meet their offset liability.

Table 18. Options to satisfy the offset requirement

Offset requirement	Credits required	Purchase credits on market	Payment into BCF	Utilise existing Boral Landholdings	Risk of offset not met
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast	427	If credits become available, Boral may pursue this option.	Yes – Boral can pay the equivalent credit cost into the BCF	The surrounding Boral landholdings may be considered as a biodiversity stewardship site. The surrounding vegetation consists of the same PCTs and would contain Squirrel Glider habitat.	No risk given the option to pay into the BCT Payment Fund.
1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	28				
Cryptostylis hunteriana	191				
Squirrel Glider	558				
Pale-headed Snake	193				
Gang-gang Cockatoo	592				

7.4 Staged-Offset Approach

The proposal will result in progressive vegetation disturbance across five distinct stages spanning approximately 10 years. The area associated with each stage are indicated on Figure 14. Boral propose to progressively offset the five stages prior to vegetation disturbance.

The area of native vegetation and habitat associated with each offset stage is provided in Table 19, and the associated credits provided in Table 20.

The first offset stage is proposed in 2021, and would involve the retirement of the following credits prior to vegetation disturbance:

- PCT1644 - Coast Tea Tree/ Old Man Banksia coastal shrubland – 28 credits
- PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland – 120 credits
- Cryptostylis hunteriana – 89 credits
- Squirrel Glider – 210 credits
- Pale-headed Snake - 60 credits
- Gang-gang cockatoo – 200 credits.

Table 19. Area of vegetation/habitat impact within each offset stage

Plant Community Type (PCT)	Vegetation zone	Staged-Offset Approach – Area (ha)					Area Total (ha)
		1 (Year 2021)	2 (Year 2023)	3 (Year 2026)	4 (Year 2031)	5 (Year 2038)	
Non-native	Non-native	1.28	0.50	0.00	0.44	0.26	2.48
PCT1644 - Coast Tea Tree/ Old Man Banksia coastal shrubland	Zone 3	2.67	0.00	0.00	0.00	0.00	2.67
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland	Zone 1	4.34	0.47	1.64	4.98	2.71	14.13
	Zone 2	0.00	0.77	2.25	0.85	0.00	3.87
	Zone 4	0.34	4.10	0.74	0.00	0.00	5.19
	Zone 5	0.86	0.13	0.00	0.10	0.62	1.71
	Zone 6	2.16	1.02	1.61	0.42	2.88	8.09
Cryptostylis hunteriana – species polygon							
PCT1644 - Coast Tea Tree/ Old Man Banksia coastal shrubland	Zone 3	2.67	0	0	0	0	2.67
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland	Zone 5	0.86	0.13	0	0.1	0.62	1.71
	Zone 6	2.16	1.02	1.61	0.42	2.88	8.09
	Total	5.69	1.15	1.61	0.52	3.5	12.47
Squirrel Glider							
1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast	Zone 3	2.67	0	0	0	0	2.67
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland	Zone 1	4.34	0.47	1.64	4.98	2.71	14.13
	Zone 5	0.86	0.13	0	0.1	0.62	1.71
	Zone 6	2.16	1.02	1.61	0.42	2.88	8.09
	Total	10.03	1.62	3.25	5.5	6.21	26.6
Pale-headed Snake							
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland	Zone 5	0.86	0.13	0	0.1	0.62	1.71
	Zone 6	2.16	1.02	1.61	0.42	2.88	8.09
	Total	3.02	1.15	1.61	0.52	3.5	9.8
Gang-gang cockatoo							
PCT1644 - Coast Tea Tree/ Old Man Banksia coastal shrubland on foredunes of the	Zone 3	2.67	0	0	0	0	2.67

Plant Community Type (PCT)	Vegetation zone	Staged-Offset Approach – Area (ha)					Area Total (ha)
		1 (Year 2021)	2 (Year 2023)	3 (Year 2026)	4 (Year 2031)	5 (Year 2038)	
Central and lower North Coast							
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland	Zone 1	4.34	0.47	1.64	4.98	2.71	14.13
	Zone 2	0	0.77	1.86	0.85	0	3.48
	Zone 5	0.86	0.13	0	0.1	0.62	1.71
	Zone 6	2.16	1.02	1.61	0.42	2.88	8.09

Table 20. Credits per offset staging

Credit Type	Vegetation zone	Total credits required	Credits per ha	Credits per stage (indicative year for credit retirement)				
				1 (Year 2021)	2 (Year 2023)	3 (Year 2026)	4 (Year 2031)	5 (Year 2038)
PCT1644 - Coast Tea Tree/ Old Man Banksia coastal shrubland	Zone 3	28	11	28	0	0	0	0
PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland	Zone 1	228	16	70	8	26	80	44
	Zone 2	29	8	0	8	13	8	0
	Zone 5	25	15	12	2	0	2	9
	Zone 6	145	18	38	18	29	8	52
Total ecosystem credits		455	-	148	36	68	98	105
Cryptostylis hunteriana	-	191	15	89	17	24	8	53
Squirrel Glider	-	558	21	210	34	68	116	130
Pale-headed Snake	-	193	20	60	22	32	9	70
Gang-gang cockatoo	-	592	20	200	44	100	126	122

8. Summary

Boral have aimed to avoid and minimise environmental impacts from the Project through detailed design and siting of the Project, along with implementation of actions aimed at mitigating and managing potential indirect impacts from the Project as detailed in section 5.1.

The unavoidable impacts of the Project on ecological values include the clearing of 35.66 ha of vegetation regarded as 'native vegetation,' as defined in the BAM. Associated fauna habitat would also be directly impacted.

Eight Assessments of significance under the EPBC Act were required for threatened biodiversity (*Cryptostylis hunteriana,* Black-faced Monarch, White-throated Needletail, Spotted-tail Quoll, Long-nosed Potoroo, Koala, New Holland Mouse and Grey-headed Flying-fox), which concluded that a significant impact as a result of the Project was unlikely. As such, there is no requirement for an EPBC Act Referral regarding Commonwealth MNES, and no need to offset them.

Biodiversity offsets required for unavoidable impacts from the Project have been calculated as follows:

- PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast– 427 credits
- PCT1644- Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast – 28 credits.

Four threatened species require offsetting as a result of the Project. Their credit requirements are as follows:

- *Cryptostylis hunteriana* – 191 credits
- Squirrel Glider - 558 credits
- Pale-headed Snake - 193 credits
- Gang-gang Cockatoo - 592 credits.

As detailed in section 7.2, Boral propose to survey for the *Cryptostylis hunteriana,* Pale-headed Snake and Gang-gang Cockatoo during the correct survey months (planned to commence in November 2020). The survey would be used to inform whether these species occur within the subject site, and if relevant, Boral will revise the associated species polygons and credit requirement. Boral propose to submit an updated BDAR detailing the survey and any credit variations.

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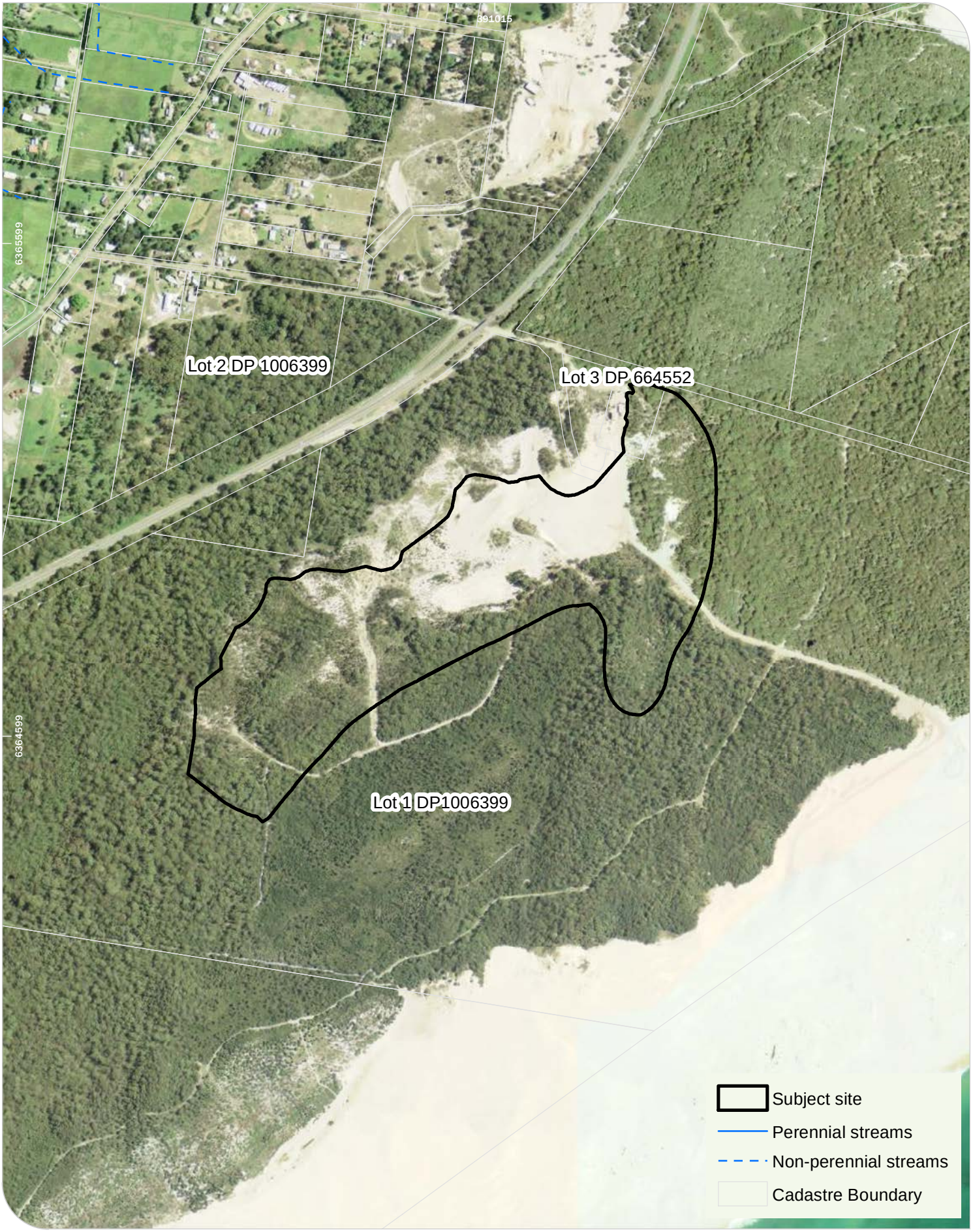
Figures

Figure 1. Regional Mapping (Element Environment 2019)

Figure 2. The Project (Element Environment)



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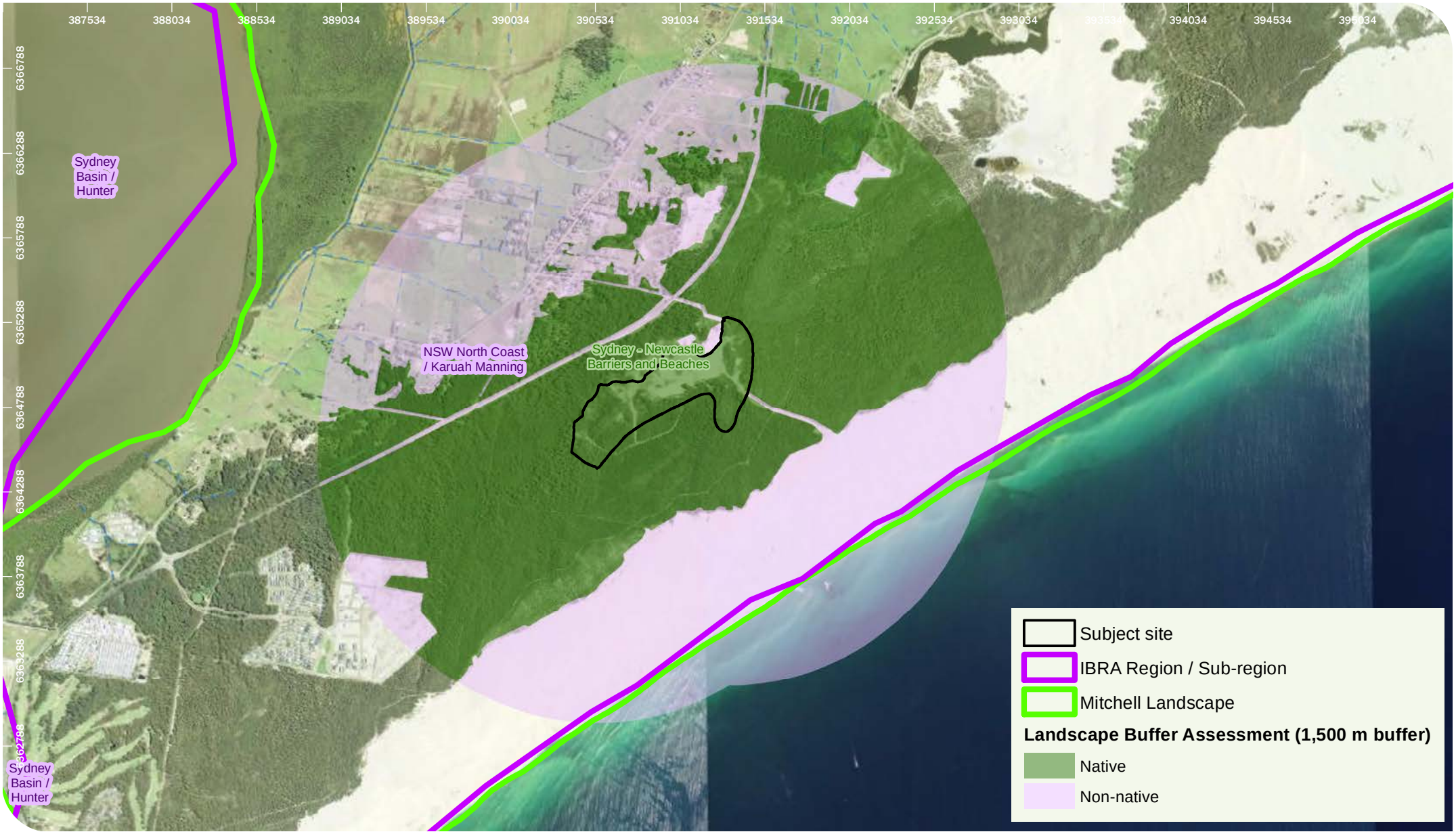
Niche Proj. #: 3706
Client: Boral Resources (NSW) Pty

Location Map
Stockton Sand Quarry Dredging Project

Figure 3



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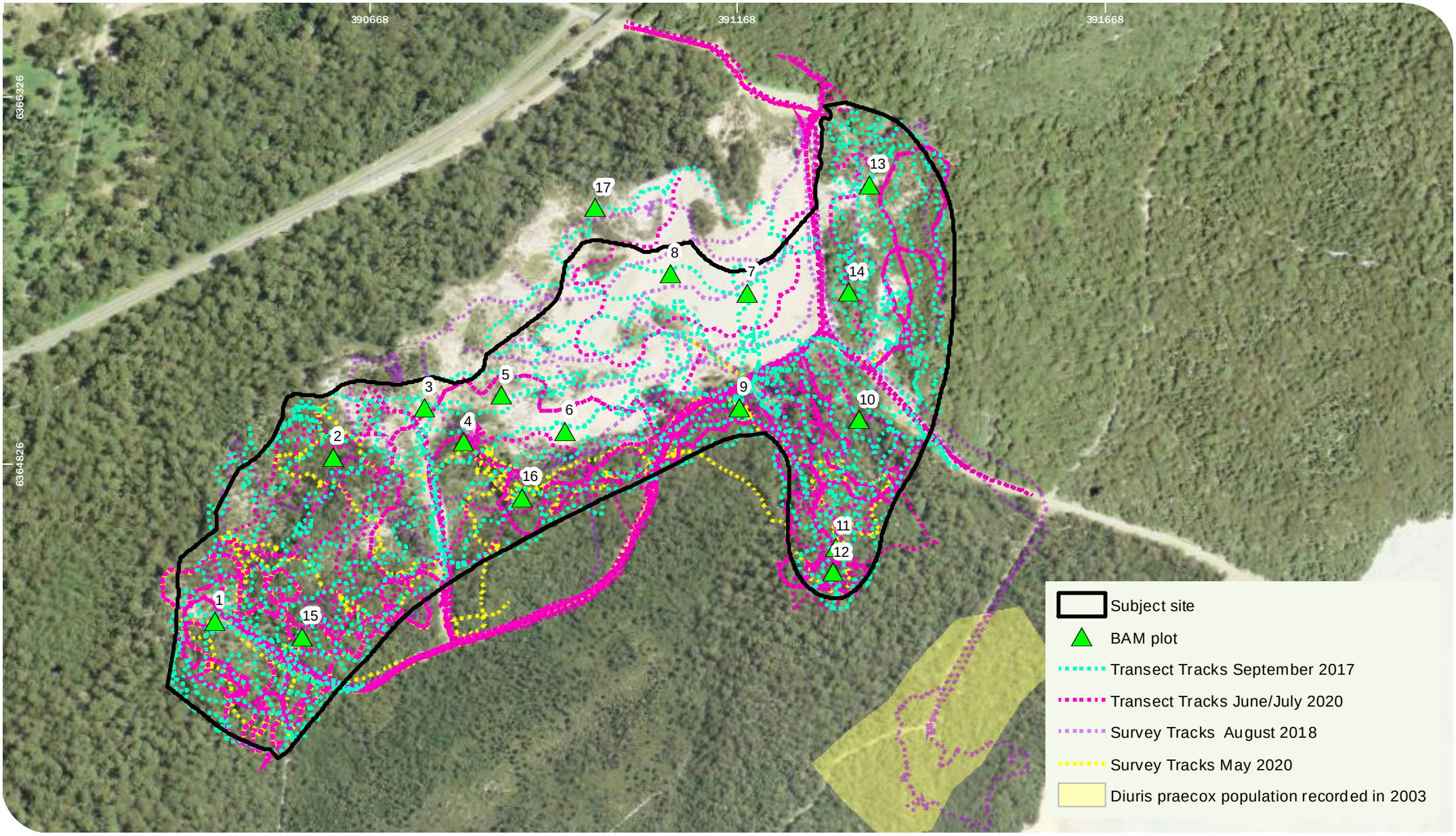
Landscape Assessment

Stockton Sand Quarry Dredging Project

Figure 4



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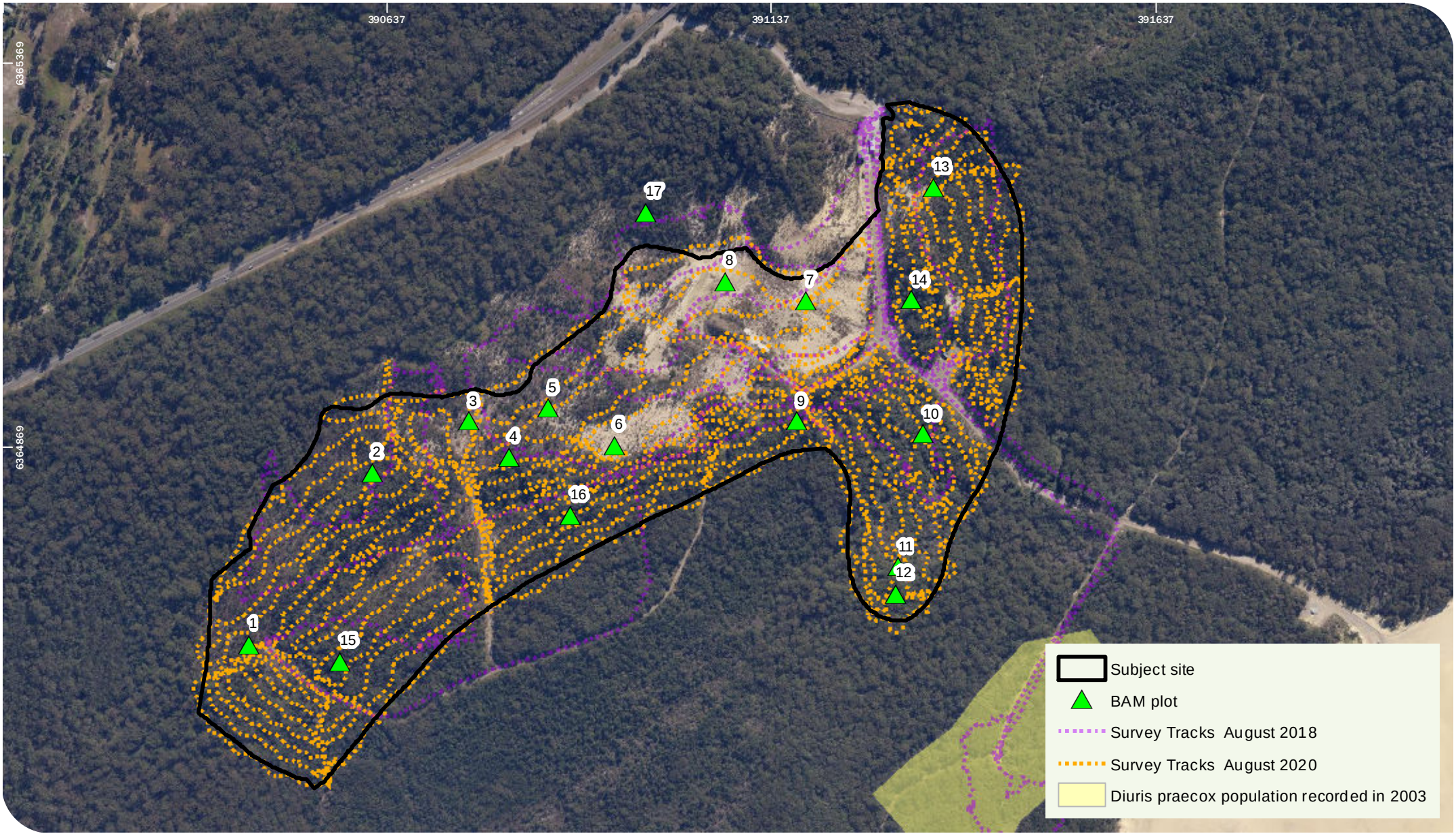
Survey effort - Flora

Stockton Sand Quarry Dredging Project

Figure 5a



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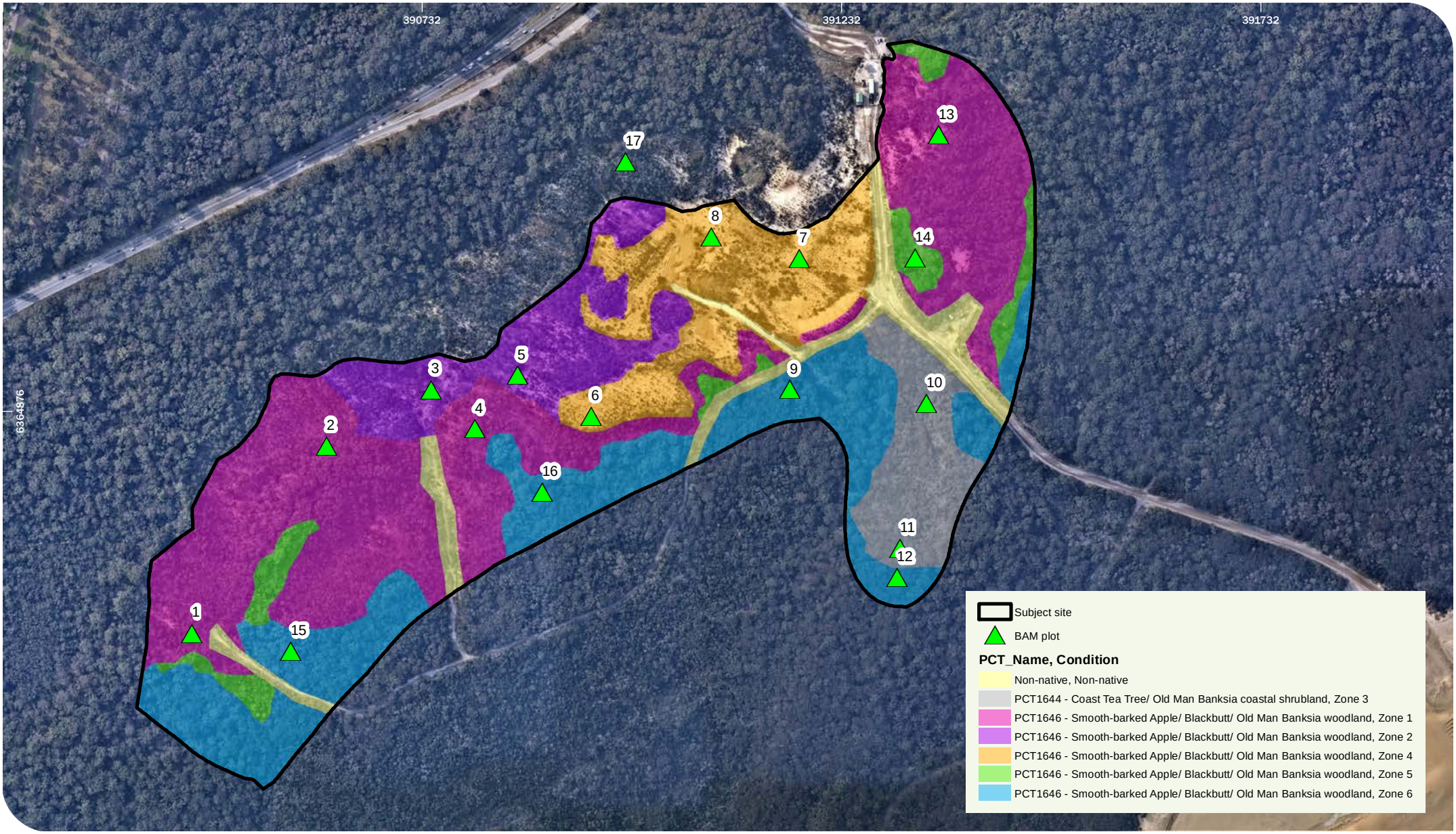
Survey effort - Flora
Stockton Sand Quarry Dredging Project

Figure 5b



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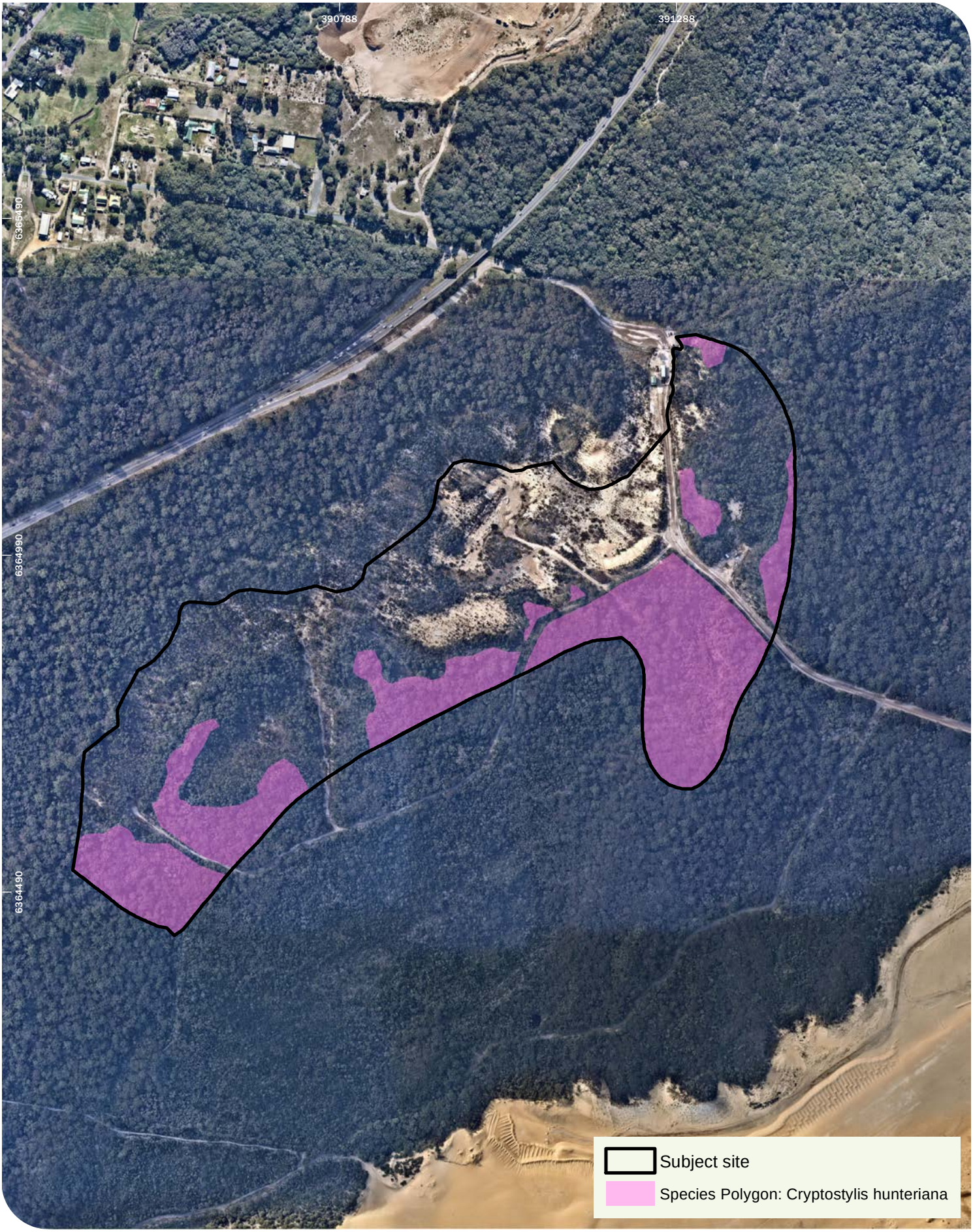
Survey effort - Flora
Stockton Sand Quarry Dredging Project

Figure 6



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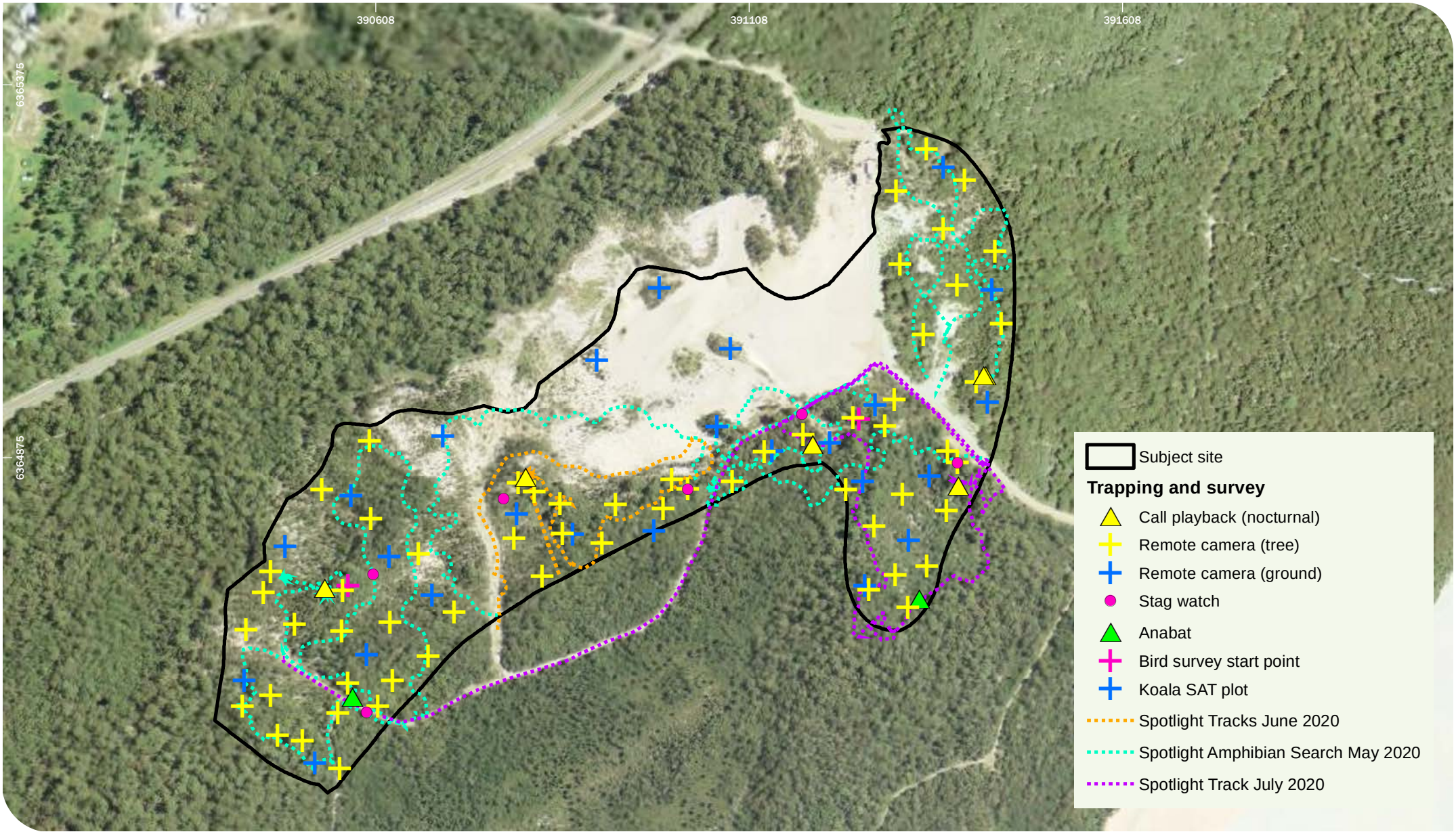
Threatened Flora - species polygon
Stockton Sand Quarry Dredging Project

Figure 7



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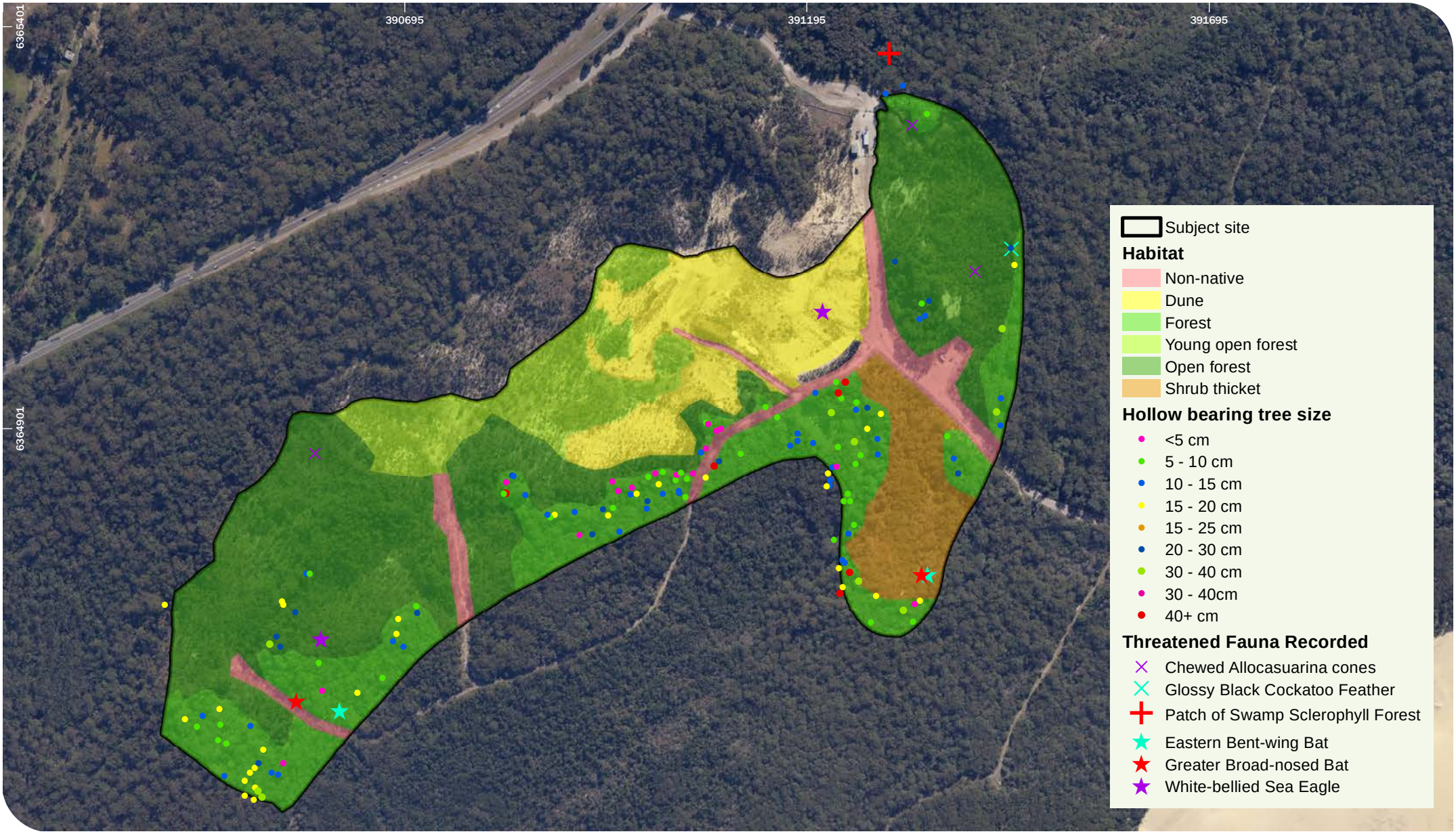
Survey effort - Fauna
Stockton Sand Quarry Dredging Project

Figure 8



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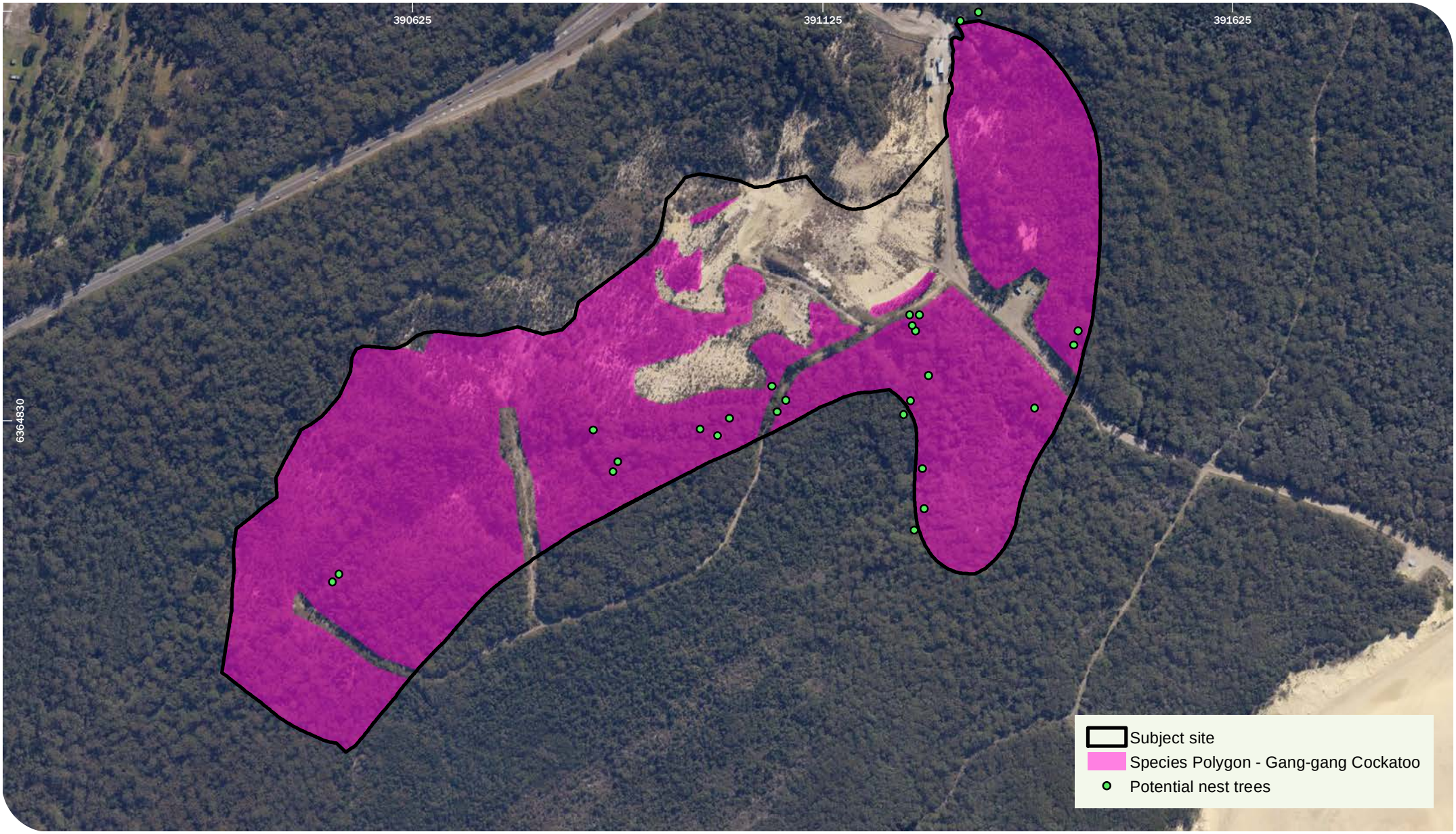
Threatened fauna and habitat
Stockton Sand Quarry Dredging Project

Figure 9



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Threatened Fauna - Species Polygon: Gang-gang Cockatoo
Stockton Sand Quarry Dredging Project

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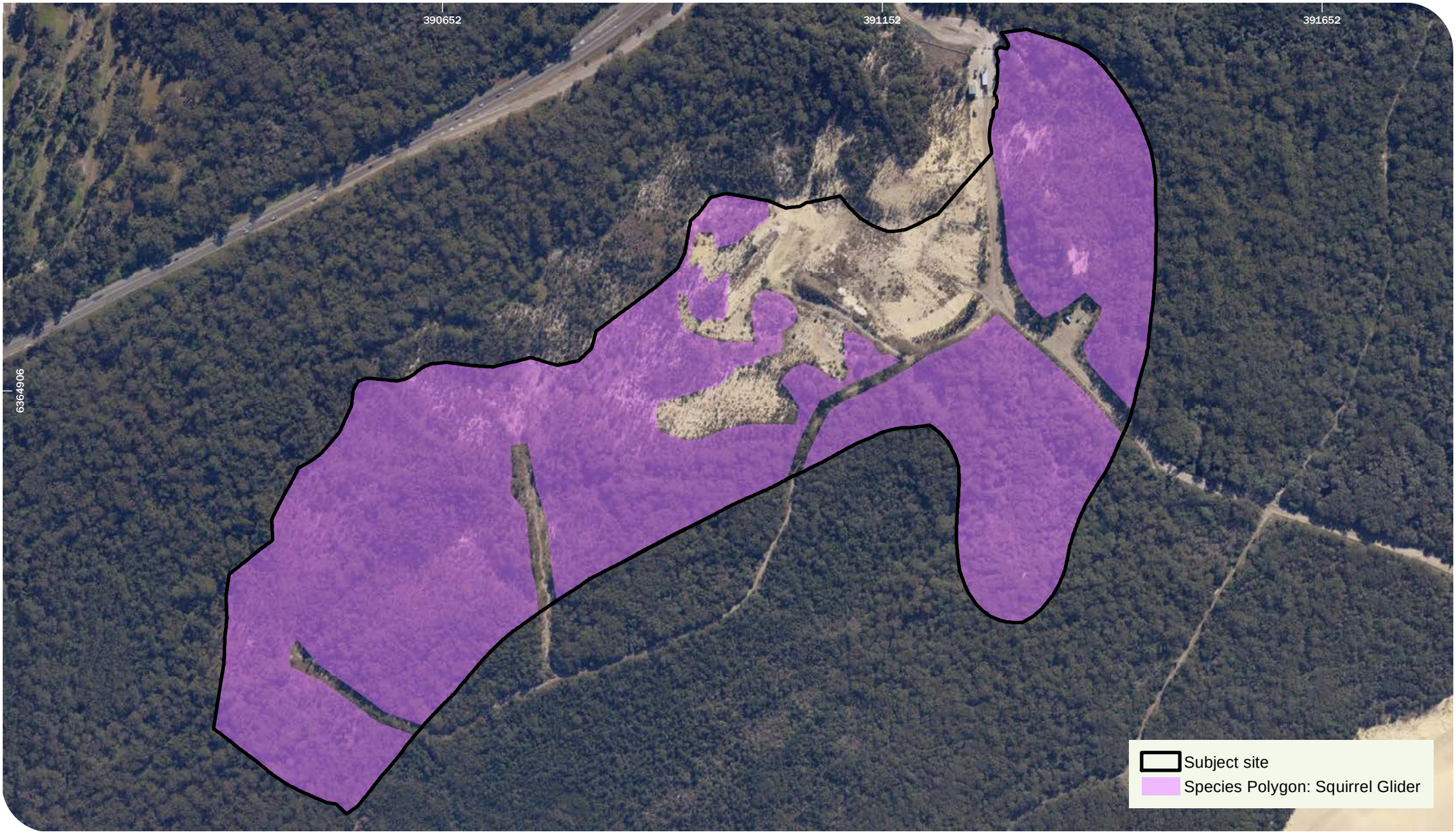
Niche Proj. #: 3706
Client: Boral Resources (NSW) Pty

Figure 10



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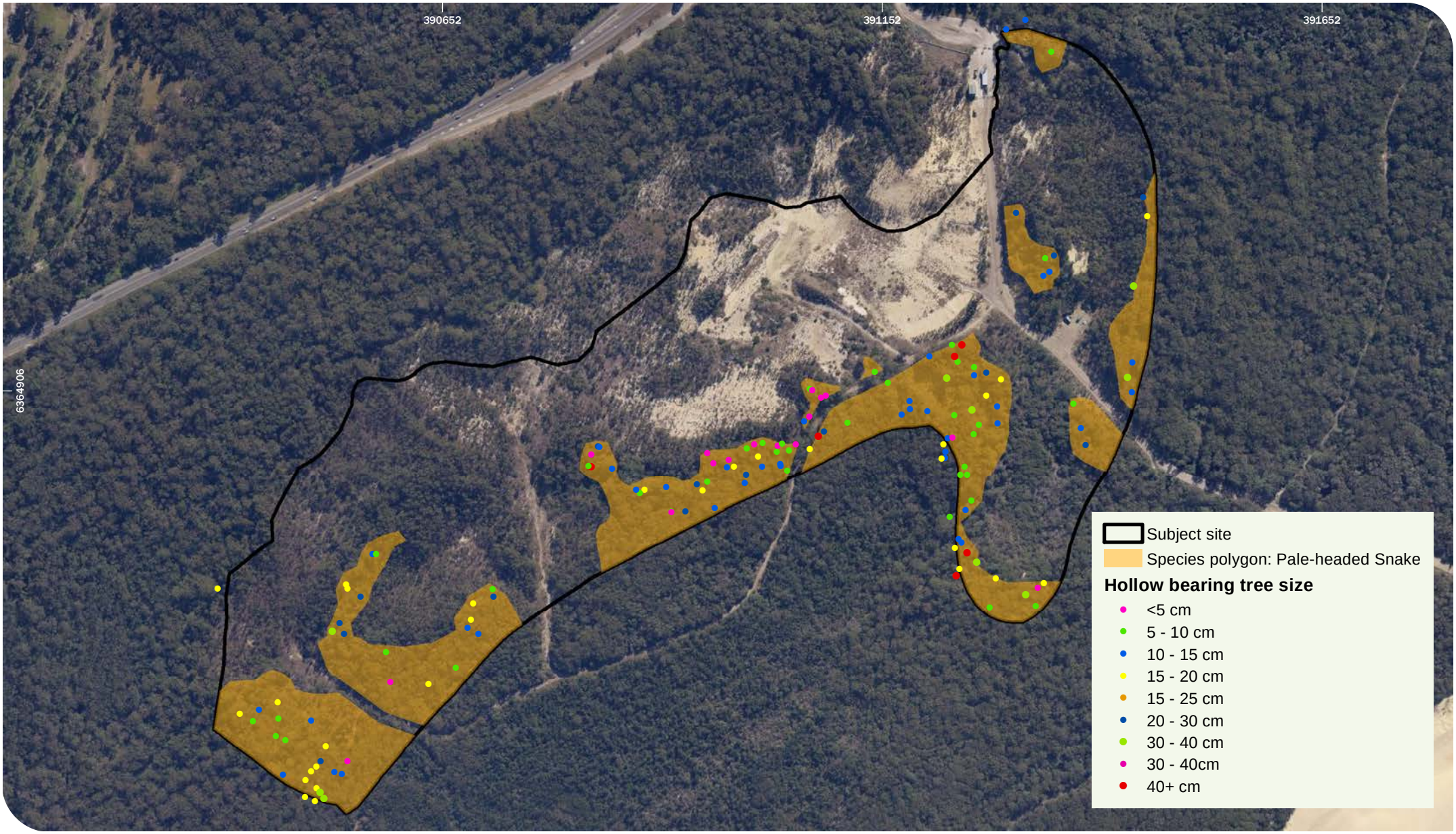
Threatened Fauna - Species Polygon - Squirrel Glider
Stockton Sand Quarry Dredging Project

Figure 11



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Threatened Fauna - Species Polygon - Pale-headed Snake
Stockton Sand Quarry Dredging Project

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Client: Boral Resources (NSW) Pty

Figure 12

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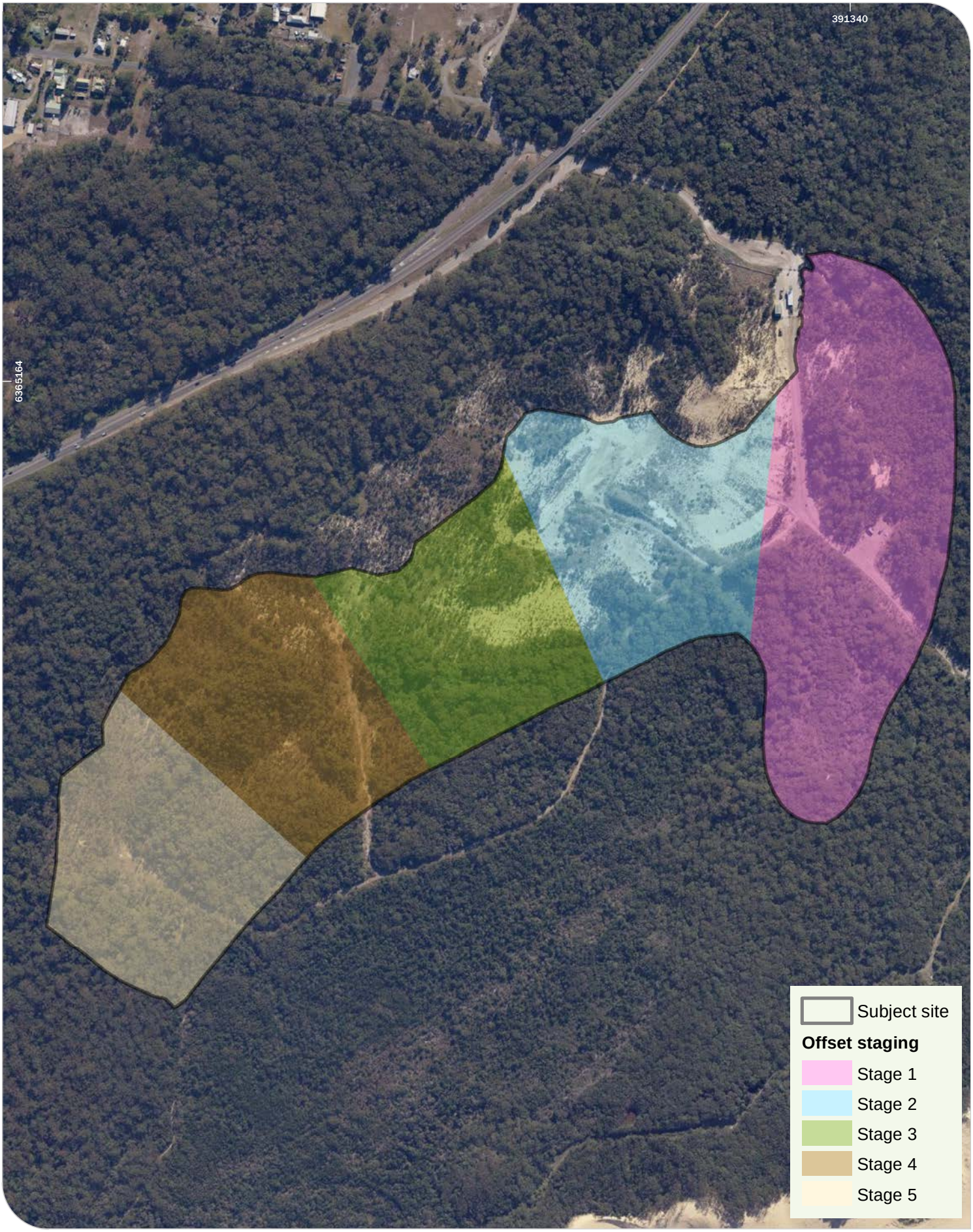
Area of direct and indirect impact
Stockton Sand Quarry Dredging Project

Figure 13



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Staged-offset Approach
Stockton Sand Quarry Dredging Project

Niche PM: Luke Baker
Niche Proj. #: 3706
Client: Boral Resources (NSW) Pty

Figure 14

Annex 1. Likelihood of Occurrence

Threatened biodiversity likelihood of occurrence

A list of subject threatened flora and fauna and threatened ecological communities within the locality (10 km radius) was determined from database searches. The list of potentially impacted species is determined from consideration of this list. In order to adequately determine the relevant level of assessment to apply to potentially affected species, further analysis of the likelihood of those species occurring within the subject site was completed.

Five categories for 'likelihood of occurrence' were attributed to species after consideration of criteria such as known records, presence or absence of important habitat features on the subject site, results of the field surveys and professional judgement. This process was completed on an individual species basis.

Species considered further in formal assessments of significance (EPBC Act) were those in the 'Known', 'High' or 'Moderate' categories and where adverse impacts for the species could reasonably occur from the development. Species listed as a 'Low' or 'None' likelihood of occurrence are those for which there is limited or no habitat present within the subject site.

Likelihood rating	Threatened flora criteria	Threatened and migratory fauna criteria
Known	The species was observed within the subject site.	The species was observed within the subject site.
High	It is likely that a species inhabits or utilises habitat within the subject site.	It is likely that a species inhabits or utilises habitat within the subject site.
Moderate	Potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the subject site.	Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be wholly dependent on the habitat present within the subject site.
Low	It is unlikely that the species inhabits the subject site.	It is unlikely that the species inhabits the subject site. If present at the site the species would likely be a transient visitor. The site contains only very common habitat for this species which the species would not rely on for its on-going local existence.
None	The habitat within the subject site is unsuitable for the species.	The habitat within the subject site is unsuitable for the species.

Likelihood of Occurrence

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
Amphibians						
Crinia tinnula	Wallum Froglet	V	-	Wallum Froglets are found in paperbark swamps and sedge swamps of the coastal 'wallum' country. Their tadpoles are adapted to acid conditions and may be outcompeted by the Common Froglet. Males call from the base of vegetation in and around the breeding site and are almost impossible to locate. Calling occurs from Autumn to Spring, being most strongly associated with flooding following rainfall. Its range extends from SE QLD to the Kurnell Peninsular of Sydney.	Low to moderate as discussed in section 4.1.4.	Species
Heleioporus australiacus	Giant Burrowing Frog	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis.	None – no potential habitat given absence of waterbodies	Species
Litoria aurea	Green and Golden Bell Frog	E	V	Inhabits a very wide range of water bodies including marshes, dams and streams, particularly those containing emergent vegetation such as bullrushes or spikerushes. It also inhabits numerous types of man-made water bodies including quarries and sand extraction sites. Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available. Known records are associated with shallow ephemeral/semi-permanent water bodies with limited flow of water. Aquatic vegetation at breeding sites includes sedges (Shoenoplectus spp., Baumea spp. and Lepironia articulata) and Broadleaf Cumbungi (Typha orientalis).	Low as discussed in section 4.1.4.	Species
Uperoleia mahonyi	Mahonys Toadlet	E	-	Current observations indicate Mahony's Toadlet inhabits ephemeral and semi-permanent swamps and swales on the coastal fringe of its range. Known records occur in heath or wallum habitats almost exclusively associated with leached (highly nutrient impoverished) white sand. Commonly associated with acid paperbark swamps, Mahony's Toadlet also is known to occur in wallum heath, swamp mahogany-paperbark swamp forest, heath shrubland and Sydney red gum woodland. Recent studies suggest intact vegetation adjacent to and within water bodies is an important habitat feature for this species.	Low to moderate as discussed in section 4.1.4.	Species
Mixophyes balbus	Stuttering Frog	E	V	Associated with streams in dry sclerophyll and wet sclerophyll forests and rainforests of more upland areas of the Great Dividing Range of NSW and down into Victoria. Breeding occurs along forest streams with permanent water where eggs are deposited within nests excavated in riffle zones by the females and the tadpoles swim free into the stream when large enough to do so. Outside of	Low to moderate as discussed in section 4.1.4.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				breeding, individuals range widely across the forest floor and can be found hundreds of metres from water.		
Birds						
Actitis hypoleucos	Common Sandpiper	-	M, MA	Utilises a wide range of coastal wetlands and some inland wetlands, mostly found around muddy margins or rocky shores. Forages in shallow water and on soft mud, roosts on rocks or vegetation such as mangroves. Northern hemisphere breeding.	Low – no wetlands or mangroves within subject site.	N/A
Anthochaera phrygia	Regent Honeyeater	CE	CE	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	Low as discussed in section 4.1.4.	Species
Apus pacificus	Fork-tailed Swift	-	M	The Fork-tailed Swift is almost exclusively aerial, flying from less than one metre to at least 300 m above ground and probably much higher.	Low – no nests found in subject site. May fly over subject site on occasion.	N/A
Arenaria interpres	Ruddy Turnstone	-	M	Mainly found in coastal regions with exposed rock coast lines or coral reefs. Also found on rock platforms with shallow tidal pools, and occasionally beaches and estuaries. Northern hemisphere breeding.	Low – no rock platforms and tidal pools.	N/A
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests.	Moderate – can occur in range of habitats.	Ecosystem
Botaurus poiciloptilus	Australasian Bittern	E	E	The Australasian Bittern is widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes and spikerushes.	Low – lack of habitat in subject site.	Species
Burhinus grallarius	Bush Stone-curlew	E	-	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights.	Low - based on survey result – discussed in section 4.1.4.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
Calidris acuminata	Sharp-tailed Sandpiper	-	M	Prefers muddy edges of shallow or brackish wetlands, with inundated or emergent sedges, saltmarsh or other low vegetation. Also found foraging in sewage ponds and flooded paddocks. Northern hemisphere breeding.	Low – lack of habitat within subject site.	N/A
Calidris canutus	Red Knot	-	M, E	Usually found foraging in soft substrate near the edge of the water on intertidal mudflats. Also have been recorded at nearby lakes, sewage ponds and floodwaters. Roosts on sandy beaches, spits and islands. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Calidris ferruginea	Curlew Sandpiper	E	CE, M	It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes the inland. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Calidris melanotos	Pectoral Sandpiper	-	M	Prefers shallow fresh to saline wetlands, found at coastal lagoons, estuaries, bays, swamps, inundated grasslands, saltmarshes and artificial wetlands. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Calidris ruficollis	Red-necked Stint	-	M	Mostly found in coastal areas including inlets, bays, lagoons and estuaries with intertidal mudflats. Occasionally on exposed ocean beaches and sometimes rocky shores and reefs. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Calidris tenuirostris	Great Knot	V	M, CE	In NSW, this species has been recorded at scattered sites along the coast to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sand flats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	The Gang-gang Cockatoo inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types, and in winter it moves to more open types at lower elevations. This species requires tree hollows for nesting and sometimes for roosting. Eucalypt trees and acacia shrubs are used for foraging. Plantations of exotic pines are usually avoided.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Discussed in section 4.1.4.	Dual
Calyptorhynchus lathami	Glossy-black Cockatoo	V	-	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Discussed in section 4.1.4.	Dual

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				Great Dividing Range where stands of sheoak occur. Black Sheoak (Allocasuarina littoralis) and Forest Sheoak (A. torulosa) are important foods.		
Charadrius bicinctus	Double-banded Plover	-	M	Found on littoral, estuarine and fresh or saline terrestrial wetlands, rocky beaches, bays and inlets. Sometimes found on exposed reefs and rock platforms. Migrates to breed in New Zealand.	Low – habitat preferences not in subject site.	N/A
Charadrius leschenaultii	Greater Sand Plover	V	M, V	Occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons. Non-breeding in Australia.	Low – habitat preferences not in subject site.	N/A
Charadrius mongolus	Lesser Sand Plover	V	M, E	Inhabits large intertidal sand flats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. Non-breeding in Australia.	Low – habitat preferences not in subject site.	N/A
Chthonicola sagittata	Speckled Warbler	V		The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Circus assimilis	Spotted Harrier	V	-	The Spotted Harrier occurs throughout the Australian mainland, except in densly forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Cuculus optatus, Cuculus saturatus	Oriental Cuckoo	-	M, MA	Mainly inhabits coniferous, deciduous and mixed forests. Breeds in northern hemisphere. Brood parasite, laying eggs in nests of other birds.	Low – habitat preferences not in subject site.	N/A
Daphoenositta chrysoptera	Varied Sittella	V	-	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
Dasyornis brachypterus	Eastern Bristlebird	E	E	Found in coastal woodlands, dense scrub and heathlands, particularly where it borders taller woodlands.	Low – not within known range of species. No records occur within locality.	Species
Diomedea antipodensis	Antipodean Albatross	V	V, M, MA	The species ranges across the southern Pacific Ocean, east to the coast of Chile and west to eastern Australia. The Antipodean Albatross breeds biennially in colonies on ridges, slopes and plateaus of isolated subantarctic islands, usually in vegetation such as grass tussocks. This species regularly occurs in small numbers off the NSW south coast from Green Cape to Newcastle during winter where they feed on cuttlefish.	None	N/A
Diomedea exulans	Wandering Albatross	E	V, M, MA	The Wandering Albatross is marine, pelagic and aerial. The Wandering Albatross visits Australian waters from Fremantle, Western Australia to northern New South Wales between June and September each year.	None	N/A
Diomedea gibsoni, Diomedea antipodensis gibsoni	Gibson's Albatross	V	V, M, MA	The species is regularly encountered on trans-Tasman shipping routes and at seas off Sydney, and regularly occurs off the NSW coast usually between Green Cape and Newcastle. This species is known only to breed on the Adams, Disappointment and Auckland Islands in the subantarctic Auckland Island group. Potential forage in NSW waters during the winter is considered significant for the species.	None	N/A
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sand flats, and mangrove vegetation.	Low – habitat preferences not in subject site.	Species
Epthianura albifrons	White-fronted Chat	V	-	Low vegetation in salty coastal and inland areas and crops. Runs along ground and is found in local flocks in Winter.	Moderate	Ecosystem
Erythrotriorchis radiatus	Red Goshawk	CE	V	Distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers. Very rare in NSW.	Low	Species
Gallinago hardwickii	Latham's Snipe	-	M	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. Seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration.	Low – habitat preferences not in subject site.	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
Gallinago megala	Swinhoe's Snipe	-	M	Occurs at edges of wetlands, swamps and freshwater streams. Also known to occur in grasslands, sewage ponds and drying claypans. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Gallinago stenura	Pin-tailed Snipe	-	M	Occurs at edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation. Also found on more open wetlands, claypans and sewage ponds. Breeds in the northern hemisphere.	Low – habitat preferences not in subject site.	N/A
Glossopsitta pusilla	Little Lorikeet	V	-	Distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range in NSW, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Mostly occur in dry, open eucalypt forests and woodlands. They feed primarily on nectar and pollen in the tree canopy. Nest hollows are located at heights of between 2 m and 15 m, mostly in living, smooth-barked eucalypts. Most breeding records come from the western slopes.	Regarded in the BAM Calculator as a 'predicted - ecosytstem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Grantiella picta	Painted Honeyeater	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits boree, brigalow and box-gum woodlands and box-ironbark forests.	None – out of range for species.	Ecosystem
Haematopus fuliginosus	Sooty Oystercatcher	V	-	In NSW the Sooty Oystercatcher occupies rocky headlands, reefs and offshore islands along the entire coast, apparently as a single continuous population.	Low – habitat preferences not in subject site.	Species
Haematopus longirostris	Pied Oystercatcher	E	-	The Pied Oystercatcher inhabits marine littoral habitats, including islands. It occupies muddy, sandy, stony or rocky estuaries, inlets and beaches, particularly intertidal mudflats and sandbanks in large marine bays.	Low – habitat preferences not in subject site.	Species
Haliaeetus leucogaster	White-bellied Sea Eagle	V	MA	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. It was also recorded during field survey flying over the subject site. No nest is present within the subject site.	Ecosystem/species
Hieraaetus morphnoides	Little Eagle	V	-	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. May nest in farmland, woodland and forest in tall trees.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem/species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
Hirundapus caudacutus	White-throated Needletail	-	M, MA	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges.	Moderate – species can occur in a range of habitat types.	N/A
Lathamus discolor	Swift Parrot	E	CE	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem/species
Limicola falcinellus	Broad-billed Sandpiper	V	M	Favours sheltered parts of the coast such as estuarine sand flats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches. Breeds in the northern hemisphere.	Low – habitat preferences not in subject site.	Species
Limosa lapponica baueri	Bar-tailed Godwit	-	M, V	Bar-tailed Godwit (spp baueri) is the eastern Australian / New Zealand sub species. Mainly found in coastal habitats such as intertidal sand flats, mudflats, estuaries, inlets, coastal lagoons and bays. Often found around beds of seagrass and saltmarsh. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Limosa limosa	Black-tailed Godwit	V	M	Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sand flats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	Ecosystem
Lophoictinia isura	Square-tailed Kite	V	-	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Macronectes giganteus	Southern Giant Petrel	E	E	The Southern Giant Petrel has a circumpolar pelagic range from Antarctica to approximately 20 S and is a common visitor off the coast of NSW. Over summer, the species nests in small colonies amongst open vegetation on antarctic and subantarctic islands, including Macquarie and Heard Islands and in Australian Antarctic territory.	None	EEC/Marine
Macronectes halli	Northern Giant-petrel	V	V	Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer.	None	EEC/Marine

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
Monarcha melanopsis	Black-faced Monarch	-	M	Found along the coast of eastern Australia, becoming less common further south. Inhabits rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Moderate – can occur in a range of habitat types.	N/A
Melithreptus gularis gularis	Black-chinned Honeyeater	V	-	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*).	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Monarcha trivirgatus	Spectacled Monarch	-	M	Coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. Prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	Low – habitat preferences not in subject site.	N/A
Motacilla flava	Yellow Wagtail	-	M	Breeds in temperate Europe and Asia. The Yellow Wagtail is a regular wet season visitor to northern Australia. Increasing records in NSW suggest this species is an occasional but regular summer visitor to the Hunter River region. The species is considered a vagrant to Victoria, South Australia and southern Western Australia. Habitat requirements for the Yellow Wagtail are highly variable, but typically include open grassy flats near water. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland, dams, waterholes; sewage farms, sometimes utilise tidal mudflats and edges of mangroves.	Low – habitat preferences not in subject site.	N/A
Myiagra cyanoleuca	Satin Flycatcher	-	M	The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	Low – habitat preferences not in subject site.	N/A
Neophema pulchella	Turquoise Parrot	V	-	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	Low – habitat preferences not in subject site.	Ecosystem
Ninox connivens	Barking Owl	V	-	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Field surveys did not detect the species utilising hollows.	Ecosystem / species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.		
Ninox strenua	Powerful Owl	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within turpentine tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Field surveys did not detect the species utilising hollows. Species is discussed in section 4.1.4.	Ecosystem/species
Numenius madagascariensis	Eastern Curlew	-	CE, MA, M	A primarily coastal distribution. Found in all states, particularly the north, east, and south-east regions including Tasmania. Rarely recorded inland. Mainly forages on soft sheltered intertidal sand flats or mudflats, open and without vegetation or cover. Breeds in the northern hemisphere.	Low – habitat preferences not in subject site Not detected during field survey.	Ecosystem
Numenius minutus	Little Curlew	-	M	Feeds in short, dry grassland and sedgeland, including dry floodplains and black soil plains, which have scattered, shallow freshwater pools. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Numenius phaeopus	Whimbrel	-	M	Usually found on intertidal mudflats of sheltered coasts. Also found in harbours, lagoons, estuaries and river deltas, often those with mangroves. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Pandion cristatus, Pandion haliaetus	Eastern Osprey	V	M, MA	Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	No nests in subject site. May occasionally fly over the subject site.	Species
Philomachus pugnax	Ruff	-	M	Generally found in fresh, brackish to saline wetlands with exposed mudflats at the edges. Breeds in northern hemisphere.	Low – habitat preferences not in subject site.	N/A
Phoebetria fusca	Sooty Albatross	V	-	In Australian waters, this species is generally recorded in winter off the south coast from Tasmania to Western Australia, while there are occasional sightings off the NSW coast, north of Grafton. This pelagic or ocean-going species inhabits subantarctic and subtropical marine waters, spending the majority of its time at sea, and rarely occurs in continental shelf waters.	None	EEC/Marine
Pluvialis fulva	Pacific Golden Plover	-	M	Coastal habitats such as beaches, mudflats, sand flats, estuaries, lagoons and evaporation ponds in salt works. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
Pluvialis squatarola	Grey Plover	-	M	Almost entirely in coastal areas including sheltered embayment's, estuaries and lagoons with mudflats and sand flats, and occasionally on rocky coasts with platforms or reef flats. Breeds in northern hemisphere.	Low – habitat preferences not in subject site.	N/A
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies	V	-	In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Pterodroma neglecta neglecta	Kermadec Petrel (west Pacific subspecies)	V	V	Typically nests on the surface in loose colonies among rocks and vegetation. On Ball's Pyramid it nests only on steep cliffs above 400 m. On Phillip I. it nests under stands of African Olive. This species is marine and highly pelagic, rarely approaching land except at colonies.	None	EEC/Marine
Rhipidura rufifrons	Rufous Fantail	-	M	Found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. Inhabits tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests.	Low – habitat preferences not in subject site.	Species
Rostratula australis	Australian Painted Snipe	E	E, MA	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	Low – may fly over site	Ecosystem
Stagonopleura guttata	Diamond Firetail	V	-	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Sternula albifrons	Little Tern	E	M	In Australia, Little Terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches.	Low – not recorded in subject site.	Species
Thalassarche cauta (sensu stricto), Thalassarche cauta cauta	Shy Albatross, Tasmanian Shy Albatross	V	V, M, MA	The Shy Albatross is a marine species occurring in subantarctic and subtropical waters, reaching the tropics in the cool Humboldt Current off South America.	None	EEC/Marine
Thalassarche melanophris	Black-browed Albatross	V	V, M, MA	The Black-browed Albatross has a circumpolar range over the southern oceans, and are seen off the southern Australian coast mainly during winter. Inhabits Antarctic,	None	N/A

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				subantarctic, subtropical marine and coastal waters over upwellings and boundaries of currents.		
Tringa brevipes, Heteroscelus brevipes	Grey-tailed Tattler	-	M, MA	Found on sheltered coasts with reefs and rock platforms, intertidal mudflats, estuaries and coastal lagoons, especially fringed with mangroves. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Tringa nebularia	Common Greenshank	-	M	Variety of inland wetlands and sheltered coastal habitats of varying salinity. Found on mudflats, saltmarsh, mangroves in embayments, harbours, deltas and lagoons. Breeds in northern hemisphere.	Low – habitat preferences not in subject site.	N/A
Tringa stagnatilis	Marsh Sandpiper	-	M	Permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, sewage farms and salt works. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	N/A
Tyto novaehollandiae	Masked Owl	V	-	Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting. Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometimes dead. Nest hollows are usually located within dense forests or woodlands. Masked Owls prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present. Field surveys did not detect the species utilising hollows.	Species/Ecosystem
Xenus cinereus	Terek Sandpiper	V	M, MA	The Terek Sandpiper mostly forages in the open, on soft wet intertidal mudflats or in sheltered estuaries, embayments, harbours or lagoons. Northern hemisphere breeding.	Low – habitat preferences not in subject site.	Ecosystem
Mammals						
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	None – subject site not within 2 km of rocky cliff lines	Ecosystem and species
Dasyurus maculatus	Spotted-tail Quoll	V	E	The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Only in Tasmania is it still considered relatively common. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. The species was not detected during extensive trapping. It is unlikely to use the Subject Site.	Ecosystem
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor. This species also	High	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites.		
Kerivoula papuensis	Golden-tipped Bat	V	-	Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Miniopterus australis	Little Bentwing-bat	V	-	Coastal north-eastern NSW and eastern Queensland. The Little Bentwing-bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel hundreds of kilometres from feeding home ranges to breeding sites. They have a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.	Moderate – thought unlikely to have breeding habitat given lack of hollows in subject site.	Ecosystem and species
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-	Eastern Bentwing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Known – recorded in subject site, though no breeding habitat.	Ecosystem and species
Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species' habits.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Myotis macropus	Southern Myotis	V	-	The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage.	Moderate – though no breeding habitat.	Ecosystem and species
Petauroides volans	Greater Glider	-	V	The Greater Glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows.	Low	Species
Petaurus norfolcensis	Squirrel Glider	V	-	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias. There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps. Within a suitable vegetation community at least one species should flower heavily in winter and one	Previously been recorded in the subject site.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				species of eucalypt should be smooth barked. Endangered population in the Wagga Wagga LGA.		
Petaurus australis	Yellow-bellied Glider	V	-	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Phascogale tapoatafa	Brush-tailed Phascogale	V	-	The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.	Low – species not recorded along Stockton beach corridor. Closest record is approximately 8km inland. The species was not detected during extensive targeted survey.	Species
Phascolarctos cinereus	Koala	V	V	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall.	Low likelihood to utilise the subject site on a regular basis. This is supported by the SAT and spotlighting survey which did not detect any usage of the subject site by Koalas. However it is noted that there are records throughout the locality. The Koala may move through the area, but given the site is predominately regeneration, is unlikely to use as main source of foraging habitat, and would likely utilise the surrounding bushland for movement given the protection from predators.	Species
Phascolarctos cinereus	Koala, Hawks Nest and Tea Gardens population	EP	-	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall.	As above	N/A
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	Inhabits coastal heath and wet and dry sclerophyll forests. Generally found in areas with rainfall greater than 760 mm. Requires relatively thick ground cover where the soil is light and sandy.	Moderate	Ecosystem

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
Pseudomys novaehollandiae	New Holland Mouse	-	V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	Moderate	Ecosystem
Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V	-	In NSW the Eastern Chestnut Mouse mainly occurs north from the Hawkesbury River area as scattered records along to coast and eastern fall of the Great Dividing Range extending north into Queensland. There are however isolated records in the Jervis bay area. In NSW the Eastern Chestnut Mouse is mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	High – however no breeding habitat in subject site.	Ecosystem and species
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Syconycteris australis	Common Blossom Bat	V	-	Coastal areas of eastern Australia from Hawks Nest in NSW to Cape York peninsula in Queensland. In areas, the distribution extends inland to coastal foothills. Common Blossom-bats often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps. They have also been recorded in a range of other vegetation communities, such as subtropical rainforest, wet sclerophyll forest and other coastal forests.	Regarded in the BAM Calculator as a 'predicted - ecosystem credit species'. Therefore, the species is presumed to be present.	Ecosystem
Flora						
Angophora inopina	Charmhaven Apple	V	V	Endemic to the Central Coast region of NSW. The known northern limit is near Karuah where a disjunct population occurs; to the south populations extend from Toronto to Charmhaven with the main population occurring between Charmhaven and Morisset. Occurs most frequently in Red Bloodwood Scribbly Gum woodland,	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				wet heath, Red Mahogany Paperbark Sedge woodland and Stringybark Red Bloodwood forest.		
Callistemon linearifolius	Netted Bottle Brush	V	-	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Three of the remaining populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve. The species has also been recorded from Yengo National Park.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Commersonia prostrata	Dwarf Kerrawang	E	E	Occurs on sandy, sometimes peaty soils in a wide variety of habitats: snow gum woodland at Rose Lagoon; Blue-leaved Stringybark open forest at Tallong; and in Brittle Gum low open woodland at Penrose; Scribbly Gum - Swamp Mahogany ecotonal forest at Tomago.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Corybas dowlingii	Red Helmet Orchid	E	-	*Corybas dowlingii* is restricted to the central coast and Hunter regions of New South Wales where it is currently known from the Port Stephens, Bulahdelah, Lake Macquarie and Freemans Waterhole areas. It is known from the local government areas of Cessnock, Great Lakes, Lake Macquarie and Port Stephens. Sheltered areas such as gullies and southerly slopes in tall open forest on well-drained gravelly soil at elevations of 10-200 m	Low – habitat not suitable as species occurs in sheltered gullies.	Species
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum, Silvertop Ash, Red Bloodwood and Black She-oak and appears to prefer open areas in the understorey of this community.	Low – lack of remnant habitat given the subject site is mainly rehabilitated quarry pit. Lack of associated canopy species.	Species
Diuris arenaria	Sand Doubletail	E	-	Known from the Tomaree Peninsula near Newcastle. This species occurs in coastal heath and dry grassy eucalypt forest on sandy flats. Grows in gently undulating country in eucalypt forest with a grassy understorey on clay soil.	Low – lack of clay soil. Not previously recorded in the locality of the subject site.	Species
Diuris praecox	Rough Doubletail	V	V	Occurs between Ourimbah and Nelson Bay. Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. Exists as subterranean tubers most of the year. It produces leaves and flowering stems in winter.	Low – species has been recorded adjacent to the subject site in remnant coastal dry sclerophyll forest. Targeted survey during the recommended	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
					survey time did not detect the species.	
Eucalyptus camfieldii	Heart-leaved Stringybark	V	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Eucalyptus parramattensis subsp. decadens		V	V	Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Grevillea parviflora subsp. parviflora	Small-flowered Grevillea	V	V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Maundia triglochinoides		V	-	Grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Flowering occurs during warmer months. Diaspore is the seed and root tubers, which are probably dispersed by water.	None – no waterbodies	Species
Melaleuca biconvexa	Biconvex Paperbark	V	V	Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Melaleuca groveana	Groves Paperbark	V	-	Widespread, scattered populations in coastal districts north of Yengo National Park to southeast Queensland. Also found as a disjunct population near Torrington on the northern tablelands. Grove's Paperbark grows in heath and shrubland, often in exposed sites, in low coastal hills, escarpment ranges and tablelands on outcopping granite, rhyolite and sandtone on rocky outcrops and cliffs.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Persicaria elatior	Tall Knotweed	V	V	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Phaius australis	Southern Swamp Orchid	E	E	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Low – lack of habitat preferences. Not detected during survey. Not previously	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
					recorded in subject site or surrounds.	
Prostanthera densa	Villous Mint Bush	V	V	This species has been recorded from the Currarong area in Jervis Bay, Royal National Park (Marley), Cronulla, Helensburgh and Port Stephens (Nelson Bay). The Sydney and Royal National Park populations were thought possibly extinct, but the species is now known to occur at Bass and Flinders Point in Cronulla. *Prostanthera densa* generally grows in sclerophyll forest and shrubland on coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Rhizanthella slateri	Eastern Australian Undergrown Orchid	V	E	Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed.	Low – no previous records and the majority of the subject site consists of rehabilitation which has changed the natural sandy soil base.	Species
Senecio spathulatus	Coast Groundsel	E	-	Coast Groundsel occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at Cudmirrah). In Victoria there are scattered populations from Wilsons Promontory to the NSW border. Coast Groundsel grows on primary dunes.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Syzygium paniculatum	Magenta Lilly Pilly	E	V	Found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State forest. On the south coast the species occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low – not detected during survey. Relatively conspicuous species. Not previously recorded in subject site or surrounds.	Species
Tetratheca juncea	Black-eyed Susan	V	V	Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is usually found in low open forest-woodland with a mixed shrub understorey and grassy groundcover. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. Cryptic species that requires survey in September-October.	Low – not detected during survey. Not previously recorded in subject site or surrounds. Habitat preferences absent given the subject site has been previously cleared.	Species
Thesium australe	Austral Toadlax	V	V	Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in	Low – headland habitat not present.	Species

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood of occurrence	Credit type
				Tasmania and Queensland and in eastern Asia. Although originally described from material collected in the SW Sydney area, populations have not been seen in a long time. It may persist in some areas in the broader region. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*).		

Threatened Ecological Community (TEC) Likelihood of occurrence

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within subject site
Central Hunter Grey Box - Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	Central Hunter Grey Box-Ironbark Woodland occurs in the Central Hunter Valley between about Singleton and Muswellbrook. It is known to occur in the Cessnock, Singleton and Muswellbrook LGAs but may occur elsewhere within the Sydney Basin Bioregion. Central Hunter Grey Box-Ironbark Woodland occurs in areas of relatively low rainfall and high temperatures. It is associated mostly with Permian lithology, and is situated on gently undulating hills, slopes and valleys, or occasionally on rocky knolls. Central Hunter Grey Box–Ironbark Woodland typically forms a woodland dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*), Kurrajong (*Brachychiton populneus* subsp. *populneus*) and Grey Box (*Eucalyptus moluccana*). Other tree species such as Rough-barked Apple (*Angophora floribunda*) and Black Cypress Pine (*Callitris endlicheri*) may be present and occasionally dominate or co-dominate. A shrub layer is often present and common shrub species include Velvet Mock Olive (*Notelaea microcarpa* var. *microcarpa*), Coffee Bush (*Breynia oblongifolia*), Blackthorn (*Bursaria spinosa* subsp. *spinosa*), *Cassinia quinquefaria* and Sticky Hop-bush (*Dodonaea viscosa*). Subshrubs may also be common and include Narrawa Burr (*Solanum cinereum*), *Phyllanthus virgatus* and Small-leaf Bluebush (*Maireana microphylla*). Ground cover can be moderately dense to dense, and consist of numerous forbs and grass species as well as a small number of ferns, sedges and twiners. The more common species include Barbed Wire Grass (*Cymbopogon refractus*), Purple Wiregrass (*Aristida ramosa*), Kidney Weed (*Dichondra repens*), Poison Rock Fern (*Cheilanthes sieberi* subsp. *sieberi*), Bristly Cloak Fern (*Cheilanthes distans*), Tall Chloris (*Chloris ventricosa*), Slender Tick-trefoil (*Desmodium varians*), Yellow Burr-daisy (*Calotis lappulacea*), Many-flowered Mat-rush (*Lomandra multiflora* subsp. *multiflora*), Blue Trumpet (*Brunoniella australis*) and *Glycine tabacina*.	Endangered	Critically Endangered	None
Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions	Central Hunter Ironbark-Spotted Gum-Grey Box Forest occurs in the central Hunter Valley mainly between Maitland and Muswellbrook. It has been recorded from Singleton, Cessnock and Muswellbrook LGAs but may occur elsewhere within the North Coast and Sydney Basin Bioregions. Central Hunter Ironbark-Spotted Gum-Grey Box Forest occupies undulating country including low rises and slopes, occurring on all aspects. It may also occur on alluvial and colluvial soils in valleys. It mostly occurs on clayey soils found on Permian sediments. Central Hunter Ironbark-Spotted Gum-Grey Box Forest typically forms an open forest or woodland dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*), Spotted Gum (*Corymbia* maculata) and Grey Box (*Eucalyptus moluccana*). Other tree species such as Red Ironbark (*Eucalyptus fibrosa*) and Forest Red Gum (*Eucalyptus* tereticornis) may be present, and occasionally dominate or co-dominate. A sparse layer of small trees including Bulloak (*Allocasuarina* luehmannii) or Silver-stemmed Wattle (*Acacia parvipinnula*) may be present in some areas. The shrub layer varies from sparse to moderately dense. Common shrub species include Gorse Bitter Pea (*Daviesia ulicifolia* subsp. *ulicifolia*), Grey Bush-pea (*Pultenaea spinosa*), Coffee Bush (*Breynia oblongifolia*), Needlebush (*Hakea* sericea) and Blackthorn (*Bursaria spinosa* subsp. *spinosa*). Ground cover can be sparse to moderately dense and consists of numerous forbs, a few grass species and occasional ferns and sedges. Common species include Poison Rock Fern (*Cheilanthes sieberi* subsp. *sieberi*), Barbed Wire Grass (*Cymbopogon refractus*), Whiteroot (*Pratia purpurascens*), Many-flowered Mat-rush (*Lomandra multiflora* subsp. *multiflora*), *Pomax umbellata*, *Glycine tabacina*, Blue Flax-lily (*Dianella revoluta*), Slender Wire Lily (*Laxmannia gracilis*), *Vernonia cinerea* var. *cinerea*, Slender Tick-trefoil (*Desmodium varians*) and Kidney Weed (*Dichondra repens*).	Endangered	Critically Endangered	None

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within subject site
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Coastal Saltmarsh occurs in the intertidal zone on the shores of estuaries and lagoons that are permanently or intermittently open to the sea. It is frequently found as a zone on the landward side of mangrove stands. Characteristic plants include *Baumea juncea*, Sea Rush (*Juncus krausii* subsp. australiensis), Samphire (*Sarcocornia quinqueflora* subsp. quinqueflora), Marine Couch (*Sporobolus virginicus*), Streaked Arrowgrass (*Triglochin striata*), Knobby Club-rush (*Ficinia nodosa*), Creeping Brookweed (*Samolus repens*), Swamp Weed (*Selliera radicans*), Seablite (*Suaeda* australis) and Prickly Couch (*Zoysia macrantha*). Occasionally mangroves are scattered through the saltmarsh. Tall reeds may also occur, as well as salt pans. Found in the tidal flats of estuaries and on the edges of intermittently opened coastal lagoons. Occurs in the upper limits of the tidal zone, and is frequently interspersed with bare ground and salt pans.	Endangered	Vulnerable	None
Coastal Upland Swamp in the Sydney Basin Bioregion	The Coastal Upland Swamp in the Sydney Basin Bioregion includes open graminoid heath, sedgeland and tall scrub associated with periodically waterlogged soils on the Hawkesbury sandstone plateaux. The Coastal Upland Swamp is generally associated with soils that are acidic and vary from yellow or grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peat soils with pallid subsoils. The vegetation of the Coastal Upland Swamp may include tall open scrubs, tall closed scrubs, closed heaths, open graminoid heaths, sedgelands and fernlands. Larger examples may include a complex of these structural forms. The flora comprising the upland swamp is diverse there are 73 plant species listed as characterising the ecological community.	Endangered	Endangered	None
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains. Generally occur below 20 m elevation on level areas. They are dominated by herbaceous plants and have very few woody species. The structure and composition of the community varies both spatially and temporally depending on the water regime: Those that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including Paspalum distichum (water couch), Leersia hexandra (swamp rice-grass), Pseudoraphis spinescens (mud grass) and Carex appressa (tussock sedge). Where they are subject to regular inundation and drying the vegetation may include large emergent sedges over 1 metre tall, such as Baumea articulata, Eleocharis equisetina and Lepironia articulata, as well as emergent or floating herbs such as Hydrocharis dubia (frogbit), Philydrum lanuginosum(frogsmouth), Ludwigia peploides subsp. montevidensis (water primrose), Marsilea mutica (nardoo) and Myriophyllum spp. (milfoils).	Endangered		None
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	Hunter Floodplain Red Gum Woodland generally forms a tall to very tall (18-35 m) woodland on floodplains and associated rises along the Hunter River and tributaries within the NSW North Coast and Sydney Basin Bioregions. Stands on major floodplains are generally dominated by Eucalyptus camaldulensis (River Red Gum) in combinations with Eucalyptus tereticornis (Forest Red Gum), Eucalyptus melliodora (Yellow Box) and Angophora floribunda (Rough-barked Apple). Within the community stands of Casuarina cunninghamiana subsp. cunninghamiana (River Oak) and Casuarina glauca (Swamp Oak) can form a part of this community. Dominant groundcovers include Cynodon dactylon (Couch), Alternanthera denticulata (Lesser Joyweed), Austrostipa verticillata(Slender Bamboo Grass), Dichondra repens (Kidney Weed), Lepidium pseudohyssopifolium (Peppercress), Pratia concolor (Poison Pratia), Urtica incisa (Stinging Nettle), Einadia hastata (Berry Saltbush), Amaranthus macrocarpus var. macrocarpus (Dwarf Amaranth), Cyperus fulvus (Sticky Sedge), Cynoglossum australe (Australian Hound's Tongue), Cyperus gracilis(Slender Flat-sedge), Glycine tabacina (Variable Glycine), Geranium solanderi (Native Geranium) and Microlaena stipoides var. stipoides (Weeping Rice Grass).	Endangered		None

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within subject site
Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	Hunter Lowland Redgum Forest is an open forest where the most common canopy tree species are *Eucalyptus tereticornis*(Forest Red Gum) and *E. punctata* (Grey Gum). Other frequently occurring canopy species are *Angophora floribunda* (Rough-barked Apple), *E. crebra* (Narrow-leaved Ironbark), *E. moluccana* (Grey Box) and *Corymbia maculata* (Spotted Gum). The shrub layer is open and common shrub species include *Breynia oblongifolia* (Coffee Bush), *Leucopogon juniperinus* (Prickly Beard-heath), *Daviesia ulicifolia* (Gorse Bitter Pea) and *Jacksonia scoparia* (Dogwood). The ground cover typically comprises grasses and herbs with common species being *Microlaena stipoides* var. *stipoides* Forest Weeping Grass, *Pratia purpurascens* (Whiteroot), *Lomandra multiflora* (Many-flowered Mat-rush), *Cymbopogon refractus* (Barbed Wire Grass), *Cheilanthes sieberi* (Poison Rock Fern) and *Dichondra repens* (Kidney Weed). Occurs between Muswellbrook, Beresfield, Mulbring and Cessnock in the Lower Hunter in the Sydney Basin and North Coast bioregions. It has been recorded from the Maitland, Cessnock, Port Stephens, Muswellbrook and Singleton LGAs, but may occur elsewhere in these bioregions. Probably less than 500 hectares of this community remains. Hunter Lowland Redgum Forest occurs on the Permian sediments of the Hunter Valley floor. Much of the remaining community is disturbed and fragmented. The floristic composition and structure of the community is influenced by both the size and disturbance history of the remaining fragments. Consequently at heavily disturbed sites only some of the species which characterise the community may be present. Occurs on gentle slopes of depressions and drainage flats on the Hunter Valley floor.	Endangered		None
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	Hunter Valley Footslopes Slaty Gum Woodland is a woodland, or occasionally an open forest, with a sparse to moderately dense tree layer with occasional small trees and a moderately dense to dense shrub layer. The tree canopy is typically dominated by *Eucalyptus dawsonii* (Slaty Gum) and/or *Eucalyptus moluccana* (Grey Box). *Acacia salicina*(Cooba) and *Allocasuarina luehmannii* (Bulloak) may form a small tree layer or be part of the upper-most canopy. Other trees which may be present include *Brachychiton populneus* subsp. *populneus* (Kurrajong), *Callitris endlicheri*(Black Cypress Pine), *Eucalyptus crebra* (Narrow-leaved Ironbark) and *Eucalyptus punctata* (Grey Gum). The shrub layer includes species such as *Olearia elliptica* (Sticky Daisy Bush), *Acacia cultriformis* (Knife-leaved Wattle), *Canthium odoratum* (Shiny-leaved Canthium), *Notelaea microcarpa* var. *microcarpa* (Native Olive), *Dodonaea viscosa* subsp. *cuneata* (Wedge-leaf Hopbush), *Acacia decora* (Western Golden Wattle) and *Solanum brownii* (Violet Nightshade). The groundcover is typically sparse to very sparse and is relatively species poor. The most frequently occurring species include *Dichondra repens*(Kidney Weed), *Lomandra multiflora* subsp. *multiflora* (Many-flowered Mat-rush), *Aristida ramosa* (Wire Grass), *Brunoniella australis* (Blue Trumpet), *Cymbopogon refractus* (Barbed Wire Grass), *Desmodium brachypodum* (Large Tick-trefoil), *Fimbristylis dichotoma* (Common Fringe-rush) and *Sida corrugata*(Corrugated Sida).	Vulnerable	Critically Endangered	None

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within subject site
Hunter Valley Vine Thicket in the NSW North Coast and Sydney Basin Bioregions	Hunter Valley Vine Thicket typically forms a low forest, usually less than 10 m tall, with a closed canopy dominated by small trees. The canopy may include *Elaeodendron australe*(Red Olive Plum), *Geijera parviflora* (Wilga), *Notelaea microcarpa* var. *microcarpa* (Native Olive), *Alectryon oleifolius* subsp. *elongatus*(Western Rosewood), *Melia azedarach* (White Cedar) and *Brachychiton populneus* subsp. *populneus* (Kurrajong). Emergent eucalypts are common and include *Eucalyptus albens* (White Box), *E. dawsonii* (Slaty Box) and *E. crebra*(Narrow-leaved Ironbark). A shrub stratum is usually present and includes *Olearia elliptica* subsp. *elliptica* (Sticky Daisy Bush) and *Rhagodia parabolica*(Mealy Saltbush). Vines are common and include *Cissus opaca* (Small-leaved Water Vine), *Marsdenia flavescens* (Hairy Milk Vine), *Parsonsia eucalyptophylla*(Gargaloo) and *Pandorea pandorana* subsp. *pandorana* (Wonga Vine). Ground cover is generally sparse and includes *Urtica incisa* (Stinging Nettle) and *Austrostipa verticillata* (Slender Bamboo Grass). Hunter Valley Vine Thicket has a highly restricted geographic distribution in the central Hunter Valley. The community occurs mostly as patches of less than 10 ha, with a few larger patches exceeding 100 ha. Approximately 85% of the pre-European distribution of the community remains. The largest occurrence is at Brushy Hill adjacent to Glenbawn Dam, north east of Scone. The only stand known to occur in a conservation reserve is at Mt Dangar within the Goulburn River National Park. Hunter Valley Vine Thicket has been recorded from the local government areas of Muswellbrook, Singleton, and Upper Hunter but may occur elsewhere within the Sydney Basin Bioregion and NSW North Coast Bioregion.	Endangered		None
Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion	Hunter Valley Weeping Myall Woodland of the Sydney Basin bioregion typically has a dense to open tree canopy up to about 15 m tall, depending on disturbance and regrowth history. The most common tree is *Acacia pendula* (Weeping Myall), which may occur with *Eucalyptus crebra* (Narrow-leaved Ironbark), *A. salicina* (Cooba) and/or trees within the *A. homalophylla* - *A. melvillei* complex. Understorey shrubs may include *Canthium buxifolium* (Stiff Canthium), *Dodonaea viscosa* (Sticky Hopbush), *Geijera parviflora* (Wilga), *Notelaea microphylla* var. *microphylla*(Native Olive) and *Senna zygophylla* (Silver Cassia). However, these shrubs are absent from some stands. The groundcover varies from dense to sparse, and is comprised of grasses such as *Austrodanthonia fulva* (a wallaby grass) and *Themeda australis* (Kangaroo Grass), and low shrubs and herbs such as *Chrysocephalum apiculatum* (Common Everlasting), *Einadia nutans* subsp. *nutans* (Climbing Saltbush), *Enchylaena tomentosa* (Ruby Saltbush), *Maireana microphylla* (Eastern Cotton Bush) and *Ptilotus semilanatus*.	Critically Endangered	Critically Endangered	None
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	Littoral Rainforest is generally a closed forest, the structure and composition of which is strongly influenced by its proximity to the ocean. The plant species of this community are predominantly rainforest species. Several species have compound leaves, and vines may be a major component of the canopy. Littoral Rainforest occurs only on the coast and is found at locations in the NSW North Coast Bioregion, Sydney Basin Bioregion and South East Corner Bioregion. Littoral Rainforest is very rare and occurs in many small stands. In total, it comprises less than one percent of the total area of rainforest in NSW. The largest known stand occurs in Iluka Nature Reserve, which is about 136 hectares in size. Not all stands of this community have been included in mapping for the Environmental Planning Policy 26, Littoral rainforest. Occurs on sand dunes and on soil derived from underlying rocks. Stands on headlands exposed to strong wind-action may take the form of dense, wind-pruned thickets. Stands are generally taller in sheltered sites such as hind dunes, although wind-pruning may still occur on their windward sides. Most stands occur within two kilometres of the sea, though are occasionally found further inland within reach of the maritime influence.	Endangered	Critically Endangered	Low

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within subject site
Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions	Restricted to a range of approximately 65 km by 35 km centred on the Cessnock - Beresfield area in the Central and Lower Hunter Valley. Within this range, the community was once widespread. A fragmented core of the community still occurs between Cessnock and Beresfield. Remnants occur within the Local Government Areas of Cessnock, Maitland, Singleton, Lake Macquarie, Newcastle and Port Stephens but may also occur elsewhere within the bioregion. Outliers are also present on the eastern escarpment of Pokolbin and Corrabare State Forests on Narrabeen Sandstone.	Endangered		None
Lower Hunter Valley Dry Rainforest in the Sydney Basin and NSW North Coast Bioregions	Lower Hunter Valley Dry Rainforest mainly occurs on the Barrington footslopes along the northern rim of the Hunter Valley Floor, where it occupies gullies and steep hillslopes with south facing aspects. It is also known from south of the Hunter River at Mt Bright and Mt View. Lower Hunter Valley Dry Rainforest has been recorded from the local government areas of Cessnock, Maitland and Port Stephens, and is also likely to occur or have occurred in Muswellbrook, Singleton, Upper Hunter and Dungog LGAs. Lower Hunter Valley Dry Rainforest typically occurs on Carboniferous sediments in gullies and on steep hillslopes with south facing aspects. It is generally found at elevations less than 300 m ASL with a mean annual rainfall less than 900 mm	Vulnerable		None
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions is an ecological community of subtropical rainforest and some related, structurally complex forms of dry rainforest. Lowland Rainforest, in a relatively undisturbed state, has a closed canopy, characterised by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. Typically, the trees form three major strata: emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes results in an irregular canopy appearance. The trees are taxonomically diverse at the genus and family levels, and some may have buttressed roots. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. In disturbed stands of this community the canopy cover may be broken, or the canopy may be smothered by exotic vines. The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions. South of the Sydney metropolitan area, Lowland Rainforest is replaced by Illawarra Subtropical Rainforest of the Sydney Basin Bioregion, which is listed as an endangered ecological community. Milton Ulladulla Subtropical Rainforest is also a related rainforest endangered ecological community that occurs still further south in the South East Corner Bioregion.	Endangered	Critically Endangered	None

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within subject site
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	Lowland Rainforest on Floodplain is a rainforest community which now occurs only as small remnants in scattered localities on the NSW north coast, with less than 1000ha in total thought to remain. Larger stands of the community typically have a dense canopy, which blocks most light from reaching the ground, creating cool, moist conditions within. Lowland Rainforest on Floodplain supports a rich diversity of plants and animals. Typical tree species in the community include figs *(Ficus macrophylla, F. obliqua* and *F. watkinsiana),* palms *(Archontophoenix cunninghamiana* and *Livistona australis),*Silky Oak *(Grevillea robusta),* Black Bean *(Castanospermum australe)* and Brush Cherry *(Syzygium australe).* Animals present include fruit-eating rainforest pigeons, Noisy Pitta, Brush-turkey, pademelons, flying foxes, the Land Mullet skink and rainforest snails. Lowland Rainforest on Floodplain generally occupies riverine corridors and alluvial flats with rich, moist silts often in subcatchments dominated by basic volcanic substrates. Major examples once occurred, and remnants remain, on the floodplains of the Tweed, Richmond, Clarence, Bellinger, Macleay, Hastings, Manning, and Hunter Rivers. Other minor river systems also support the community. This community occurs on fertile soils in lowland river valleys.	Endangered	Critically Endangered	None
Quorrobolong Scribbly Gum Woodland in the Sydney Basin Bioregion	Quorrobolong Scribbly Gum Woodland is a low shrubby woodland with the overstorey dominated by *Eucalyptus racemosa* (Scribbly Gum). Other tree species present include *E. piperita* (Sydney Peppermint), *E. resinifera* (Red Mahogany), *Angophora costata* (Smooth-barked Apple) and *E. punctata* (Grey Gum). There is usually a well developed shrub layer with common species being *Leptospermum trinervium* (Slender Tea-tree), *Acacia parvipinnula* (Silver-stemmed Wattle), *Persoonia linearis*(Narrow-leaved Geebung) and *Leptospermum polygalifolium* (Tantoon). The ground layer is often sparse and frequently occurring species are *Imperata cylindrica* var. *major* (Blady Grass), *Panicum simile* (Two-colour Panic), *Pratia purpuracens* (Whiteroot), *Lomandra cylindrica* (Needle Mat-rush) and *Dianella revoluta*. Currently known from only a small area between Quorrobolong and Mulbring in the Cessnock local government area, but may also occur elsewhere within the Hunter Valley. The current known extent is about 70 hectares; the pre-European extent is estimated to have been only 160 hectares, reflecting the limited area of the sand deposit on which it occurs. Not known to occur within any conservation reserves. Occupies gentle slopes and rises on a residual sand deposit overlying the Permian clay sediments of the Hunter Valley floor.	Endangered		None
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	As the name suggests, this EEC is found on the river flats of the coastal floodplains. It has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include Eucalyptus tereticornis (forest red gum), E. amplifolia (cabbage gum), Angophora floribunda (rough-barked apple) and A. subvelutina (broad-leaved apple). Eucalyptus baueriana (blue box), E. botryoides (bangalay) and E. elata (river peppermint) may be common south from Sydney, E. ovata (swamp gum) occurs on the far south coast, E. saligna (Sydney blue gum) and E. grandis (flooded gum) may occur north of Sydney, while E. benthamii is restricted to the Hawkesbury floodplain.	Endangered		None

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within subject site
Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include *Eucalyptus tereticornis* (forest red gum), *E. siderophloia* (grey ironbark), *Corymbia intermedia* (pink bloodwood) and, north of the Macleay floodplain, *Lophostemon suaveolens* (swamp turpentine). Other trees may be scattered throughout at low abundance or locally common at few sites, particularly where there is an influence from lithic substrates upslope. These include *Eucalyptus moluccana* (grey box), *E. propinqua* (grey gum), *E. seeana*(narrow-leaved red gum), *Angophora subvelutina* (broad-leaved apple), *E. robusta* (swamp mahogany), *Eucalyptus resinifera* subsp. *hemilampra* (red mahogany), *E. acmenoides* (white mahogany), *Angophora woodsiana, A. paludosa* and rainforest trees such as *Ficus*spp. (figs) and *Cupaniopsis* spp (tuckeroos). A layer of small trees may be present, including *Allocasuarina torulosa* (forest oak), *Alphitonia excelsa* (red ash), *Glochidion ferdinandi* (cheese tree), *Callistemon* spp. (bottlebrushes), *Melaleuca* spp. (paperbarks) *andCasuarina glauca* (swamp oak). Scattered shrubs include *Breynia oblongifolia* (coffee bush), *Acacia concurrens* (curracabah), *Commersonia* spp., and *Hibiscus* spp. Occasional vines include *Eustrephus latifolius* (wombat berry), *Parsonsia straminea* (common silkpod) and *Geitonoplesium cymosum* (scrambling lily). The groundcover is composed of abundant forbs, scramblers and grasses including *Imperata cylindrica* var. *major* (blady grass), *Themeda australis* (kangaroo grass), *Vernonia cinerea, Dianella caerulea* (blue flax lily), *Pratia purpurascens* (whiteroot), *Cheilanthes sieberi* subsp. *sieberi,* and *Dichondra repens* (kidney weed). The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.	Endangered		None
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which *Casuarina glauca* (swamp oak) is the dominant species northwards from Bermagui. Other trees including *Acmena smithii* (lilly pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and *Melaleuca ericifolia* is the only abundant tree in this community south of Bermagui. The understorey is characterised by frequent occurrences of vines, *Parsonsia straminea, Geitonoplesium cymosum* and *Stephania japonica* var. *discolor*, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter. The composition of the ground stratum varies depending on levels of salinity in the groundwater. Under less saline conditions prominent ground layer plants include forbs such *Centella asiatica, Commelina cyanea, Persicaria decipiens*and *Viola banksii*; graminoids such as *Carex appressa, Gahnia clarkei, Lomandra longifolia, Oplismenus imbecillis*; and the fern *Hypolepis muelleri*. On the fringes of coastal estuaries, where soils are more saline, the ground layer may include the threatened grass species, *Alexfloydia repens*, as well as *Baumea juncea, Juncus kraussii, Phragmites australis, Selliera radicans* and other saltmarsh species. Known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes, Port Stephens, Maitland, Newcastle, Cessnock, Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Hawkesbury, Baulkham Hills, Hornsby, Lane Cove, Blacktown, Auburn, Parramatta, Canada Bay, Rockdale, Kogarah, Sutherland, Penrith, Fairfield, Liverpool, Bankstown, Wollondilly, Camden, Campbelltown, Wollongong, Shellharbour, Kiama, Shoalhaven, Eurobodalla and Bega Valley but may occur elsewhere in these bioregions. Major examples once occurred on the floodplains of the Clarence, Macleay, Hastings, Manning, Hunter, Hawkesbury, Shoalhaven and Moruya Rivers.	Endangered	Endangered	Low

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within subject site
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	This swamp community has an open to dense tree layer of eucalypts and paperbarks although some remnants now only have scattered trees as a result of partial clearing. The trees may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality where the tree stratum is low and dense. For example, stands dominated by *Melaleuca ericifolia* typically do not exceed 8 m in height. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. The most widespread and abundant dominant trees include *Eucalyptus robusta*(swamp mahogany), *Melaleuca quinquenervia* (paperbark) and, south from Sydney, *Eucalyptus botryoides* (bangalay) and *Eucalyptus longifolia*(woollybutt). Other trees may be scattered throughout at low abundance or may be locally common at few sites, including *Callistemon salignus* (sweet willow bottlebrush), *Casuarina glauca* (swamp oak) and *Eucalyptus resinifera* subsp. *hemilampra* (red mahogany), *Livistona australis* (cabbage palm) and *Lophostemon suaveolens* (swamp turpentine). A layer of small trees may be present, including *Acacia irrorata* (green wattle), *Acmena smithii* (lilly pilly), *Elaeocarpus reticulatus* (blueberry ash), *Glochidion ferdinandi* (cheese tree), *Melaleuca linariifolia* and *M. styphelioides*(paperbarks). Shrubs include *Acacia longifolia, Dodonaea triquetra, Ficus coronata, Leptospermum polygalifolium* subsp. *polygalifolium* and *Melaleuca* spp. Occasional vines include *Parsonsia straminea, Morinda jasminoides* and *Stephania japonica* var. *discolor*. The groundcover is composed of abundant sedges, ferns, forbs, and grasses including *Gahnia clarkei, Pteridium esculentum, Hypolepis muelleri, Calochlaena dubia, Dianella caerulea, Viola hederacea, Lomandra longifolia, Entolasia marginata* and *Imperata cylindrica*. On sites downslope of lithic substrates or with soils of clay-loam texture, species such as *Allocasuarina littoralis, Banksia oblongifolia, B. spinulosa, Ptilothrix deusta* and *Themeda australis*, may also be present in the understorey.	Endangered		Low
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	A complex of vegetation types largely restricted to freshwater swamps in coastal areas. These also vary considerably due to fluctuating water levels and seasonal conditions. Characteristic species include sedges and aquatic plants such as *Baumea* species, *Eleocharis sphacelata*, *Gahnia* species, *Ludwigia peploides* subsp. *montevidensis* and *Persicaria* species. Occurs on sand dunes and low-nutrient sandplains along coastal areas in the Sydney Basin bioregion. It is known from the Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Woollahra, Waverley, Botany, Rockdale, Randwick, Sutherland and Wollongong local government areas, but is likely to occur elsewhere within the bioregion. Has been extensively cleared and filled and remnants are often small and disturbed. Largely restricted to freshwater swamps in swales and depressions on sand dunes and low nutrient sandplains such as those of the Warriewood and Tuggerah soil landscapes. Swampy areas on alluvium with a saline influence do not fall within this community.	Endangered		None

Threatened Ecological Community	Description	BC Act Status	EPBC Act Status	Likelihood of occurrence within subject site
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Themeda Grassland on seacliffs and coastal headlands is found on a range of substrates in the NSW North Coast, Sydney Basin and South East Corner bioregions. Stands on sandstone are infrequent and small. Larger stands are found on old sand dunes above cliffs, as for example at Cape Banks and Henry Head in Botany Bay National Park, and on metasedimentary headlands, as for example at McCauleys Headland in Coffs Coast Regional Park, Look-at-me-now Headland, Dammerels Head and Bare Bluff in Moonee Beach Nature Reserve and Wilson's Headland in Yuraygir National Park. Individual stands of the community are often very small, a few square metres, but at some sites larger stands of up to several hectares or tens of hectares occur. Overall, the community has a highly restricted geographic distribution comprising small, but widely scattered patches. The community is found on a range of substrates, although stands on sandstone are infrequent and small. Larger stands are found on old sand dunes above cliffs, for example at Cape Banks and Henry Head in Botany Bay National Park, and on metasedimentary are rarely adamellite headlands on the north coast. Individual stands of the community are often very small, a few square metres, but at some sites larger stands of up to several hectares or tens of hectares occur. Overall, the community therefore has a highly restricted geographic distribution comprising small, but widely scattered patches.	Endangered		None
Umina Coastal Sandplain Woodland in the Sydney Basin Bioregion	A low woodland dominated by trees of Eucalyptus botryoides and Angophora floribunda with a diverse understorey of sclerophyllous shrubs species including Banksia integrifolia, Banksia serrata, Monotoca elliptica, Macrozamia communis, Acacia ulicifolia, Platysace lanceolata, Acacia suaveolens and Allocasuarina littoralis. Eucalyptus botryoides is the dominant tree in the zone immediately behind the beach, while Angophora floribunda is dominant in the zone beyond up to 2 km from the beach. Largely restricted to coastal sands on the Umina, Woy Woy and Ettalong Sandplain, a beach ridge system within the Gosford local government area. Including ecotonal areas, less than 10% (being less than 10 hectares) of the community's estimated original cover of about 80 hectares remains. This comprises four main remnants at Umina, while a few smaller remnant patches and scattered trees around Pearl Beach and Patonga and elsewhere on the 'Peninsula' indicate its former distribution.	Endangered		None
Warkworth Sands Woodland in the Sydney Basin Bioregion	Warkworth Sands Woodland is a low woodland dominated by *Angophora floribunda* (Rough-barked Apple) and *Banksia integrifolia* subsp. *integrifolia*(Coast Banksia). Other tree species may be present such as *Eucalyptus tereticornis* (Forest Red Gum)and *E. glaucina* (Slaty Red Gum). Shrub and ground layer species commonly present include *Acacia filicifolia* (Fern-leaved Wattle), *Melaleuca thymifolia* (Thyme Honey-myrtle), *Brachyloma daphnoides* (Daphne Heath), *Pteridium esculentum* (Bracken), *Pimelea linifolia* (Slender Rice Flower), *Imperata cylindrica* var. *major* (Blady Grass), *Chrysocephalum apiculatum* (Common Everlasting) and *Glycine clandestina*. Small drainage lines within the area occuied by this community may support the presence or higher abundance of certain species (such as *Melaleuca thymifolia*) and the absence or lower abundance of others (such as *Banksia integrifolia* subsp. *integrifolia*). Such areas are included as part of this community.	Endangered	Critically Endangered	None
White Box, Yellow Box, Blakely's Red Gum Woodland and Derived Native Grassland	White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box Eucalyptus albens, Yellow Box E. melliodora and Blakely's Red Gum E. blakelyi. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. The community also includes a range of mammal, bird, reptile, frog and invertebrate fauna species. Intact stands that contain diverse upper and mid-storeys and groundlayers are rare.	Endangered	Critically Endangered	None

Annex 2. Plant Community Type

PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland on coastal sands of the Central and Lower North Coast

Habitat: PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland has been mapped as occurring throughout the majority of the subject site, in five different condition classes based on similar age of rehabilitation and natural succession:

- Zone 1 = 14.13 ha
- Zone 2 = 3.87 ha
- Zone 4 = 5.19 ha
- Zone 5 = 1.71 ha
- Zone 6 = 8.09 ha.

Whilst it is noted in this report that much of the subject site consists of planting, as per the OEH (2018) Biodiversity Assessment Method Operational Manual, '*Planted native vegetation is treated in the same way as native vegetation if it meets the definition of native vegetation in Section 5A of the Local Land Services Act 2013. Where the vegetation is a mix of local and non-local planted species the assessor should consider the best matching PCT based on the local species present*'. As such, we have aligned the areas of native rehabilitated land to PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland due to the following:

PCT1646 - Smooth-barked Apple/ Blackbutt/ Old Man Banksia woodland occupied the subject site prior to vegetation clearing for the former inland extraction area; and

- The canopy tubestock planted within the subject site (*Eucalyptus pilularis, Corymbia gummifera*, and *Angophora costata*) are the dominant species of PCT1646.
- The structure of the PCT within the subject site is highly attributed to the age of the regeneration that has taken place over the past decade. The structure associated with each of the vegetation zones have been provided in the table below.

In summary, the vegetation recorded within the subject site is consistent with the description of PCT1646 due to the following:

- The dominant canopy species recorded within the subject site comprise *Eucalyptus pilularis, Corymbia gummifera,* and *Angophora costata* which are dominants within PCT1646
- The subject site occurs on quaternary dune sands
- The structure of the remnant condition class is an open forests to woodland dominated in the canopy by Angophora's
- The structure of the remnant condition class consists of a sparse mid-stratum that is typically characterised by Banksia's
- The structure of the remnant condition class is relatively sparse and is characterised by grasses and ferns.

Conservation Status: PCT1646 does not align to any TECs under the BC or EPBC Acts.

Condition classes: Five condition classes were assigned to PCT1646 within the subject site:

Vegetation zone	Description	Photo of vegetation zone
Zone 1	Canopy: dominated by planted E*ucalyptus pilularis,* and *Corymbia gummifera.* The age of eucalypts are approximately 10 years old. None have developed hollows and are approximately 5 metres in height. Midstorey and shrub layer: Relatively sparse shrub layer consisting of planted native species: *Acacia sophorae, A. suaveolens, A. ulicifolia, Allocasuarina littoralis, Angophora costata, Aotus ericoides,* and *Leptospermum* species. Ground cover: Very sparse ground cover dominated by planted and naturally regenerating species including: *Lomandra longifolia, Pteridium esculentum, Imperata cylindrica, Hibbertia virgata,* and *Themeda australis.*	 **Plate 10. Vegetation zone – Zone 1**
Zone 2	Canopy: No large canopy present. Very sparse planted *Angophora costata* and *Corymbia gummifera*. Many of the canopy species are less than 2 metres in height and are sparsely scattered throughout the zone. Midstorey: Very sparsely scattered tubestock of *Acacia suaveolens, Allocasuarina littoralis, Banksia serrata, Bossiaea heterophylla* and *Dillwynia retorta.* Ground cover was particularly sparse in term of native vegetation cover. Some planted success of *Carpobrotus glaucescens, Lomandra longifolia, Pteridium esculentum, Imperata cylindrica, Hibbertia virgata,* and *Themeda australis.*	 **Plate 11. Vegetation zone – Area 2**
Zone 4	Canopy: No large canopy present. Very sparse planted *Angophora costata* and *Corymbia gummifera*. Many of the canopy species are less than 1 metres in height and are sparsely scattered throughout the zone. Midstorey: Very sparsely scattered tubestock of *Acacia suaveolens, Allocasuarina littoralis, Banksia serrata, Bossiaea heterophylla* and *Dillwynia retorta.* Ground cover was particularly sparse in term of native vegetation cover. Some planted success of *Carpobrotus glaucescens, Lomandra longifolia, Imperata cylindrica, a*nd *Themeda australis.*	 **Plate 12. Vegetation zone – Zone 4**
Zone 5	Canopy: dominated by *Eucalyptus pilularis, Angophora costata* and *Corymbia gummifera*. Typical height is approximately 10 metres and 20% Projected foliage cover. In-fill planting has occurred throughout the area, though has a high resilience. Midstorey and shrub layer: Relatively moderate cover of shrubs including: *Acacia sophorae, A. ulicifolia, Banksia integrifolia, B. serrata, Bossiaea rhombifolia, Leptospermum* species. Ground cover: Dominant species include: *Pteridium esculentum, Imperata cylindrica, Themeda australis.*	 **Plate 13. Vegetation zone – Zone 5**

Vegetation zone	Description	Photo of vegetation zone
Zone 6	Canopy: dominated by *Eucalyptus pilularis, Angophora costata* and *Corymbia gummifera*. Typical height is approximately 12 metres and 30% Projected foliage cover. Some in-fill planting though due to the resilience and natural succession, has been combined as one vegetation zone. Midstorey and shrub layer: Relatively moderate to dense cover of shrubs including: *Acacia sophorae, A. ulicifolia, Banksia integrifolia, B. serrata, Bossiaea rhombifolia, Leptospermum* species. Ground cover: Dominant species include: *Pteridium esculentum, Imperata cylindrica, Themeda australis, Glycine* species*, Hibbertia virgata.*	 **Plate 14. Vegetation zone – Zone 6**

PCT1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast

Habitat: PCT1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes has been mapped as occurring to the east of the subject site as a 2.67 ha patch. The area has been historically cleared and rehabilitated with tubestock and natural regeneration comprising predominately of *Leptospermum laevigatum* (Plate 15).

The area of rehabilitation has been aligned to PCT1646 given the following:

- Dominance of *Leptospermum laevigatum* which is a key diagnostic species of the PCT
- Occasional *Banksia serrata* and *Angophora costata* which are also key diagnostic upper stratum species
- The following species were recorded in the vegetation zone and are diagnostic species of the PCT: *Acacia longifolia, Dodonaea triquetra, Ricinocarpos pinifolius, Monotoca elliptica, Kennedia rubicunda, Pteridium esculentum, Lomandra longifolia* and *Hardenbergia violacea.*

The structure of the PCT within the subject site is described as follows:

- Canopy: Occasional presence of *Angophora costata* more towards the patch boundaries. The canopy has a projected foliage cover of approximately 5-10 percent and is approximately 15 metres in height.
- Midstorey and shrub layer: Dominated by *Leptospermum laevigatum* which forms a thicket in areas. Other shrubs include *Allocasuarina littoralis*, *Acacia longifolia, Dodonaea triquetra, Ricinocarpos pinifolius, Monotoca elliptica.*
- Ground layer: A very sparse ground layer which is likely attributed to the high amounts of leave litter and the shading from the *Leptospermum laevigatum* across the vegetation zone. Common ground cover recorded included: *Imperata cylindrica, Themeda australis, Dianella caerulea,* and *Pomax umbellata.*

Conservation Status: This PCT does not align to a TEC under the BC or EPBC Acts.

Plate 15. PCT1644 - Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes within the subject site

Non-native vegetation

Portions of the subject site where there are no native species present have been attributed to a 'non-native' vegetation type. These areas typically include existing access tracks, haul road, areas of bare sand, and existing infrastructure.

Annex 3. Floristic plot data

Note: field data was collected in electronic format, therefore raw data sheets have not been provided in this report. We can supply the raw data files in an excel format as required.

C = cover; A = Abundance; *plot outside of subject site

Species	Growth form	Common Name	Plot name – Cover/Abundance																															
			11 _C	11 _A	5 _C	5 _A	4 _C	4 _A	3 _C	3 _A	2 _C	2 _A	12 _C	12 _A	9 _C	9 _A	17 _C *	17 _A	7 _C	7 _A	6 _C	6 _A	1 _C	1 _A	10 _C	10 _A	13 _C	13 _A	8 _C	8 _A	14 _C	14 _A	15 _C	15 _A	16 _C	16 _A
Carpobrotus glaucescens	Forb (FG)	Pigface			1	20	1	30	0.5	10							5	30	0.2	3			0.5	10	1	5	1	5	0.2	10						
Hydrocotyle bonariensis*	Weed other																		0.1	2									0.2	10						
Platysace lanceolata	Shrub (SG)	Shrubby Platysace	1	5											2	20															0.1	20				
Bidens pilosa*	Weed other	Cobbler's Pegs					0.2	20	0.3	20							0.1	5													0.2	20				
Cassinia arcuata	Shrub (SG)	Sifton Bush					0.2	1									0.2	1																		
Chrysanthemoides monilifera*	HTW		5	10			0.5	5					2	30	0.1	1	0.2	1					0.1	1	2	10					1	5	1	5		
Heterotheca grandiflora*	Weed other	Telegraph Weed			1	50			50	1000							0.1	20	1	100																
Hypochaeris radicata*	Weed other	Catsear															0.1	2											0.1	5	0.1	5				
Sonchus oleraceus*	Weed other	Common Sowthistle					0.1	1																												
Pandorea pandorana	Other (OG)	Wonga Wonga Vine	0.1	1									2	10	0.1	1																	0.1	2		
Wahlenbergia gracilis	Forb (FG)	Sprawling Bluebell			0.5	30	0.1	20	0.1	1					0.2	20	0.5	50					0.1	1							0.1	5	0.1	10	0.1	5
Petrorhagia dubia*	Weed other								0.1	1																										
Allocasuarina littoralis	Tree (TG)	Black She-Oak	1	1	1	2					2	5			2	3	0.5	1			0.5	1			1	3	5	5								
Carex spp.	Grass & grasslike (GG)						0.1	1																									0.1	5	0.1	5
Pteridium esculentum	Fern (EG)	Bracken	3	100			0.1	1					70	200	1	20							0.5	5							3	30	15	20	10	10
Hibbertia virgata	Shrub (SG)										0.1	1	0.5	5			0.2	5															0.2	4		
Leucopogon parviflorus	Shrub (SG)	Coastal Beard-heath	5	10	2	10	5	5			20	50	40	30	2	10	1	20					2	10	15	20							1	5	0.1	5
Ricinocarpos pinifolius	Shrub (SG)	Wedding Bush									0.5	10					0.1	1					0.2	5												
Aotus ericoides	Shrub (SG)										0.5	3									0.5	1					1	3								
Bossiaea heterophylla	Shrub (SG)	Variable Bossiaea			0.2	2											0.2	1					0.2	2												
Bossiaea rhombifolia	Shrub (SG)						0.5	5			1	30	1	20			0.2	15	0.2	2			30	50	5	20	1	5	0.2	3			0.5	1		
Bossiaea scolopendria	Shrub (SG)				0.5	5											0.5	1																		
Dillwynia retorta	Shrub (SG)				1	20					1	10							1	5	2	10					2	8	0.5	5	0.2	5			0.1	3
Glycine tabacina	Other (OG)	Variable Glycine			0.1	1							0.5	20			0.1	1							1	3					0.1	5	0.1	5	0.1	5
Hardenbergia violacea	Other (OG)	False Sarsaparilla			1	20	0.5	5			0.1	2							0.5	2	0.1	1	0.1	1	1	2			0.5	4	0.2	3	0.1	1	0.1	3
Kennedia rubicunda	Other (OG)	Dusky Coral Pea											2	10	0.5	10	0.1	2			0.2	3					0.5	3								
Acacia longifolia	Shrub (SG)		5	20	20	20	5	5	2	10	0.1	3	1	10			5	10	10	50	0.5	1	5	15	10	20	2	5	5	7						
Acacia suaveolens	Shrub (SG)	Sweet Wattle			0.1	1	0.2	1			0.1	2																								
Acacia ulicifolia	Shrub (SG)	Prickly Moses					0.2	1			0.1	1	0.1	1					0.1	1			0.5	10					0.2	2						
Gonocarpus tetragynus	Forb (FG)	Poverty Raspwort											0.5	10																						
Gonocarpus teucrioides	Forb (FG)	Germander Raspwort	2	10	0.5	20					0.5	20					0.5	20					0.1	1									0.2	10	0.2	2
Lomandra longifolia	Grass & grasslike (GG)	Spiny-headed Mat-rush			0.2	2	0.2	3			5	50	2	50	1	10	0.5	10					2	20	5	15					3	20			1	5
Eustrephus latifolius	Other (OG)	Wombat Berry											0.1	1																			0.1	1	0.1	5
Angophora costata	Tree (TG)	Sydney Red Gum	3	3	3	5	0.5	2	3	6	2	2	60	20	5	3	5	10			5	10	2	3	5	3	20	20			3	3	5		5	3
Corymbia gummifera	Tree (TG)	Red Bloodwood	3	2	2	4					10	10	5	2	3	1							2	3			3	2							1	2
Eucalyptus pilularis	Tree (TG)	Blackbutt	2	2			40	30			10	20			30	15							40	25			10	5			5	5	10		10	
Leptospermum laevigatum	Shrub (SG)	Coast Teatree	60	50	1	1																			50	100										
Oenothera indecora subsp. bonariensis*	Weed other				0.5	20			15	500									5	150									1	5						
Corybas aconitiflorus	Forb (FG)	Spurred Helmet Orchid											0.2	10																					0.1	5
Gastrodia sesamoides	Forb (FG)	Cinnamon Bells													0.1	1																				

Species	Growth form	Common Name	Plot name – Cover/Abundance																															
			11 _C	11 _A	5 _C	5 _A	4 _C	4 _A	3 _C	3 _A	2 _C	2 _A	12 _C	12 _A	9 _C	9 _A	17 _C *	17 _A	7 _C	7 _A	6 _C	6 _A	1 _C	1 _A	10 _C	10 _A	13 _C	13 _A	8 _C	8 _A	14 _C	14 _A	15 _C	15 _A	16 _C	16 _A
Oxalis rubens	Forb (FG)														0.5	20															0.1	10			0.1	10
Passiflora spp.*	Other (OG)						0.5	1																												
Dianella caerulea var. producta	Forb (FG)		3	6	0.5	20	5	100			0.1	1	0.5	10	10	200	0.3	10					2	30	3	25					0.2	5	1	5	0.5	10
Breynia oblongifolia	Shrub (SG)	Coffee Bush					0.1	1																	1	1					0.2	2	1	2	1	3
Poranthera corymbosa	Shrub (SG)										0.1	1																								
Poranthera ericifolia	Forb (FG)																0.1	1																		
Cynodon dactylon	Grass & grasslike (GG)	Common Couch													0.2	10																				
Ehrharta erecta*	HTW	Panic Veldtgrass																							1	10										
Eragrostis brownii	Grass & grasslike (GG)	Brown's Lovegrass							0.2	3													0.5	10												
Eragrostis curvula*	HTW	African Lovegrass			5	100	5	50											5	50							0.5	6	2	20	1	5				
Imperata cylindrica	Grass & grasslike (GG)	Blady Grass	3	200			0.1	5	20	1000	0.5	20	1	50	10	100	40	1000					10	50							5	20	5	10	5	15
Melinis repens*	Weed other	Red Natal Grass			40	1000	40	1000	50	1000					0.2	20	50	1000	1	30			0.5	5	2	100			0.5	20						
Panicum maximum*	Weed other	Guinea Grass					40	1000							1	50									3	80										
Rytidosperma spp.	Grass & grasslike (GG)												0.1	1																			1	5	1	5
Themeda australis	Grass & grasslike (GG)	Kangaroo Grass	2	100									2	50			3	50					0.5	30	11	100					1	5	1	5		
Banksia integrifolia	Tree (TG)	Coast Banksia											0.5	1											1	2	2	3								
Banksia serrata	Tree (TG)	Old-man Banksia	2	3	1	2	1	3	0.5	1			1	3	2	3					2	10											5	2	1	5
Persoonia levis	Shrub (SG)	Broad-leaved Geebung											2	1																						
Persoonia oblongata	Shrub (SG)		5	10	1	3	0.8	3	0.5	1	0.1	1			0.2	1	10	30			1	3	2	5			1	2								
Pomaderris elliptica	Shrub (SG)																										0.1	1								
Pomax umbellata	Forb (FG)	Pomax															0.5	15															0.1	5	0.2	0.5
Exocarpos cupressiformis	Shrub (SG)	Cherry Ballart											1	1																						
Gnidia squarrosa*	Weed other				2	100			5	500							0.1	2	0.1	5										5						
Caladenia catenata	Forb (FG)																														0.1	50	0.2	50	0.5	1
Leptospermum trinervium	Shrub (SG)																																5			

Annex 4. BAM plot transect scores

Note: field data was collected in electronic format, therefore raw data sheets have not been provided in this report. We can supply the raw data files in an excel format as required.

Key to growth form groups: TG - Tree; SG - Shrub; GG - Grass and Grass-like; FG - Forb; EG - Fern; OG – Other; **Function codes:** NLT - Number of large trees; TSSC - Tree Stem Size Class; NTH - Number of trees with hollows; FL - Course Woody Debris (fallen logs); LL - mean leaf litter cover; HTW - High Threat Weeds

* 1 m^2 litter quadrats were placed at 5 m (left), 15 m (right), 25 m (left), 35 m (right) and 45 m (left) along the central 50 m transect, all positioned 5 m from the transect centreline and alternating to the left and right from the transect centreline (as indicated).

plot	pct	Patch size	Condition class	zone	easting	northing	bearing	Comp Tree	Comp Shrub	Comp Grass	Comp Forbs	Comp Ferns	Comp Other	Struc Tree	strucS hrub	Struc Grass	Struc Forbs	Struc Ferns	Struc Other	Fun Large Trees	Fun Hollowt rees	Fun Litter Cover	Fun Len Fallen Logs	Fun Tree Stem 5to9	Fun Tree Stem 10to19	Fun Tree Stem 20to29	Fun Tree Stem 30to49	Fun Tree Stem 50to79	Fun Tree Regen	Fun High Threat Exotic
1	1646	101	Zone 1	56	390457.5	6364611	270	3	7	4	4	1	1	44.0	39.9	13.0	2.7	0.5	0.1	Absent	0	90	12	Y	Y	N	N	N	0	0.1
2	1646	101	Zone 1	56	390618.5	6364835	250	4	11	2	2	0	1	24.0	23.6	5.5	0.6	0.0	0.1	Absent	0	70	22	Y	Y	N	N	N	0	0.0
3	1646	101	Zone 2	56	390742.9	6364902	53	2	2	2	2	0	0	3.5	2.5	20.2	0.6	0.0	0.0	Absent	0	30	10	Y	N	N	N	N	0	0.0
4	1646	101	Zone 1	56	390795.4	6364855	8	3	8	3	3	1	2	41.5	12.0	0.4	6.1	0.1	1.0	Absent	0	80	8	Y	Y	Y	N	N	0	5.5
5	1646	101	Zone 2	56	390846.3	6364919	43	4	8	1	4	0	2	7.0	25.8	0.2	2.5	0.0	1.1	Absent	0	20	14	Y	N	N	N	N	0	5.0
6	1646	101	Zone 4	56	390933.9	6364870	38	3	4	0	0	0	2	7.5	4.0	0.0	0.0	0.0	0.3	Absent	0	5	26	Y	N	N	N	N	0	0.0
7	1646	101	Zone 4	56	391182	6365058	272	0	4	0	1	0	1	0.0	11.3	0.0	0.2	0.0	0.5	Absent	0	5	0	Y	N	N	N	N	0	5.0
8	1646	101	Zone 4	56	391073	6365084	86	0	4	0	1	0	1	0.0	5.9	0.0	0.2	0.0	0.5	Absent	0	5	5	Y	N	N	N	N	0	2.0
9	1646	101	Zone 6	56	391167.8	6364923	175	5	3	3	4	1	2	42.0	4.2	11.2	10.8	1.0	0.6	Present	4	80	10	Y	Y	Y	Y	Y	0	0.1
10	1644	101	Zone 3	56	6364885	391334	88	3	5	2	2	0	2	7.0	80.0	16.0	4.0	0.0	2.0	Absent	0	85	1	Y	Y	N	N	N	0	3.0
11	1644	101	Zone 3	56	391302.1	6364712	92	5	5	2	2	1	1	11.0	76.0	5.0	5.0	3.0	0.1	Absent	0	90	0	Y	N	N	N	N	0	5.0
12	1646	101	Zone 6	56	391298.6	6364678	190	4	7	4	3	1	4	66.5	45.6	5.1	1.2	70.0	4.6	Present	5	75	10	Y	Y	Y	Y	Y	0	2.0
13	1646	101	Zone 1	56	391348.1	6365205	200	5	6	0	1	0	1	40.0	7.1	0.0	1.0	0.0	0.5	Absent	0	50	0	Y	Y	Y	N	N	0	0.5
17	1646	101	Outside of impact area	56	390973	6365171	90	2	9	3	6	0	2	5.5	17.4	43.5	6.9	0.0	0.2	Absent	0	7.5	0	Y	N	N	N	N	0	0.2
14	1646	101	Zone 5	56	391321	6365056	110	2	3	3	4	1	2	25.0	0.5	9.0	0.5	3.0	0.3	Absent	3	80	18	Y	Y	Y	Y	N	1	2.0
15	1646	101	Zone 6	56	390576	6364585	112	3	5	4	5	1	4	20.0	7.7	7.1	1.6	15.0	0.4	Absent	4	75	22	Y	Y	Y	Y	Y	1	1.0
16	1646	101	Zone 6	56	390876	6364777	96	4	3	4	7	1	3	17.0	1.2	7.1	1.7	10.0	0.3	Absent	3	80	16	Y	Y	Y	Y	N	1	0.0

Annex 5. Fauna species list

Group	Scientific	Common name	Status	Observation	Camera trap
Aves	*Cracticus tibicen*	Australian Magpie	P	H	X
Aves	*Corvus coronoides*	Australian Raven	P	O H	
Aves	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P	H	
Aves	*Platycercus elegans*	Crimson Rosella	P	O H	
Aves	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P	O H	
Aves	*Psophodes olivaceus*	Eastern Whipbird	P	O H	
Aves	*Eopsaltria australis*	Eastern Yellow Robin	P	O H	
Aves	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P	O H	
Aves	*Rhipidura albiscapa*	Grey Fantail	P	H	
Aves	*Dacelo novaeguineae*	Laughing Kookaburra	P	O H	
Aves	*Dicaeum hirundinaceum*	Mistletoebird	P	O H	
Aves	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P	O H	
Aves	*Manorina melanocephala*	Noisy Miner	P	O H	X
Aves	*Strepera graculina*	Pied Currawong	P	O H	
Aves	*Zosterops lateralis*	Silvereye	P	O H	
Aves	*Cacatua galerita*	Sulphur-crested Cockatoo	P	O H	
Aves	*Malurus cyaneus*	Superb Fairy-wren	P	O H	
Aves	*Sericornis frontalis*	White-browed Scrubwren	P	O H	
Aves	*Rhipidura leucophrys*	Willie Wagtail	P	O H	
Aves	*Acanthiza nana*	Yellow Thornbill	P	O H	
Aves	*Haliaeetus leucogaster*	White-bellied Sea Eagle	V, M	O	
Aves	*Coracina novaehollandiae*	Black-faced cuckoo-shrike	P	O	
Aves	*Anas castanea*	Chestnut teal	P	O	
Aves	*Artamus cyanopterus*	Dusky woodswallow	P	O	
Aves	*Platycercus eximius*	Eastern Rossella	P	O	
Aves	*Eolophus roseicapillus*	Galah	P	O	
Aves	*Cracticus torquatus*	Grey butcherbird	P	O H	
Aves	*Grallina cyanoleuca*	Magpie Lark	P	O	
Aves	*Dicaeum hirundinaceum*	Mistletoebird	P	O	
Aves	*Falco cenchroides*	Nankeen Kestrel		O	
Aves	*Philemon corniculatus*	Noisy Friar Bird	P	O H	
Aves	*Rufous Whilster*	Pachycephala rufiventris	P	O	
Aves	*Welcome Swallow*	Hirundo neoxena	P	O	
Aves	*Epthianura albifrons*	White-fronted chat	P	O	
Aves	*Lichenostomus chrysops*	Yellow-faced honeyeater	P	O	

Group	Scientific	Common name	Status	Observation	Camera trap
Aves	*Calyptorhynchus funereus*	Yellow-tailed black-cockatoo	P	O	
Aves	*Neochmia temporalis*	Red-browed finch	P	O	
Aves	*Zosterops lateralis*	Silvereye	P	O	
Mammalia	*Trichosurus vulpecula*	Common Brushtail Possum	P	O	X
Mammalia	*Pseudocheirus peregrinus)*	Common Ringtail Possum	P	O	X
Mammalia	*Miniopterus schreibersii*	Eastern Bentwing Bat	V	Anabat	
Mammalia	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V	Anabat	Camera trap
Mammalia	*Oryctolagus cuniculus*	Rabbit	U	O	
Mammalia	*Wallabia bicolor*	Swamp Wallaby	P	O	
Mammalia	*Vulpes vulpes*	Fox	U	O H	
Reptilia	*Physignathus lesueurii*	Eastern water dragon	P	O	
Reptilia	*Eulamprus quoyii*	Eastern water-skink	P	O	
Reptilia	*Pseudechis porphyriacus*	Red-bellied black snake	P	O	
Reptilia	*Ctenotus robustus*	Striped Skink	P	O	
Reptilia	*Tiliqua scincoides*	Eastern Blue Tongue	P	O	

Key: W – heard; O – observed; U – ultrasonic bat call (D – definite ID, P – probable ID); V = Vulnerable.

Note: field data was collected in electronic format, therefore raw data sheets have not been provided.

Annex 6. Weather Condition

Weather conditions during survey and trapping (BoM 2020– Newcastle Nobby Station)

Date	Day	Temps		Rain	Max wind gust		9:00 AM				3:00 PM			
		Min	Max		Dir	Spd	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
		°C	°C	mm	km/h		°C	%	km/h		°C	%	km/h	
May														
20	We	10.6	23.8	0			15		N	9				
21	Th	12.6	16.8	2			13.8	96	Calm					
22	Fr	8	16.6	8.2			11	78	Calm					
23	Sa	10.5	16.2	0.8			12.5	71	NW	37				
24	Su	10.4	18	0.2			14.5	69	SW	37				
25	Mo	8.6	16.5	0			16.4	56	SW	28				
26	Tu	12.2	20.2	33.2			15.1	97	Calm					
27	We	10.7	19.8	1.4			14.5	88	Calm					
28	Th	9.8	23.2	0			11.8	99	Calm					
29	Fr	11.2	19.2	0			16.2	77	Calm					
30	Sa	8.2	20	0.4			13.8	87	Calm					
31	Su	9.7	21.2	0.2			13	94	NW	9				
June														
1	Mo	12.9	22.6	0	W	57	14.9	83	NW	6	21.9	44	NW	33
2	Tu	8.6	15.8	0	WNW	54	10.4	69	WNW	35	14.5	59	W	22
3	We	9	18.1	0.6	S	61	12.7	67	WNW	26	16.9	54	SSW	30
4	Th	12	16.5	0	SSW	54	13.8	63	SW	24	15.2	66	SW	19
5	Fr	9.6	19.4	0	NW	26	12.1	77	NW	17	18.9	51	NW	13
6	Sa	8.3	18.2	0	NW	19	11.9	80	NW	11	17.4	69	SE	7
7	Su	7.5	17.1	0	SE	41	9.8	100	WNW	11	16.4	79	SSW	11
8	Mo	9.8	18.4	9.6	SSW	50	13.8	84	SW	17	15.8	75	SW	24
9	Tu	13.6	18.7	19.6	ESE	50	17.4	84	SE	30	17.8	87	SSE	26
10	We	15.2	17.3	6.6	ENE	43	15.4	100	ENE	22	16.7	99	E	17
11	Th	14.7	19.4	10.6	S	33	15.3		NW	13	18.5	84	SSW	11
12	Fr	14.7	18.1	0.2	SW	31	16.1	89	SSW	15	17.3	89	SSW	17
13	Sa	13.3	19.4	0	NNW	19	14.2	100	WNW	7	18.6	90	ESE	4
14	Su	14.2	21.1	11.2	NW	48	14.8		NNW	17	21.1	54	NW	28
15	Mo	11	19.3	0			13.3	67	WNW	30	18.8	47	NW	17
16	Tu	11.1	20	0			13.4	76	NW	24	19.5	56	NW	19
17	We	10.2	18.7	0	SE	54	14.2	78	WNW	9	17.9	78	SSE	41
18	Th	14.2	18.2	0.6	SE	43	16.2	74	S	22	17.5	62	SSE	17
19	Fr	10.1	19.2	0.4	ENE	28	10.7		NW	9	18.9	68	ENE	11
20	Sa	8.4	20.5	0	NW	28	9.9		NW	15	20.3	58	NNW	11
21	Su	9.8	15.3	0.2	W	56	12.5	98	NW	9	12.9	86	N	6
22	Mo	10.2	16.2	7.4	NW	54	12.7	76	NW	22	15.5	57	NW	33
23	Tu	8.9	16.1	0.2	NW	46	11.4	77	WNW	30	15.3	53	NW	28
24	We	9.9	18.1	0	NW	56	12.2	71	NW	39	17.7	52	WNW	30

Date	Day	Temps		Rain	Max wind gust		9:00 AM				3:00 PM			
		Min	Max		Dir	Spd	Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
		°C	°C	mm	km/h		°C	%	km/h		°C	%	km/h	
25	Th	10.2	17.7	0	NW	39	12.3	74	WNW	22	17.3	55	WNW	28
26	Fr	8.9	18.7	0	SSE	31	13	65	WNW	9	16.3	68	S	20
27	Sa	12.6	16.4	0	SSE	41	15.6	79	S	31	14.7	80	S	22
28	Su	11.6	15.7	0.4	S	39	13.8	78	WSW	11	15	75	S	26
29	Mo	9.2	18	0	ESE	20	11.7	98	NW	9	16.6	76	S	11
30	Tu	8.6	19	0	NNW	20	10.1	100	NW	11	18.7	59	N	9
July														
1	We	8.3	19.9	0.2	NW	30	10.7	83	NW	20	19.5	43	NW	20
2	Th	9.8	23.2	0	NW	44	12.9	76	NW	19	23	39	NW	24
3	Fr	12.8	20.4	0.2	S	31	15.3	73	SSW	9	20	47	W	13

Annex 7. Hollow-bearing tree register

Note: field data was collected in electronic format, therefore raw data sheets have not been provided in this report. We can supply the raw data files in an excel format as required.

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
97	-32.849141	151.833274	Hollow-bearing tree	2	Blackbutt	<5 cm
128	-32.852263	151.830274	Hollow-bearing tree	1	Eucalyptus pilularis	<5 cm
137	-32.851452	151.830804	Hollow-bearing tree	1	Angophora costata	<5 cm
250	-32.850558	151.838684	Hollow-bearing tree	1	Angophora	<5 cm
263	-32.849007	151.837667	Hollow-bearing tree	1	Bloodwood	<5 cm
277	-32.849143	151.834689	Hollow-bearing tree	1	Red Bloodwood	<5 cm
278	-32.849249	151.834758	Hollow-bearing tree	2	Blackbutt	<5 cm
282	-32.849217	151.834946	Hollow-bearing tree	1	Blackbutt	<5 cm
284	-32.849056	151.835259	Hollow-bearing tree	2	Angophora floribunda	<5 cm
287	-32.849077	151.835542	Hollow-bearing tree	2	Blackbutt	<5 cm
306	-32.849739	151.834242	Hollow-bearing tree	1	Angophora costata	<5 cm
337	-32.849096	151.835796	Hollow-bearing tree	1	Corymbia gummifera	<5 cm
338	-32.848783	151.835928	Hollow-bearing tree	1	Corymbia gummifera	<5 cm
340	-32.84851	151.83597	Hollow-bearing tree	1	Eucalyptus pilularis	<5 cm
342	-32.848564	151.836134	Hollow-bearing tree	1	Angophora costata	<5 cm
343	-32.848586	151.836152	Hollow-bearing tree	1	Angophora costata	<5 cm
95	-32.849067	151.833374	Hollow-bearing tree	3	Blackbutt	10 - 15 cm
96	-32.84929	151.833528	Hollow-bearing tree	8	Blackbutt	10 - 15 cm
98	-32.849486	151.834182	Hollow-bearing tree	1	Blackbutt	10 - 15 cm
101	-32.849511	151.833819	Hollow-bearing tree	2	Red bloodwood	10 - 15 cm
105	-32.851722	151.829204	Hollow-bearing tree	1	E pilularis	10 - 15 cm
112	-32.851841	151.829839	Hollow-bearing tree	1	Corymbia gummifera	10 - 15 cm
113	-32.852397	151.829489	Hollow-bearing tree	1	E pilularis	10 - 15 cm
121	-32.852369	151.830113	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
127	-32.852389	151.830201	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
151	-32.850909	151.831748	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
152	-32.850971	151.831884	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
165	-32.847322	151.838867	Hollow-bearing tree	3	Blackbutt	10 - 15 cm
166	-32.847363	151.838791	Hollow-bearing tree	3	Blackbutt	10 - 15 cm
169	-32.848563	151.83985	Hollow-bearing tree	2	Angophora costata	10 - 15 cm
170	-32.848257	151.839861	Hollow-bearing tree	3	Blackbutt	10 - 15 cm
209	-32.850082	151.837762	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
210	-32.850053	151.837726	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
215	-32.848871	151.838217	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
217	-32.848698	151.838214	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
220	-32.848372	151.837937	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
223	-32.848164	151.837343	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
225	-32.848737	151.837363	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
227	-32.849015	151.837609	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
229	-32.849157	151.837579	Hollow-bearing tree	1	Angophora floribunda	10 - 15 cm
230	-32.849221	151.837575	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
233	-32.848712	151.837152	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
234	-32.848765	151.837053	Hollow-bearing tree	1	Angophora costata	10 - 15 cm
245	-32.848927	151.839225	Hollow-bearing tree	1	Blackbutt	10 - 15 cm
253	-32.849756	151.837813	Hollow-bearing tree	6	Angophora	10 - 15 cm
267	-32.848629	151.837151	Hollow-bearing tree	10	Angophora costata	10 - 15 cm
273	-32.850138	151.830609	Hollow-bearing tree	2	Blackbutt	10 - 15 cm
280	-32.849292	151.834925	Hollow-bearing tree	3	Blackbutt	10 - 15 cm
290	-32.848828	151.835865	Hollow-bearing tree	4	Angophora costata	10 - 15 cm
316	-32.849706	151.834769	Hollow-bearing tree	1	Corymbia gummifera	10 - 15 cm
320	-32.849456	151.835137	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
327	-32.849286	151.835352	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
332	-32.849283	151.835573	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
333	-32.849258	151.835569	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
345	-32.844738	151.838607	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
347	-32.844832	151.838375	Hollow-bearing tree	1	Eucalyptus pilularis	10 - 15 cm
99	-32.849508	151.833916	Hollow-bearing tree	1	Blackbutt	15 - 20 cm
106	-32.851758	151.828972	Hollow-bearing tree	1		15 - 20 cm
111	-32.851647	151.829433	Hollow-bearing tree	1	A costata	15 - 20 cm
114	-32.852624	151.829754	Hollow-bearing tree	1	Dead	15 - 20 cm
115	-32.852453	151.829759	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
116	-32.852365	151.829829	Hollow-bearing tree	1	E pilularis	15 - 20 cm
117	-32.852312	151.829892	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
120	-32.852107	151.83001	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
123	-32.852534	151.829894	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
126	-32.852667	151.829872	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
132	-32.850445	151.830281	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
133	-32.850489	151.830294	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
140	-32.851479	151.831269	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
149	-32.850656	151.831821	Hollow-bearing tree	1	Angophora costata	15 - 20 cm
150	-32.850826	151.831792	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
159	-32.850474	151.82872	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
172	-32.846761	151.840059	Hollow-bearing tree	2	Blackbutt	15 - 20 cm
202	-32.848419	151.838265	Hollow-bearing tree	1	Angophora costata	15 - 20 cm
203	-32.85046	151.838175	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
205	-32.850518	151.838755	Hollow-bearing tree	1	Angophora costata	15 - 20 cm
207	-32.850357	151.837733	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
208	-32.850146	151.837682	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
219	-32.848585	151.83808	Hollow-bearing tree	1	Angophora costata	15 - 20 cm
228	-32.849079	151.837553	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
231	-32.849224	151.837531	Hollow-bearing tree	1	Angophora floribunda	15 - 20 cm
240	-32.849114	151.835929	Hollow-bearing tree	1	Angophora floribunda	15 - 20 cm

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
281	-32.849286	151.835006	Hollow-bearing tree	2	Pink Bloodwood	15 - 20 cm
312	-32.849528	151.834624	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
328	-32.849179	151.835305	Hollow-bearing tree	1	Eucalyptus pilularis	15 - 20 cm
94	-32.849061	151.833358	Hollow-bearing tree	1	Blackbutt	20 - 30 cm
118	-32.852259	151.829945	Hollow-bearing tree	1	Eucalyptus pilularis	20 - 30 cm
130	-32.850956	151.830248	Hollow-bearing tree	1	Eucalyptus pilularis	20 - 30 cm
131	-32.850844	151.830198	Hollow-bearing tree	1	Dead tree	20 - 30 cm
134	-32.850572	151.830453	Hollow-bearing tree	1	Eucalyptus pilularis	20 - 30 cm
148	-32.850594	151.832072	Hollow-bearing tree	1	Eucalyptus pilularis	20 - 30 cm
161	-32.84671	151.838473	Hollow-bearing tree	5	Blckbutt	20 - 30 cm
163	-32.847157	151.838921	Hollow-bearing tree	5	Blackbutt	20 - 30 cm
173	-32.846569	151.840015	Hollow-bearing tree	3	Blackbutt	20 - 30 cm
201	-32.848348	151.838087	Hollow-bearing tree	1	E pilularis	20 - 30 cm
246	-32.8491	151.839282	Hollow-bearing tree	9	Blackbutt	20 - 30 cm
271	-32.84893	151.83611	Hollow-bearing stag	0		20 - 30 cm
308	-32.849736	151.834412	Hollow-bearing tree	1	Angophora costata	20 - 30 cm
313	-32.849458	151.834555	Hollow-bearing tree	1	Angophora costata	20 - 30 cm
321	-32.849368	151.835151	Hollow-bearing tree	1	Eucalyptus pilularis	20 - 30 cm
124	-32.852577	151.829936	Hollow-bearing tree	1	Eucalyptus pilularis	30 - 40 cm
125	-32.852645	151.829982	Hollow-bearing tree	1	Eucalyptus pilularis	30 - 40 cm
129	-32.850928	151.830108	Hollow-bearing tree	1	Angophora costata	30 - 40 cm
168	-32.848413	151.8398	Hollow-bearing tree	1	Angophora costata	30 - 40 cm
171	-32.847478	151.83989	Hollow-bearing tree	7	Blackbutt	30 - 40 cm
247	-32.85063	151.838533	Hollow-bearing tree	1	Angophora	30 - 40 cm
251	-32.850294	151.837945	Hollow-bearing tree	1	Angophora	30 - 40 cm
257	-32.84873	151.837907	Hollow-bearing tree	3	Blackbutt	30 - 40 cm
261	-32.848402	151.837606	Hollow-bearing tree	1	Angophora smooth	30 - 40 cm
206	-32.85043	151.837694	Hollow-bearing tree	6	Eucalyptus pilularis	40+ cm
222	-32.848061	151.837793	Hollow-bearing tree	1	Eucalyptus pilularis	40+ cm

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
252	-32.850195	151.837827	Hollow-bearing tree	2	Angophora	40+ cm
259	-32.848181	151.837702	Hollow-bearing tree	1	Blackbutt	40+ cm
270	-32.848984	151.836041	Hollow-bearing tree	3	Angophora costata	40+ cm
275	-32.849267	151.833275	Hollow-bearing stag	0		40+ cm
93	-32.850518	151.832062	Hollow-bearing tree	6	Blackbutt	5 - 10 cm
100	-32.849542	151.833858	Hollow-bearing tree	5	Blackbutt	5 - 10 cm
107	-32.851839	151.829128	Hollow-bearing tree	1	A costata	5 - 10 cm
108	-32.851994	151.82941	Hollow-bearing tree	1	E. Pilularis	5 - 10 cm
109	-32.852034	151.829521	Hollow-bearing tree	1	E pilularis	5 - 10 cm
110	-32.851817	151.829441	Hollow-bearing tree	1	A costata	5 - 10 cm
142	-32.851319	151.831604	Hollow-bearing tree	1	Eucalyptus pilularis	5 - 10 cm
158	-32.851144	151.830759	Hollow-bearing tree	1	Dead - unsure if hollows	5 - 10 cm
160	-32.845063	151.838918	Hollow-bearing tree	4	Blackbutt	5 - 10 cm
164	-32.847181	151.83882	Hollow-bearing tree	3	Blackbutt	5 - 10 cm
211	-32.849827	151.837624	Hollow-bearing tree	1	Angophora costata	5 - 10 cm
218	-32.848883	151.837988	Hollow-bearing tree	1	Eucalyptus pilularis	5 - 10 cm
221	-32.848288	151.837941	Hollow-bearing tree	1	Angophora costata	5 - 10 cm
242	-32.848444	151.836887	Hollow-bearing tree	1	Angophora floribunda	5 - 10 cm
244	-32.848675	151.83914	Hollow-bearing tree	3	Blackbutt	5 - 10 cm
248	-32.850756	151.838098	Hollow-bearing tree	3	Angophora	5 - 10 cm
249	-32.850752	151.838657	Hollow-bearing tree	3	Angophora	5 - 10 cm
254	-32.84966	151.837887	Hollow-bearing stag	0		5 - 10 cm
255	-32.848979	151.837923	Hollow-bearing tree	2	Angophora	5 - 10 cm
258	-32.848236	151.837739	Hollow-bearing tree	1	Blackbutt	5 - 10 cm
260	-32.84802	151.837643	Hollow-bearing tree	1	Blackbutt	5 - 10 cm
262	-32.848787	151.837687	Hollow-bearing tree	3	Angophora floribunda	5 - 10 cm
264	-32.849309	151.837811	Hollow-bearing stag	0		5 - 10 cm
265	-32.849393	151.837839	Hollow-bearing tree	3	Blackbutt	5 - 10 cm
266	-32.849396	151.837756	Hollow-bearing tree	2	Angophora smooth	5 - 10 cm

ID no.	latitude	longitude	Habitat feature	No. hollows	Tree	Size category
269	-32.848846	151.836394	Hollow-bearing tree	4	Angophora costata	5 - 10 cm
274	-32.850137	151.83065	Hollow-bearing tree	2	Blackbutt	5 - 10 cm
276	-32.849266	151.833242	Hollow-bearing stag	0		5 - 10 cm
279	-32.849438	151.834686	Hollow-bearing tree	3	Bloodwood	5 - 10 cm
283	-32.849099	151.835168	Hollow-bearing tree	1	Blackbutt	5 - 10 cm
285	-32.849043	151.835357	Hollow-bearing stag	0		5 - 10 cm
286	-32.849138	151.835529	Hollow-bearing stag	0		5 - 10 cm
288	-32.849054	151.835596	Hollow-bearing tree	3	Angophora costata	5 - 10 cm
289	-32.849124	151.835677	Hollow-bearing tree	3	Angophora costata	5 - 10 cm
305	-32.849736	151.83424	Hollow-bearing tree	1	Angophora costata	5 - 10 cm
334	-32.849329	151.835655	Hollow-bearing tree	1	Corymbia gummifera	5 - 10 cm
339	-32.848497	151.835938	Hollow-bearing tree	1	Eucalyptus pilularis	5 - 10 cm
344	-32.848384	151.836739	Hollow-bearing tree	1	Eucalyptus pilularis	5 - 10 cm

Annex 8. Ecosystem and species credits required (BAM-C Credit report)

BAM Credit Summary Report

Proposal Details

Assessment Id
00021010/BAAS17033/20/00021011

Proposal Name
3706 Stockton Sand Dredging SSD_2020

BAM data last updated *
20/08/2020

Assessor Name
Luke Baker

Report Created
07/09/2020

BAM Data version *
30

Assessor Number
BAAS17033

BAM Case Status
Open

Date Finalised
To be finalised

Assessment Revision
0

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Coast Tea Tree - Old Man Banksia coastal shrubland on foredunes of the Central and lower North Coast								
3	1644_Area_3	21.0	2.7	0.25	High Sensitivity to Potential Gain	2.00		28
							Subtotal	**28**

Smooth-barked Apple - Blackbutt - Old Man Banksia woodland on coastal sands of the Central and Lower North Coast								
1	1646_Area_1	43.0	14.1	0.25	High Sensitivity to Potential Gain	1.50		228
2	1646_Area_2	19.8	3.9	0.25	High Sensitivity to Potential Gain	1.50		29
4	1646_Area_4	4.8	5.2	0.25	High Sensitivity to Potential Gain	1.50		0
5	1646_Area_5	39.0	1.7	0.25	High Sensitivity to Potential Gain	1.50		25
6	1646_Area_6	47.7	8.1	0.25	High Sensitivity to Potential Gain	1.50		145
							Subtotal	**427**
							Total	**455**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAII	Species credits
Callocephalon fimbriatum / Gang-gang Cockatoo (Fauna)						
1646_Area_1	43.0	14.13	0.25	2	False	304
1646_Area_2	19.8	3.48	0.25	2	False	34
1644_Area_3	21.0	2.67	0.25	2	False	28
1646_Area_5	39.0	1.71	0.25	2	False	33
1646_Area_6	47.7	8.09	0.25	2	False	193
					Subtotal	**592**
Cryptostylis hunteriana / Leafless Tongue Orchid (Flora)						
1644_Area_3	21.0	2.67	0.25	1.5	False	21
1646_Area_5	39.0	1.71	0.25	1.5	False	25

1646_Area_6	47.7	8.09	0.25	1.5	False	145
					Subtotal	**191**
Hoplocephalus bitorquatus / Pale-headed Snake (Fauna)						
1646_Area_5	39.0	1.71	0.25	2	False	33
1646_Area_6	47.7	8.09	0.25	2	False	193
					Subtotal	**226**
Petaurus norfolcensis / Squirrel Glider (Fauna)						
1646_Area_1	43.0	14.13	0.25	2	False	304
1644_Area_3	21.0	2.67	0.25	2	False	28
1646_Area_5	39.0	1.71	0.25	2	False	33
1646_Area_6	47.7	8.09	0.25	2	False	193
					Subtotal	**558**

Annex 9. EPBC Act Significant Impact Criteria Assessment

Matters for Assessment

Assessments of Significance and supplementary information (where relevant) are presented for the following MNES in relation to the Project:

- *Cryptostylis hunteriana*
- Black-faced Monarch
- White-throated Needletail
- Spotted-tail Quoll
- Long-nosed Potoroo
- Koala
- New Holland Mouse
- Grey-headed Flying-fox.

Cryptostylis hunteriana	
Criteria (Vulnerable Species)	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
Cryptostylis hunteriana is known from the Gan Gan Hill and Tomaree Headland. It has not been previously recorded within the Worimi Conservation Areas, nor within the immediate vicinity of the site. A survey was not completed during the recommended survey time, however a survey is proposed in November 2020, and an amended BDAR reflecting the outcome of the survey would be submitted. The species is known to be associated with moist and sandy soils and is also known to grow in dry or peaty soils. The species is a saprophyte and therefore reliant on a symbiotic relationship with mycorrhizal fungus. Based on the relatively low natural regeneration evident within much of the former quarry pit, the potential for the species to occur on the rehabilitated quarry areas (Zone 1, Zone 2 and Zone 4) seems highly unlikely based on the current natural regeneration at the site and historic disturbance. Some potential may occur within Zone 5 and Zone 6 given these zones have greater soil resilience and recruitment. We have also assumed Zone 3 may contain habitat for the species given as it offered slightly greater resilience than the other vegetation zones that were once a former mine pit. We have therefore assumed that these vegetation zones, which occupy 12.47 ha, may provide some habitat for Cryptostylis hunteriana, however this is likely a conservative estimate. We do note that the OEH species profile for Cyptosytylis hunteriana listed the following eucalypts that the species is associated with: *Eucalyptus sclerophylla, E. sieberi,Corymbia gummifera* and *Allocasuarina littoralis*. Of the trees mentioned, only the *Corymbia gummifera* was present within the subject site, which is also widely distributed across many of the PCTs along the Worimi Conservation Areas and Stockton region. *Allocasuarina littoralis* was also occasionally observed within the area of potential habitat. Both *Corymbia gummifera* and *Allocasuarina littoralis* were widely planted by Boral through the subject site. The species is also associated with the occurrence of *Cryptostylis erecta* which was not recorded during the September field surveys when the species is known to be flowering. It seems unlikely that the Project would lead to a long-term decrease in the size of an important population of *Cryptostylis hunteriana* given the habitat present is relatively marginal, and the species is not known to occur within Worimi Conservation Lands that occurs near to the subject site. The habitat immediately adjacent to the subject site within the Boral lease is likely to be more suitable for the species based on resilience and intact structure, and may offer a number of associated canopy species that the subject area does not contain. Such areas would not be impacted by the Project.	Unlikely – targeted survey is proposed to provide further support on conclusion
reduce the area of occupancy of an important population;	
A survey to confirm if a population occurs within the subject site will be completed during the survey months (scheduled November 2020). Based on a desktop review of previous records and habitat where the species is known to occur, a low likelihood for the species to occur within the subject site has been attributed. For the reasons stated above, the potential habitat is relatively marginal based on a comparison to where the species has been previously recorded. Habitat surrounding the subject site may offer greater association to the habitat types that the species has previously recorded in. Such areas surrounding the subject site, which includes Worimi Conservation lands, would not be impacted by the Project.	Unlikely – targeted survey is proposed to support conclusion
fragment an existing important population into two or more populations;	
The area of potential habitat that will be impacted by the Project occurs within and immediately adjacent to former mine pits. No fragmentation of habitat will occur as the edges of the former pit will be expanded. No fragmentation of potential habitat for the species is likely to occur.	Potential habitat unlikely to

	be fragmented.
adversely affect habitat critical to the survival of a species;	
As previously discussed, 12.47 ha of potential habitat may be impacted by the Project. A field survey will be carried out in November 2020 to confirm the presence/absence of the species and suitability as potential habitat. The surrounding areas which have a greater connection to species that the Cryptostylis hunteriana is associated with, will not be impacted by the Project. Areas of potential habitat within the Worimi are formally protected under conservation zoning. As such, potential habitat for the species will persist in the locality. It therefore seems unlikely that the loss of potential habitat from the Project would result adversely affect habitat critical to the survival of Cryptosylis hunteriana.	Unlikely – targeted survey is proposed to support conclusion
disrupt the breeding cycle of an important population	
The Project is unlikely to reduce any known pollinators that may impact upon the pollination between populations within the locality.	Unlikely
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The Project is unlikely to decrease the availability of habitat to the extent that the species is likely to significantly decline. The Project would impact upon 12.47 ha of potential habitat, which is a conservative estimate as previously discussed. The remainder of potential habitat outside of the subject site would not be impacted by the Project.	Unlikely – targeted survey is proposed to support conclusion
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	
The Project is unlikely to increase invasive species being established in adjacent areas that would impact upon potential Cryptostylis hunteriana habitat, due to the following: - It is unlikely that invasive weeds would spread into adjacent areas given Boral would implement weed control and suppression activities detailed in the Biodiversity Management Plan. Boral is currently undertaking such activities for their operations. For instance, Boral has undertaken weed control measures such as weed spraying (in particular targeting Bitou Bush).	Unlikely
introduce disease that may cause the species to decline, or	
The Project is unlikely to introduce disease that may impact potential habitat for the Cryptostylis hunteriana. During the site survey, no areas of die back from Phytophthora cinnamomi or other soil pathegons were observed. The potential for such an event to occur, is relatively low.	Unlikely
interfere substantially with the recovery of the species.	
The Project is unlikely to substantially impact the recovery of the species due to the following: - Area of potential habitat is marginal based on previous records, and habitat descriptions including associated species - No known local populations occur in the Worimi Conservation Area (which would likely offer greater habitat associations) - Indirect impacts to potential habitat would be mitigated as discussed in the report. - Fragmentation of potential habitat would not occur - Pollinators and dispersal mechanisms of a potential population adjacent to the subject site, are unlikely be impacted.	Unlikely
Conclusion: Impacts from the Project largely relate to the removal of potential habitat for the species. As discussed, the habitat is relatively marginal and we have completed this assessment as a precaution. Boral propose to survey for the species during the recommended survey period and revise the conservative offset requirement presented in	

this assessment, where appropriate. Based on this assessment, the potential for a significant impact to occur to Cryptosytylis hunteriana placing the species at risk of extinction is relatively low.

Koala

In assessing the significance of the impact from the proposed action on the Koala, the '*EPBC Act referral guidelines for the vulnerable koala*' were applied to the assessment. The following information is presented prior to the Assessment of Significance for the Koala to demonstrate application of the guidelines and to assist with understanding the assessment and its conclusion.

Koala Habitat Assessment Scoring (Department of the Environment (2014). EPBC Act Referral Guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory). Commonwealth of Australia, 2014.):

Attribute	Score	Habitat Appraisal
Koala occurrence	+1	Koalas have not been recorded by Boral within the subject site nor their mining lease. Koala have been encountered infrequently adjacent to the subject site as evident with the records from BioNet. The closest record is along Nelson Bay Road towards the entrance to the Quarry (record from 2013). The result of the survey indicate that the Koala is not frequently using the subject site.
Vegetation Structure and composition	0	Habitat scoring was applied across the subject site using floristic data and cover values from 400m^2 quadrats. The mapping indicated that the majority of the subject site did not contain either two or more known primary or secondary feed trees that occupied more than 50% of the quadrat.
Habitat connectivity	+2	The subject site is part of a contiguous landscape of > 500 ha.
Key existing threats	+1	There is no known documented or anecdotal evidence of Koala mortality from dog attack or vehicle collision within the subject site or surrounds. Dogs, trucks, and vehicle movements are all present within the subject site.
Recovery value	0	Uncertain whether the habitat within the subject sites will be important in achieving the interim recovery objectives. The habitat is not thought to specifically act as a habitat refuge. The subject site has already been impacted and Koalas are still occurring within the locality which demonstrates that the subject site is not of significance importance to the survival of the population.
Total	**4/10**	

Koala (vulnerable)	
Criteria (Vulnerable Species)	Likelihood
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
It is considered unlikely that the Project would lead to a long-term decrease in the size of an important population of the Koala. The subject site is centred around the previously cleared mine pit. The location of the subject site does not occur within an area that is frequently used by Koalas, as evident in the results of the field survey. The location of the subject site would not fragment habitat, or impeded connectivity for the species given the surrounding native vegetation would remain intact. It is highly unlikely that the Project would decrease an important population of the Koala	Unlikely
reduce the area of occupancy of an important population;	
No important population occurs within the subject site. The Project is unlikely to reduce the occupancy of an important population as the subject site is not used on a regular basis by the Koala. The Koala can utilise a range of eucalypts for foraging, and as such, any portion of the site that contain eucalypts could be used by the Koala. However, our field survey results confirmed that the Koala is not utilising the subject site frequently.	Unlikely
fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for the identified population. As previously discussed, the subject site would not result in fragmentation or obstruction of movement throughout the landscape.	Unlikely
adversely affect habitat critical to the survival of a species;	
The habitat within the subject site is not regarded as habitat critical to the survival of the Koala as determined through application of the Koala habitat assessment tool (DoE 2014), which is illustrated in the table above. The habitat within the disturbance area scores a 4/10. A score of less than 5 does not indicate critical habitat.	Unlikely
disrupt the breeding cycle of an important population	
Habitat within the subject site is not thought to be a key breeding area due to the low number of records surrounding the subject site, no signs of the Koala during field survey, and given the species has not been recorded by mine staff over the past decade. Therefore, removal of the habitat is unlikely to disrupt the breeding cycle of the population. The area constitutes a very small proportion of the overall habitat for the population as clearing evidence by the scale of the vegetation corridor along Stockton Beach.	Unlikely
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The subject site does not contain primary or secondary feed trees as defined in the DoE (2014) guideline. The surrounding locality offers a greater availability of foraging habitat for the Koala. The removal of potential habitat within the subject site is unlikely to have any impact on patterns of Koala movement, or impact foraging resources such that the species is likely to decline.	Unlikely
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	
Predatory species such as foxes and wild dogs are already established within the locality. The Project is unlikely to further encourage these threats from occurring.	Unlikely
introduce disease that may cause the species to decline, or	

The main diseases affecting Koalas are chlamydial infections. The Project would not increase exposure to such infections as Koalas from the local population would not have increased contact with other Koala populations including infected populations.	Unlikely
interfere substantially with the recovery of the species.	
The following aspects are considered in relation to the possibility of the Project to interfere with the recovery of the Koala (from DoE 2014): *Increasing koala fatalities in habitat critical to the survival of the koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities.* There is no reason to suspect that dogs would become more prevalent within the subject site or surrounds as a result of the Project; *Increasing koala fatalities in habitat critical to the survival of the koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities.* There have been no reported Koala fatalities due to vehicle strike within the quarry or along access roads. Additional vehicle movements are expected to occur as a result of the Project but are expected to presented a low risk to the Koala. The Project would ensure the continuation of the current regime of vehicle movements within the subject site. There are strict speed controls on the vehicles operating within the quarry and as such it is considered that the risk of increased fatalities such that multiple ongoing fatalities occur is very low; *Facilitating the introduction or spread of disease or pathogens for example Chlamydia or Phytophthora cinnamomi, to habitat critical to the survival of the koala, that are likely to significantly reduce the reproductive output of koalas or reduce the carrying capacity of the habitat*; The Project is not likely to introduce Chlamydia or Phytophthora cinnamomic to the subject site and surrounds. All works will be undertaken as per the BMP detailed in section 5 of this BDAR. *Creating a barrier to movement to, between or within habitat critical to the survival of the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala.* The subject site would not create a barrier to Koala movement. As shown on Figure 9, a wildlife movement corridor would still remain. *Changing hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term.* The Project is unlikely to alter the hydrology to the extent that it would result in the degradation of remaining habitat critical to the survival of the Koala.	Unlikely
Conclusion: It is unlikely that the Project would result in a significant impact to an important population of the Koala.	

Migratory Species - Black-faced Monarch, White-throated Needletail	
Criteria (Migratory Species)	Likelihood
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	
substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species, or	
No important habitat for any of the potentially occurring migratory species is likely to occur within the subject site.	Unlikely
result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	
No invasive species of particular significance to the identified migratory species are expected to be established as a result of the Project. The subject site is already affected by invasive plants including some high threat weeds and introduced fauna such as the Rabbit which have some potential to adversely impact most fauna occurring within the subject site and surrounds. New invasive species are unlikely to become established due to the Project if mitigation measures are adhered to, including pest and weed management.	Unlikely
seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	
None of the potentially occurring migratory species would have a significant proportion of their population occurring within the subject site.	Unlikely
Conclusion: The Project would remove 35.66 hectares of native vegetation, which for the most part, consists of sparsely scattered tubestock with a lack of microhabitat features such as fallen logs and hollow-bearing trees. None of the above species occur in significant numbers within the subject site and the subject site does not support significant breeding habitat such that it may be used by a significant number of individuals to conduct any aspect of their lifecycle including foraging, breeding, overwintering or sheltering. The Project is not likely to result in a significant impact on the Black-faced Monarch or the White-throated Needletail.	

Grey-headed Flying-fox (Vulnerable)	
Criteria (Vulnerable Species)	**Likelihood**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
It is not expected that any impacts on breeding or roosting habitat for the Grey-headed Flying-fox would result from the Project as breeding/roosting camps will not be impacted and do not occur in the subject site. Impacts from the Project constitute impacts to foraging habitat of which approximately 35.66 hectares would be cleared. The foraging habitat is considered to be of marginal quality for the species, being mostly rehabilitation, with areas of remnant woodland. There are a variety of different canopy species present within proposed disturbance areas, some of which may contribute to winter and spring food availability. The significance of this contribution is not expected to be high as the expanse of similar foraging habitat within the locality is high. Regardless, potential foraging habitat would remain relatively abundant within the locality and the currently proposed removal of foraging habitat is not expected to cause a long-term decrease to any population of the species.	Unlikely
reduce the area of occupancy of an important population;	
No Grey-headed Flying Fox camp sites occur in the subject site or immediate surrounds. The Grey-headed Flying Fox forage opportunistically, often at distances up to 30 km from camps, and occasionally up to 60-70 km per night, in response to patchy food resources (Augee and Ford 1999; Tidemann 1999). The subject site may be used on occasion for foraging given the species feeds on a variety of eucalypts, which occur within a wide range vegetation communities. The reduction of 35.66 ha of potential habitat for the species is relatively minor compared to the availability of habitat across the locality. And furthermore, the proposed development would not restrict the Grey-headed Flying-fox from utilising foraging habitat throughout the locality. We therefore conclude that the Project would not reduce the availability of occupancy for an important population such that any significant disruption to the species would occur.	Unlikely
fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for any population of the species. The Grey-headed Flying-fox is a mobile species and the Project would not impact on areas where the species is known to breed and roost.	None
adversely affect habitat critical to the survival of a species;	
Habitat critical to the survival of the species has been loosely nominated within DECCW (2009) *Draft National Recovery Plan for the Grey-headed Flying-fox.* The Draft plan contains a definition for critical foraging habitat, and critical roosting habitat which have been addressed below: <u>Critical Roosting Habitat</u> DECCW (2009) states that habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to survival, or essential habitat, for Grey-headed Flying-foxes. Roosting habitat that: 1. *is used as a camp either continuously or seasonally in > 50% of years* **Response**: The subject site and immediate surrounds are not used as a camp site presently, or historically. 2. *has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 10 000 individuals, unless such habitat has been used only as a temporary refuge, and the use has been of limited duration (i.e. in the order of days rather than weeks or months)*	Unlikely

Response: As discussed above, the subject site and immediate surrounds are not used as a camp site presently, or historically. 3. *has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 2 500 individuals, including reproductive females during the final stages of pregnancy, during lactation, or during the period of conception (i.e. September to May).* **Response**: As above. <u>Critical Foraging Habitat</u> DECCW (2009) states that foraging habitat that meets at least one of the following criteria can be explicitly identified as habitat critical to survival, or essential habitat, for Grey-headed Flying Foxes. Natural foraging habitat that is: 1. *productive during winter and spring, when food bottlenecks have been identified (ParryJones and Augee 1991, Eby et al. 1999):* **Response:** The DECCW (2009) do not provide guidance around what constitutes a 'productive' natural foraging habitat, nor a 'food bottleneck'. As previously discussed, the subject site may be used on occasion for foraging given the species feeds on a variety of eucalypts. We have conservatively determined 30.66 ha of potential foraging habitat occurs within the Study Area. Similar potential foraging habitat is relatively available throughout the locality which would not be impacted by the Project. For the most part, the foraging habitat surrounding the subject site is likely to be in a better condition to that of the subject site, given historic vegetation clearing and grazing has not occurred. As such, whilst the site does contain potential foraging habitat, it is unlikely to be of significantly productive during both winter and spring to an extent that it is critical foraging habitat for the species. 2. *known to support populations of > 30 000 individuals within an area of 50 km radius (the maximum foraging distance of an adult)* **Response**: The subject site does not support a population of >30,000 individuals. 3. *productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May)* **Response:** No, the subject site is highly unlikely to be productive for the species given absence of roost sites and the distance from known camps. As discussed above, the locality contains important feed trees and foraging habitat that is not impacted by the Project. 4. *productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions)* **Response:** No, the subject site is highly unlikely to be productive for the species given absence of roost sites and the distance from known camps. No commercial crops or important commercial fruit trees would be impacted by the Project. 5. *known to support a continuously occupied camp* **Response:** No camp site occur within the subject site.	
disrupt the breeding cycle of an important population	
The Project is unlikely to disrupt the breeding cycle of the species as breeding events for this species primarily take place within camps, none of which would be adversely impacted by the Project.	None
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the local abundance of similar habitat. The Project would not isolate areas of foraging habitat.	Unlikely
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	

The Project is unlikely to increase the likelihood of weeds being established in areas adjacent to disturbance areas that constitute potential foraging habitat for the species. The Project will include measures to control weeds becoming established in such areas through the implementation of a Landscape and Rehabilitation Plan. Potential invasive predators such as the fox are likely to be already present within the subject site and the Project is not expected to increase the level of predation threat for the Grey-headed Flying-fox.	Unlikely
introduce disease that may cause the species to decline, or	
There are no known documented diseases that are currently contributing to the decline of the species. The Project in not expected to cause an increased risk of any bat diseases.	Unlikely
interfere substantially with the recovery of the species.	
The Project does not directly or substantially interfere with any of the specific recovery objectives under the draft National Recovery Plan (Commonwealth of Australia 2017). A general objective is to lessen the currently operating threats to the species which includes the removal of foraging habitat. The Project is therefore not consistent with this general objective. However, the amount and type of foraging habitat removal is not considered to constitute substantial interference with the recovery of the species.	Unlikely
Conclusion: Impacts from the Project relate to the removal of foraging habitat for the Grey-headed Flying-fox within the proposed disturbance areas. Whilst protection of foraging habitat is considered important for this species, impacts from the Project are not considered to be significant for the following reasons: • The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size; • Similarly important foraging habitat occurs throughout the locality including within protected areas.	

Spotted-tail Quoll Vulnerable)	
Criteria (Vulnerable Species)	**Likelihood**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
The Spotted-tail Quoll was not recorded during the extensive field survey, nor has been recorded previously at the subject site and within the Boral mining lease. Impacts from the Project constitute impacts to potential foraging habitat of which approximately 35.66 hectares would be cleared. The foraging habitat is considered to be of marginal quality for the species, being mostly rehabilitation, with areas of remnant woodland. Potential foraging habitat would remain abundant within the locality. It is unlikely that the subject site provides the only foraging resource for the species in the locality. The proposed removal of potential foraging habitat is therefore not expected to cause a long-term decrease to any population of the species.	Unlikely
reduce the area of occupancy of an important population;	
It is unlikely that an important population of the Spotted-tail Quoll occurs in the subject site, as the species was not detected during the survey, and there is only one previous record of the species within a 10 km radius of the subject site. The Project would not impact the area of occupancy of the Spotted-tail Quoll for the following reasons: • The areas to be cleared are not sufficient in extent to impact the area of occupancy of the species at a 2km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN); and • Spotted-tail Quoll would still be expected to forage within the vicinity of the subject site, given potential foraging habitat extends beyond the subject site boundary.	Unlikely
fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for any population of the species. The Long-nosed Potoroo is a mobile species and the Project would not impact on areas where the species is known to occur.	None
adversely affect habitat critical to the survival of a species;	
Habitat critical to the survival of the species is not likely to include the subject site, as no known previous records occur in the subject site. Further, the majority of the subject site does not support the dense understorey that is considered important for the species, as it consists of rehabilitated areas where the understorey and ground cover is sparse. Therefore, the potential foraging habitat to be removed is not considered critical to the species survival.	Unlikely
disrupt the breeding cycle of an important population	
The Project is unlikely to disrupt the breeding cycle of the species as the habitat to be impacted by the Project is marginal and no known populations occur in the subject site.	None
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the local abundance of similar habitat. The Project would not isolate areas of foraging habitat.	Unlikely
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	

The Project is unlikely to increase the likelihood of weeds being established in areas adjacent to disturbance areas that constitute potential foraging habitat for the species. The Project will include measures to control weeds becoming established in such areas through the implementation of a Landscape and Rehabilitation Plan. Potential invasive predators such as the fox are likely to be already present within the subject site and the Project is not expected to increase the level of predation threat for the Spotted-tail Quoll.	Unlikely
introduce disease that may cause the species to decline, or	
There are no known documented diseases that are currently contributing to the decline of the species. The Project in not expected to cause an increased risk of any diseases.	Unlikely
interfere substantially with the recovery of the species.	
Currently, there is no recovery plan for this species. The amount and type of foraging habitat removal required for the Project is not considered to constitute substantial interference with the recovery of the species.	Unlikely
Conclusion: Impacts from the Project relate to the removal of foraging habitat for the Spotted-tail Quoll Potoroo within the proposed disturbance areas. Whilst protection of foraging habitat is considered important for this species, impacts from the Project are not considered to be significant for the following reasons: • The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size; • Similarly important foraging habitat occurs throughout the locality including within protected areas.	

Long-nosed Potoroo (Vulnerable)	
Criteria (Vulnerable Species)	**Likelihood**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
The Long-noised Potoroo was not recorded during the extensive field survey, nor has been recorded previously at the subject site and within the Boral mining lease. Impacts from the Project constitute impacts to potential foraging habitat of which approximately 35.66 hectares would be cleared. The foraging habitat is considered to be of marginal quality for the species, being mostly rehabilitation, with areas of remnant woodland. Potential foraging habitat would remain abundant within the locality. It is unlikely that the subject site provides the only foraging resource for the species in the locality. The proposed removal of potential foraging habitat is therefore not expected to cause a long-term decrease to any population of the species.	Unlikely
reduce the area of occupancy of an important population;	
It is unlikely that an important population of the Long-nosed Potoroo occurs in the subject site, as the species was not detected during the survey, and there is only one previous record of the species within a 10 km radius of the subject site. The Project would not impact the area of occupancy of the Long-nosed Potoroo for the following reasons: • The areas to be cleared are not sufficient in extent to impact the area of occupancy of the species at a 2km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN); and • Long-nosed Potoroo would still be expected to forage within the vicinity of the subject site, given potential foraging habitat extends beyond the subject site boundary.	Unlikely
fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for any population of the species. The Long-nosed Potoroo is a mobile species and the Project would not impact on areas where the species is known to occur.	None
adversely affect habitat critical to the survival of a species;	
Habitat critical to the survival of the species is not likely to include the subject site, as no known previous records occur in the subject site. Further, the majority of the subject site does not support the dense understorey that is considered important for the species, as it consists of rehabilitated areas where the understorey and ground cover is sparse. Therefore, the potential foraging habitat to be removed is not considered critical to the species survival.	Unlikely
disrupt the breeding cycle of an important population	
The Project is unlikely to disrupt the breeding cycle of the species as the habitat to be impacted by the Project is marginal and no known populations occur in the subject site.	None
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the local abundance of similar habitat. The Project would not isolate areas of foraging habitat.	Unlikely

result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	
The Project is unlikely to increase the likelihood of weeds being established in areas adjacent to disturbance areas that constitute potential foraging habitat for the species. The Project will include measures to control weeds becoming established in such areas through the implementation of a Landscape and Rehabilitation Plan. Potential invasive predators such as the fox are likely to be already present within the subject site and the Project is not expected to increase the level of predation threat for the Long-nosed Potoroo.	Unlikely
introduce disease that may cause the species to decline, or	
There are no known documented diseases that are currently contributing to the decline of the species. The Project in not expected to cause an increased risk of any diseases.	Unlikely
interfere substantially with the recovery of the species.	
Currently, there is no recovery plan for this species. The amount and type of foraging habitat removal required for the Project is not considered to constitute substantial interference with the recovery of the species.	Unlikely
Conclusion: Impacts from the Project relate to the removal of foraging habitat for the Long-nosed Potoroo within the proposed disturbance areas. Whilst protection of foraging habitat is considered important for this species, impacts from the Project are not considered to be significant for the following reasons: • The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution (predominately the understorey is sparse) or size; • Similarly important foraging habitat occurs throughout the locality including within protected areas.	

New Holland Mouse (Vulnerable)	
Preamble The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. The New Holland Mouse has been attributed a moderate likelihood of occurrence as the species has been recorded within Worimi Regional Park and Worimi State Conservation Area and may utilise the subject site for foraging.	
Criteria (Vulnerable Species)	**Likelihood**
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
lead to a long-term decrease in the size of an important population of a species;	
Impacts from the Project constitute impacts to foraging habitat of which approximately 35.66 hectares would be cleared. The foraging habitat is considered to be of marginal quality for the species, being mostly rehabilitation, with some areas of remnant woodland. Over time, foraging habitat would be at least partially restored through rehabilitation works. Regardless of rehabilitation works, potential foraging habitat would remain abundant within the locality and the currently proposed removal of foraging habitat is not expected to cause a long-term decrease to any population of the species.	Unlikely
reduce the area of occupancy of an important population;	
The Project would not impact the area of occupancy of the New Holland Mouse for the following reasons: • The areas to be cleared are not sufficient in extent to impact the area of occupancy of the species at a 2km grid square scale (which is the standard unit for measuring area of occupancy according to the IUCN); and • New Holland Mouse would still be expected to forage within the vicinity of the subject site, given potential habitat extends beyond the subject site boundary.	Unlikely
fragment an existing important population into two or more populations;	
The Project is unlikely to increase fragmentation for any population of the species. The New Holland Mouse is a mobile species and the Project would not impact on areas where the species is known to occur.	None
adversely affect habitat critical to the survival of a species;	
Habitat critical to the survival of the species is not likely to include the subject site, as no known previous records occur in the subject site. The potential foraging habitat to be removed is not considered critical to the species survival, given the majority of the area to be impacted consists of rehabilitated areas.	Unlikely
disrupt the breeding cycle of an important population	
The Project is unlikely to disrupt the breeding cycle of the species as the habitat to be impacted by the Project is marginal (mostly rehabilitation) and no known populations occur in the subject site.	None
modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;	
The extent of foraging habitat to be removed is not considered sufficient to result in the decline of the species given the local abundance of similar habitat. The Project would not isolate areas of foraging habitat.	Unlikely
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;	

The Project is unlikely to increase the likelihood of weeds being established in areas adjacent to disturbance areas that constitute potential foraging habitat for the species. The Project will include measures to control weeds becoming established in such areas through the implementation of a Landscape and Rehabilitation Plan. Potential invasive predators such as the fox are likely to be already present within the subject site and the Project is not expected to increase the level of predation threat for the New Holland Mouse.	Unlikely
introduce disease that may cause the species to decline, or	
There are no known documented diseases that are currently contributing to the decline of the species. The Project in not expected to cause an increased risk of any diseases.	Unlikely
interfere substantially with the recovery of the species.	
Currently, there is no recovery plan for this species. The amount and type of foraging habitat removal required for the Project is not considered to constitute substantial interference with the recovery of the species.	Unlikely
Conclusion: Impacts from the Project relate to the removal of foraging habitat for the New Holland Mouse within the proposed disturbance areas. Whilst protection of foraging habitat is considered important for this species, impacts from the Project are not considered to be significant for the following reasons: • The habitat to be removed is not considered to be particularly important foraging habitat in terms of its constitution or size; • Similarly important foraging habitat occurs throughout the locality including within protected areas.	

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Accredited BAM assessors (NSW)
Biodiversity Stewardship Site Agreements (NSW)
Offset site establishment and management
Offset brokerage
Advanced Offset establishment (QLD)

APPENDIX D Geomorphology Report

Boral Stockton Sand Quarry: impact on coastal environment of proposed dredging operation

Report prepared for Boral Land & Property Group (NSW)

Coastal Studies, August 2019

Document History and Status

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Boral Stockton Sand Quarry: impact on coastal environment of proposed dredging operation

Report prepared for Boral Land & Property Group (NSW)

by

Professor Andrew D Short
Coastal Studies

30 August 2019

Contents

Cover image: Stockton beach and dunes and Boral quarry site, 10 /01/16 (Source: Google Earth)

Executive Summary

Boral is proposing to extract an estimated 9 million tonnes of sand from a 36 ha sand dune site that has been previously excavated to 5 m AHD. The present proposal is to excavate the same site to 15 m depth (-15 m AHD) over a 25-year period. The site is located within the existing Boral Stockton sand quarry and following the previous excavation the site was landscaped and rehabilitated with native vegetation. This report assesses the potential impacts of the proposed extraction on the broader coastal environment and dune system.

The excavation will result in a 15 m deep lake that may be left as a lake or backfilled and rehabilitated or developed for housing. If the lake remains its sides will be battered and stabilised with VEMN, while the surrounding dunes will be landscaped and rehabilitated with natural vegetation. Regardless of the final use of the site it will be surrounded by 5-20 m high vegetated sand dunes with a minimum buffer of 500 m between the site and mobile dunes to the south, and at least 1 km between the site and Stockton beach and shoreline. These buffers are sufficient to ensure that the site will have no impact on the surrounding environment outside of the immediate boundary. It will have no impact on beach processes or on sand blown inland from the beach, deflation basin and mobile dunes. All of these processes are too remote and/or upwind of the site to be impacted by the excavation. The present dune mobility, largely outside the Boral quarry, will continue on irrespective of the proposed site excavation.

1 Introduction

The Boral Stockton sand quarry has an area of 246 ha and has been operated by Boral since 1992. Between 1996 and 2008 sand was extracted from the middle of the site to an elevation of 5 metres (m) Australian Height Datum (AHD) following which it was progressively landscaped and rehabilitated. The present project proposes to extract sand from the same site, an area of 36 ha, to a depth of -15 m AHD. It proposes to extract approximately 9 million tonnes of sand over a 25-year period.

This report assesses the potential impacts of the proposed extraction on the broader coastal environment and dune system. The excavation will leave a 15 m deep freshwater lake located within and surrounded by 5-20 m high vegetated sand dunes. In accordance with the 2006 Rehabilitation and Landscape Management Plan the site will undergo landscaping and rehabilitation of the lake boundary and surrounding dunes in order to stabilise and vegetate these boundaries. Following this there are three potential options for the site. It could be left as a freshwater lake to provide habitat for local flora and fauna. This would require partially backfilling with suitable Virgin Excavated Natural Material (VENM) to stabilise pit edges and submerged batters; it could be backfilled and rehabilitated with native vegetation; or backfilled and developed for residential housing.

The site is surrounded by at least 500 m of densely vegetated dunes and is located at least 500 m and downwind from the nearest mobile dunes and at least 1 km from the Stockton beach shoreline. Given the size and nature of this buffer zone it cannot and will not have any physical interaction with or impact on these systems, namely beach processes or the movement of sand from the beach into the mobile dunes and their encroachment on the vegetated hind dunes. The predominant impacts will be in the immediate vicinity of the site itself in the excavation, buffering and revegetation of the surrounding dune slopes. Once they are landscaped and rehabilitated they should remain vegetated and stable.

2 Stockton beach-dune system

Boral's Stockton sand quarry is located towards the southern end of a 32 km long coastal outer sand barrier consisting of Stockton Beach and the backing sand dunes that extend up to 3 km inland, which are in turn backed by a swampy inter-barrier depression (Fullerton Cove) and an inner barrier (Tomago Sands) extending up to 12 km inland. The inner barrier was deposited by waves and wind during the last sea level highstand about 120,000 years ago. The modern outer sand barrier has evolved over the past 7,000 years following the inundation of Stockton Bight by the rising sea level that stabilised around present sea level approximately 6,500 years ago. At that time sand was supplied to the initial beach by waves transporting material shoreward from the inner continental shelf and spreading it the length of the embayment to link the Hunter River entrance with Birubi Point in the north. As sand continued to be supplied to the coast the shoreline gradually built seaward by up to 2 km. The prograding shoreline was capped by a series of well vegetated undulating shore-parallel foredune ridges and swales with an elevation between 5 and 10 m (#1 on Figure 1). The foredune ridges provided a suitable sheltered area close to the ocean shore for aboriginal occupation sites, and most occupation sites located in the barrier system are located on these former ridges. The onshore sand supply continued until about 5,000 years ago, following which was the first of three phases of dune instability and landward migration of bare mobile sand dunes and shoreline recession. The evolution of the system was investigated by Thom et al. (1992) and the following summary is based on this work.

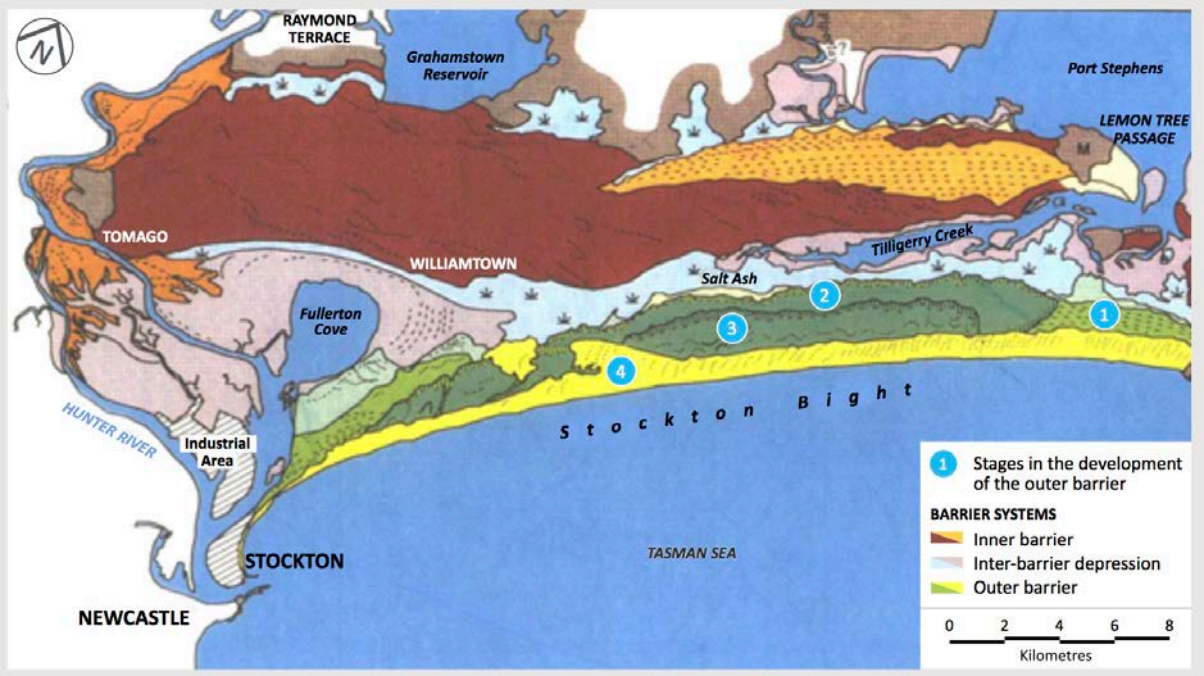

Figure 1 Stockton Bight Quaternary geomorphology showing the inner barrier (brown and orange), inter-barrier depression (light blue and purple) and outer barrier (green and yellow). Numbers (1-4) refer to stage in the development of the outer barrier (modified from Thom et al., 1992).

The *first phase* of mobile dunes occurred between 5,200 and 4,000 years ago (Thom et al. 1992). These dunes moved up to 2 km inland and rose to elevations reaching 20 m. They moved over and completely buried the former foredune ridges (#1 on Figure 1). The dunes then stabilised and were densely vegetated (#2 on Figure 1). The *second phase* of mobile dune activity occurred approximately 2,000 years ago. These dunes moved up to 1.5 km inland partially burying the first phase dunes and the foredune ridges. They then stabilised and became vegetated (#3 on Figure 1). The *third phase* commenced about 500 years ago and remains active today (#4 on Figure 1), with bare mobile sand extending on average several hundred meters inland, but reaching over 2 km inland east of Williamstown, and occupying 12% of the total Stockton barrier system. The remaining original foredune ridges and first and second phase dunes (#1, 2 and 3 on Figure 1), that is 88% of the dunes, are well vegetated and stable.

Figure 2 provides a schematic cross-section of the Stockton dunes. Stockton has an exposed 30-50 m wide high energy beach (0-4 m AHD) composed of medium to fine quartz sand. Sand from the beach is blown into the ~100 m wide, 4-10 m high foredune (#1, Figure 2) that parallels the rear of the beach and in places through gaps in the foredune into the 100-300 m wide deflation basin (#3 and 5) which has an elevation between 2-6 m. Sand is exported from the deflation basin by strong southerly winds and deposited in the 5-20 m high bare mobile dune field (#4, the third phase dunes), which in the vicinity of the quarry are between 200-300 m wide. As the sand moves out of the deflation basin it erodes the western wall of the basin exposing the long buried foredune ridges (#2) and their buried dark soil horizon, vegetation remnants and occasional occupation sites. The mobile dune field has been arranged by the strong southwest winds into transverse dunes (i.e. perpendicular or transverse to the formative southwest wind), with crests aligned southeast-northwest. The transverse dunes average 15 m in height and are spaced between 100-200 m apart. Strong southerly

winds cause them to migrate both to the northeast at rates between 5 to 15 m per year, averaging 7 m per year, and to the northwest at rates between 3 and 5 m per year. In the process, the dunes move into and bury the vegetated hind dunes (the first and second phases dunes; indicated by #6 Figure 2) (Coastal Studies, 2017). This third phase of dune activity is natural and has been operating at this scale for approximately the past 500 years. However, off-road vehicle activity is presently exacerbating the dune instability in the areas it is permitted. The existing quarries are located in the hind dune area (#6) downwind of the beach and active dunes and can have no impact on sand transport into the dunes and towards the quarry.

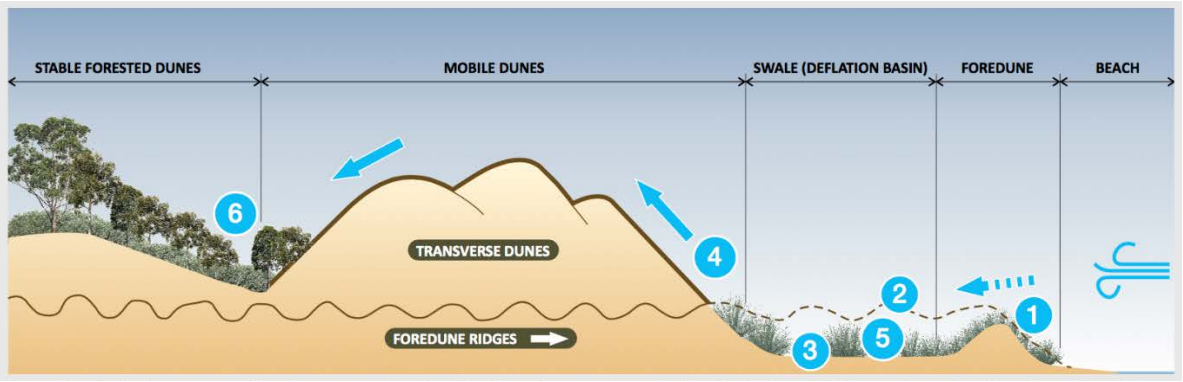

Figure 2 A schematic cross-section of the Stockton dunes showing the beach and foredune (1); the undulating surface of the buried and prior foredune ridges (2), with the dashed line showing the area eroded by wind and transported into the transverse dunes; the vegetated (5) and bare (3) deflation basin (swale) surface; wind-blown sand transport from the deflation basin into the transverse dunes (4); and the vegetated hind dune (6) (source: Coastal Studies, 2017).

3 Boral sand quarry site – the existing environment

The Boral Stockton sand quarry is located at Fullerton Cove Bay approximately 10 km north of the Hunter River. The quarry site covers 246 ha and includes an eastern section containing active third phase bare dunes, while the bulk of the site contains the forested first and second phase dunes. The proposed dredging area is located in the area of first and second phase dunes. The site was previously quarried to an elevation of 5 m AHD, then reshaped and rehabilitated with soil and native vegetation.

The proposed extraction area has an area of 36 ha and is located between 1 to 1.7 km landward of the Stockton beach shoreline and between 500 m and 1 km landward of the bare mobile Stockton sand dunes. It is surrounded by vegetated coastal sand dunes between 5 and 20 m in height (Figure 3).

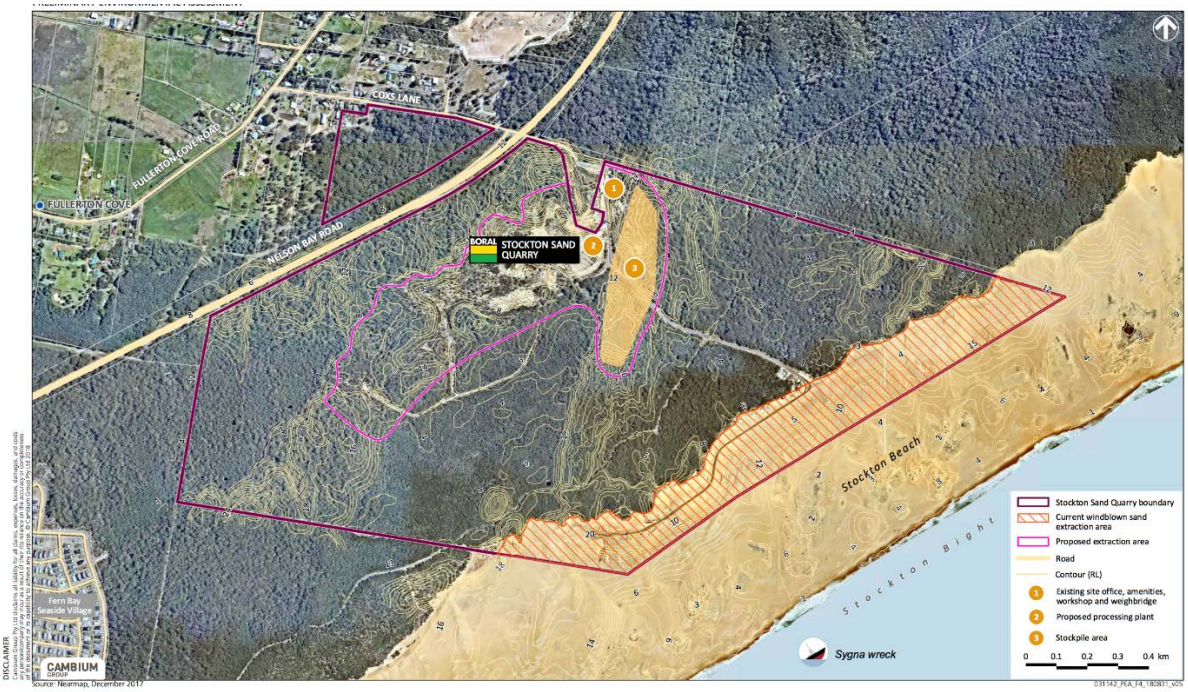

Figure 3 The Boral Stockton quarry boundary and location and topography of the proposed extraction site (Boral, 2018)

4 Potential impacts on the broader coastal environment and dune system

4.1 Vegetation

Vegetation surveys and mapping has previously been undertaken by ERM (1994, 2005) which indicated the proposed extraction area has a '*coastal sand apple-blackbutt community'*, which is typical of central NSW coast hind dune vegetation (Carolin and Clarke 1991). The proposed site has been previously quarried for sand and rehabilitated with native vegetation. This vegetation will be removed and the site excavated to a maximum depth of -15 m AHD. What happens to the site after extraction will depend on its future land use which could range from a freshwater lake to complete backfilling for rehabilitation with native vegetation or residential development (Boral 2018).

4.2 Groundwater

The proposed site consists of quartz sand deposited by waves and wind during the past 7,000 years, as detailed above in section 2. The sand is unconsolidated and porous resulting in most precipitation infiltrating into the sand and moving down to the groundwater table with no surface drainage. The groundwater table varies in elevation from between 1.5 to 5.5 m in the proposed site area to as much as 20 m below the higher dunes (Boral 2018). The groundwater is monitored by Boral as part of the groundwater monitoring program which was developed as part of the existing development consent.

The low vegetated dunes that presently occupy the site will be replaced with an open lake. Groundwater and surface water assessments have been undertaken to consider any changes in the movement of water into the lake and adjacent hydraulic gradients.

4.3 Dune morphology (topography)

The major physical impact of the proposed extraction will be the excavation of the existing 5 m high surface to a depth -15 m AHD, in the process removing an estimated 9 million tonnes of sand and leaving a freshwater-filled lake. The lake shores will undergo edge stabilisation involving batters graded to the angle of natural repose, setback of development (i.e. haul roads) from the pond edge, and where necessary the use of VENM.

Once excavation operations are complete the long-term morphology of the site will depend on which of three options are pursued – a freshwater lake, complete backfilling and rehabilitation with soil and native vegetation or backfilling with residential development, similar to the adjacent Fern Bay village.

If the site remains a freshwater lake it will provide a new wetland habitat for flora and fauna within the sand dune system. If it is backfilled and rehabilitated it will return the site to a state similar to that pre-excavation, that is, a low undulating area covered in native vegetation. If it is developed for residential use it will look similar to the adjacent Fern Bay village.

Whichever option is pursued the site will be surround by 5-20 m high sand dunes covered in native vegetation, with at least a 500 m wide vegetated zone between the site's southern boundary and the bare mobile Stockton sand dunes, and at least a 1.3 km wide buffer from the Stockton beach shoreline. Both these buffers are more than adequate to protect the site from wind-blown sand and shoreline erosion and/or marine inundation.

4.4 Sand transport and surrounding beach-dune system

The proposed excavation site will leave a -15 m AHD deep freshwater lake which may or may not be backfilled. Whatever the eventual outcome the site cannot and will not impact the beach, foredune, deflation basin and mobile transverse dunes as it is physically removed from and downwind of these environments. A buffer of at least 500 m of vegetated dunes lies between the southern boundary of the excavation site and the mobile dunes. This is more than sufficient to physically isolate it from these environments. Likewise, it cannot and will not impact the existing sand transport both along the beach and in the active mobile (third phase) dunes, as again it is physically isolated from their environments. The vegetated first and second phase dunes that will surround the proposed site will be graded, battered and vegetated to ensure their stability as part of the rehabilitation program. Once the vegetation is established they should remain stable and well vegetated.

5 Conclusions

The proposed sand extraction area within the Boral Stockton sand quarry covers an area of 36 ha, and will result in a 15 m deep freshwater lake being formed in a previously quarried area presently consisting of 5 m high vegetated sand dunes. Post-excavation the lake may be left as a freshwater lake or backfilled to be revegetated or developed for housing. The removal of the dunes and excavation of the lake will impact the surrounding vegetation and groundwater the details of which are covered in other reports (ERM 1994, 2005; RPS 2016; Jacobs 2018; Boral 2018). This report has focused on the impacts on the surrounding dune

and coastal environment. While the excavation will leave a 15 m deep freshwater lake, the landscaping and rehabilitation works on the lake boundary and surrounding dunes should both vegetate and stabilise these boundaries in accordance with the 2006 Rehabilitation and Landscape Management Plan. As the site is surrounded by at least 500 m of densely vegetated dunes and is located at least 500 m and downwind from the mobile dunes and 1 km from the Stockton beach shoreline, it cannot have any physical interaction with or impact on these systems. The major impacts will be in the immediate vicinity of the site itself in the excavation and buffering of the surround dune slopes. Once they are landscaped and rehabilitated they should remain vegetated and stable.

6 References

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APPENDIX E Quarry method: Best Practice Considerations

Table 1.1: Project design considerations

Project element	Options	Considerations	Why the preferred option?
Source/location of works	Existing site; New site; or Land based extraction or marine extraction	There are several other sand reserves and operations within proximity to the site. These are currently owned by Boral competitors and are not viable options. Boral has and continues to investigate alternative resource sites across NSW. Investigations have not been identified as suitable alternative to date due to the following: ▪ capital costs; ▪ availability of an alternate site with the appropriate sand quality; and ▪ legal and planning framework. Marine based sand extraction is not currently supported by existing legal frameworks.	Investigations of the south coast of NSW failed to identify a new site or resources that were suitably zoned or located near transport infrastructure or customers. On balance, there was a lack of availability of viable new sites. Accordingly, Boral selected to progress an option to maximise the use and value of an existing asset. The benefits of utilising the existing site include: ▪ maximisation of an existing asset; ▪ permissible/consistency with established planning framework; and ▪ previous disturbance on the site results in reduced potential for new or additional impacts, particularly in relation to archaeology/biodiversity etc.
Extraction methodology	Dry extraction or wet extraction	To obtain the same volume of sand resource using dry extraction would require works to stay at RL 4 m AHD, thereby requiring removal of approximately 106 ha of vegetation. This alternate footprint would expand to include areas to the west of the preferred project site, extending towards Nelson Bay Road and east south east along the shared Worimi lands boundary towards Stockton Bight and the existing windblown sand extraction area. The majority of this land has not been previously disturbed by earlier extractive industries. Increasing the disturbance footprint would increase the environmental impacts (e.g.	Wet extraction techniques support a reduced disturbance footprint that can be contained to an area that has been previously disturbed. The smaller footprint avoids unnecessary harm to biodiversity and potential archaeology, and minimises visual amenity, noise, air quality and social impacts. Wet extraction techniques generally have less residual environmental impacts involving minimal truck movements to extract the material, and minimal air emissions as wet stockpiled material does not generate dust.

Project element	Options	Considerations	Why the preferred option?
		vegetation removal, noise, air quality, visual impacts, social, heritage/archaeology). Increased use of water required to minimise windblown sand. Visual impacts – to achieve the same volume of resource, dry extraction techniques would require an increase in the area of land cleared.	
Wet extraction methods	Possible methods for wet extraction: ▪ dredge; or ▪ dewater aquifer (to support dry extraction).	The option to dewater the aquifer would have increased impacts by lowering the aquifer by pumping water from the aquifer for storage in water tanks or similar. These techniques remove water from the aquifer until dry extraction methods can be used, thereby compounding the potential for adverse and increased environmental and social impacts. The range of impacts that could arise from a dewatering method would include those associated with lowering of the water table including, increased potential for the generation of ASS, impact on groundwater dependent ecosystems, impact on other groundwater users, and impact on groundwater and surface water recharge and the water cycle.	It is evident from the potential array of impacts likely to result from dewatering that dredging is the best outcome based on the reduced potential for adverse environmental impact. It also presents as the most practical option, as the water is not required to removed and stored elsewhere while operations progress.
Dredge type	There are multiple dredge types, including: ▪ mechanical; ▪ hydraulic; and/or ▪ electric.	Mechanical – not appropriate for fine sand material types, increased costs; noise from heavy plant; intensity of operation (management issues). Hydraulic dredge better than mechanical when working with fine material. However, requires the use of more oils and required to be stored on a pontoon in the dredge pond. The option to use an electric dredge reduces the need to introduce oils to water there by reducing the potential for water pollution.	The electric dredge will not reduce the need to use oils and lubricants that can pose a potential impact to groundwater quality. This type of dredge is also well suited to working with fine grained sand material.
Electric dredge types	Options considered: ▪ suction dredge; or	Cutter-suction dredges are typically used on hard surface materials such as gravel. The cutting action increases noise generation and	The fine to medium grained sand material present at the site is better suited to the use of a suction dredge as it

Project element	Options	Considerations	Why the preferred option?
	▪ cutter suction dredge	contributes to increased turbidity (lowering water quality). Use of a cutter-section dredge is not suitable for the material type due to free flowing nature of sand not requiring cutting.	is relatively free flowing and does not require cutting. The suction dredge, in part due to the material, will have low noise operating levels and will not increase turbidity in the same manner.
Wash plant	Options considered: ▪ cyclone (dewater); ▪ screw (dewater); and/or ▪ dewatering screen.	The process of washing sand ensures a higher quality of product allowing the resource to be used for a broader range of end uses. The following matters were considered in identifying the preferred washplant/dewatering plant: ▪ Product quality; ▪ Efficiency of the plant and capacity to remove excess moisture from product; and ▪ Cost of maintaining and operating plant **Screw/sludge dewatering** relies on gravity for water and sand to be separated. The resultant moisture content in the sand tends to be higher, requiring longer stockpiling times and potentially increases the volumes of trucks required to move product (as a higher moisture content will increase the weight thereby reducing product volume able to be moved).	The preferred wash/dewatering plant is the pre-screen; cyclone dewatering screen. The method of washing the sand has been selected with the aim of improving the quality of the end resource as well as removing as much water/moisture content as possible. Dewatering using cyclone is more efficient achieves a lower moisture content than screw or gravity dewatering process. Allowing for material to be removed and dispatched faster while negating the need to stockpile large quantities of material for long periods of time (thereby avoiding material being lost through wind erosion or affecting local air quality).
Utilities (power)	Diesel generators or electricity network supply	The depot is currently connected to the local power grid. Investigations were made into extending power further into the site to reduce reliance on diesel, which would have an improved emissions outcome and reduce the volume of and use of fuels on site. However, in the short term this option is not financially viable.	In the short term use of diesel fuels to support the generators and operation of the dredging plant will be implemented. To ensure the protection of the underground aquifer refuelling techniques including handfilling will be adopted, which are known to have a reduced incidence of spillages.

Project element	Options	Considerations	Why the preferred option?
		Furthermore, dependant on the alignment of the electricity conduits there is potential for increased impact on vegetation.	All refuelling of mobile plant will occur within the depot where there is permanent, impervious surface and bunding to prevent the migration of fuels through sand to the aquifer.
Stacker options, used to stockpile product (affixed to the washplant)	Options considered included: ▪ telescopic stacker (fully automated); and/or ▪ radial/fixed stacker.	Radial fixed stackers stockpile material in a standard conical fashion with the arm of the stacker static over a single position until the stockpile height is achieved. This method results multiple conical stockpiles and in issues of product segregation (course to medium material located at the base and around the edges with finer grain material centralised to the centre conical), thereby resulting in a poorly blended and degraded material. Radial fixed stackers also result in higher levels of dust as re-blending is typically required. The process of re-blending would result in increased environmental impacts associated increased vehicle movements and formation of the stockpiles (separated finer material at the top is more susceptible to windblown losses). Less vehicle movements would be required as no double handling (reduced vehicles; reduced dust so improved air quality).	The telescopic stacker stockpiles in specification material and limits the need for re-blending. This in turn reduces the generation of dust and improves air quality as the product is not unnecessarily moved around or 'processed'. The telescopic conveyor builds layered windrows to minimise material segregation, and can increase stockpile capacities by 30%.
Waste management – screened material	Options considered included: ▪ Dispose off-site; and/or ▪ Reuse on site.	Option to reuse on site as road base on haul roads (maintenance and construction) or direct to landfill off-site. Disposing of material off-site contributes to increased costs, truck volumes and associated noise and potential traffic impacts.	Reuse is the most practical and viable outcome in relation to avoiding unnecessary costs in terms of disposal and transportation. Reuse avoids unnecessary environmental impacts associated with additional truck movements, noise, dust and the like.
Vegetation clearing	Options considered: ▪ clear all vegetation in a single stripping campaign; or	Increased areas of clearing have the potential to increase the rate of erosion by wind, impacting on air quality, local amenity and resource quantities.	Undertaking clearing efforts progressively reduces potential air quality impacts and prevents loss of resource.

Project element	Options	Considerations	Why the preferred option?
	▪ progressive campaign vegetation removal.		