Section 6

Assessment of Issues

PREAMBLE

This section provides background information on the topography within and surrounding the Project Area and relevant climate data relied upon for a number of the environmental assessments of the Project. The subsequent subsections relate to the range of environmental components that would be influenced, to varying degrees, by the Project. For each component, information is provided on the existing environment together with the proposed safeguards and mitigation measures and the likely impacts the Project would have following the implementation of these measures.

*The various environmental components are addressed generally in the order prioritised in the risk analysis (**Appendix E**) although the economic and social impacts are intentionally placed at the end of Section 6 as both assessments rely upon information presented in the earlier subsections.*

It is noted that, given the processing within the existing fixed processing plant and transportation of Quarry products produced from rock extracted from the Albion Park Quarry are already approved activities, matters relating to the crushing and screening of quarry materials in the existing fixed processing plant, product stockpiling and road transportation do not need to be covered in this Section. Nevertheless, impacts associated with road transportation have been assessed in Sections 6.3.7.2 and 6.12.

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6.1 Environmental Setting

6.1.1 Introduction

The assessment of the environmental impacts of the Project in this section is reliant upon background information common to many environmental issues. Key features of the Project Area and surrounding region, including community, surrounding land uses, land ownership, natural and built features, risks and hazards are described in Section 2. In this subsection, background information is provided on the topography and climate.

For the purposes of the impact assessments for air quality, noise and visibility, a locality of Shell Cove West has been defined, as shown on **Figure 6.1.1**. This locality includes the southwestern part of the suburb of Shell Cove, as well as the recent subdivisions in the north of the suburb of Dunmore and including the Shellharbour Anglican College. The Shell Cove West locality generally represents those areas of residential development closest to and east of the Project.

6.1.2 Topography

The Quarry is located within the Wentworth Hills ridge system which extends east from Stockyard Mountain at an elevation generally above 70m AHD. The Wentworth Hills form the watershed divide between the Lake Illawarra catchment to the north and the Rocklow Creek and Minnamurra River catchments to the south (**Figure 6.1.1)**. The northern valleys of the Wentworth Hills are broad and open and drain northwest towards Lake Illawarra and the southeastern valleys are incised and drain towards the Minnamurra River.

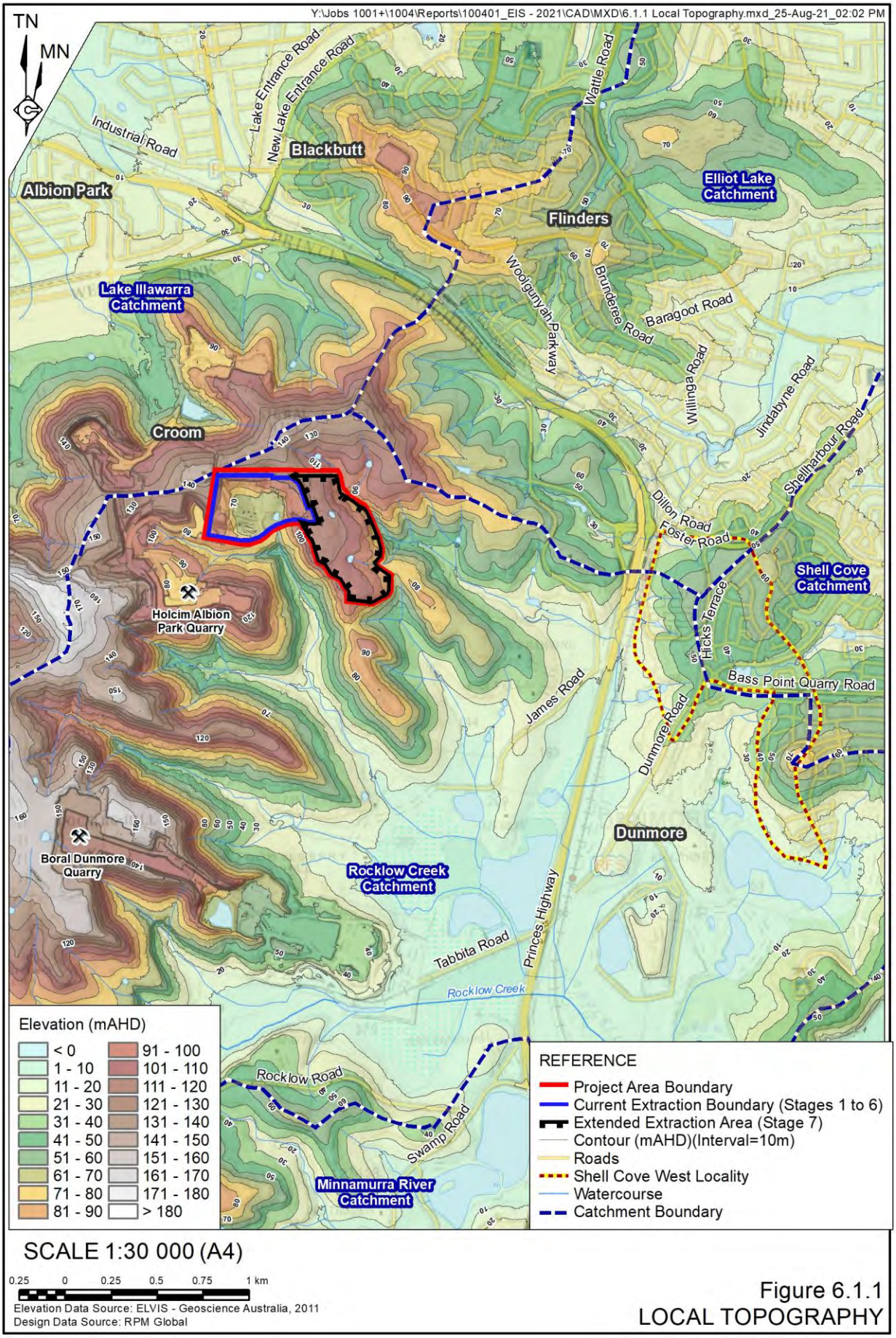
The elevation of the land reduces eastward towards the coast with localised hills north and east of the Princes Highway generally above 30m AHD occupied by the suburbs of Blackbutt, Flinders and Shell Cove. The alignment of the Princes Highway east of the Project Area follows a broad open valley with elevations generally below 10m AHD, which separates the Wentworth Hills to the west and the hills of Shell Cove to the east (**Figure 6.1.1)**.

The Stage 7 extraction area occupies a north-northwest trending ridge within the Wentworth Hills, with elevations ranging from a maximum of approximately 125m AHD at the northern end of the ridge in Stage 7 to a minimum of approximately 65m AHD towards the base of the eastern slope. Modified landforms within the Wentworth Hills are associated with current and previous extraction areas of active quarries (**Figure 6.1.1**).

6.1.3 Climate

6.1.3.1 Introduction

Temperature data is drawn from the Bureau of Meteorology-operated Albion Park (Shellharbour Airport) weather station (Station Number 068241) located approximately 4.5km to the northwest of the Project Area at an elevation of approximately 8m AHD. This station provides continuous meteorological data for the period June 1999 to February 2021.


Y:\Jobs 1001+\1004\Reports\100401_EIS - 2021\CAD\MXD\6.1.1 Local Topography.mxd_25-Aug-21_02:02 PM
TN
MN
Industrial Road
Lake Entrance Road
New Lake Entrance Road
Blackbutt
Albion Park
Waittle Road
Elliot Lake Catchment
Flinders
Lake Illawarra Catchment
Woolgunyah Parkway
Brunderee Road
Baragoot Road
Willinga Road
Jindabyne Road
Shellharbour Road
Croom
Dillon Road
Foster Road
Shell Cove Catchment
Holcim Albion Park Quarry
Hicks Terrace
Bass Point Quarry Road
James Road
Dunmore Road
Dunmore
Boral Dunmore Quarry
Rocklow Creek Catchment
Princes Highway
Tabbita Road
Rocklow Creek
Rocklow Road
Swamp Road
Minnamurra River Catchment
Elevation (mAHD)
< 0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 - 160
161 - 170
171 - 180
> 180
REFERENCE
Project Area Boundary
Current Extraction Boundary (Stages 1 to 6)
Extended Extraction Area (Stage 7)
Contour (mAHD)(Interval=10m)
Roads
Shell Cove West Locality
Watercourse
Catchment Boundary
SCALE 1:30 000 (A4)
0.25 0 0.25 0.5 0.75 1 km
Elevation Data Source: ELVIS - Geoscience Australia, 2011
Design Data Source: RPM Global
Figure 6.1.1
LOCAL TOPOGRAPHY

The best available rainfall data to assist in compiling surface water runoff parameters for the Project Area has been drawn from the Bureau of Meteorology operated station at Albion Park Post Office (Station No. 068000) which has collected rainfall data for over 126 years. Site-specific data for both rainfall and evaporation relied upon in the groundwater assessment was sourced from the Queensland Government's SILO database using the data from Albion Park Post Office and other surrounding stations (see Section 6.10.2.1).

Cleary Bros has maintained a meteorological station within the Project Area since 2005. Data from this station has been used principally for operational reasons with the above longer term data relied upon for the various environmental assessments.

6.1.3.2 Temperature

January is typically the hottest month, with a mean maximum temperature of 27.0ºC and a mean minimum temperature of 17.1°C. The highest recorded temperature of 45.8ºC was in January 2013. July is the coldest month with an average maximum temperature of 17.8ºC and an average minimum temperature of 6.3ºC (**Table 6.1.1**).

Table 6.1.1
Meteorological Data[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature (Bureau of Meteorology Station No 068241 (Albion Park (Shellharbour Airport))													
Mean Maximum (°C)	27	26.4	25.3	23.3	20.7	18.1	17.8	18.8	21.4	23.1	24.2	25.7	22.7
Mean Minimum (°C)	17.1	17.2	15.6	12.2	8.8	7.2	6.3	6.5	8.5	10.9	13.4	15.3	11.6
Highest (°C)	45.8	41	39.6	34.8	28	25	28	28	34.4	38	41.8	43.4	45.8
Highest Year	2013	2000	2018	2018	2007	2004	2017	2015	2017	2004	2020	2019	2013
Rainfall (Bureau of Meteorology Station No 680000 (Albion Park Post Office))													
Mean Monthly Rainfall (mm)[2]	103	121	130	101	92	108	70	67	58	75	83	78	1 084
Mean Monthly Pan Evaporation (mm)[3]	195	155	139	101	75	60	69	96	124	156	171	202	1 541

Note 1: Covering the period June 1999 to February 2021

Note 2: Based on records from 1893 to end of 2019.

Note 3: Based on records from 1970 to end of 2019.

6.1.3.3 Rainfall

Monthly average rainfall at Albion Park Post Office varies between 58mm and 130mm, with rainfall generally spread relatively evenly through the year, with late summer through autumn generally the wettest months and late winter to early spring the driest months. The total average annual rainfall is 1 084mm (**Table 6.1.1**).

6.1.3.4 Evaporation

Average evaporation at the Albion Park Post Office varies from 58mm per month in August to 130mm per month in March, equivalent to 1.9mm per day and 4.2mm per day respectively. The average annual evaporation is 1 541mm per year.

6.1.3.5 Wind

Project-specific meteorological conditions were modelled by Northstar (2022), as described in Section 6.2. The modelling defined 2017 as the most representative year for assessing air quality impacts. **Figure 6.1.2** presents the annual and seasonal wind roses for the Project for 2017, which show a predominant west to southwest component to the wind direction in winter, a southwest component in autumn, a northeast component in summer, and a mix of west and northeast components in spring.

Section 6.3.3.1 provides further information on the occurrence of noise-enhancing daytime winds.

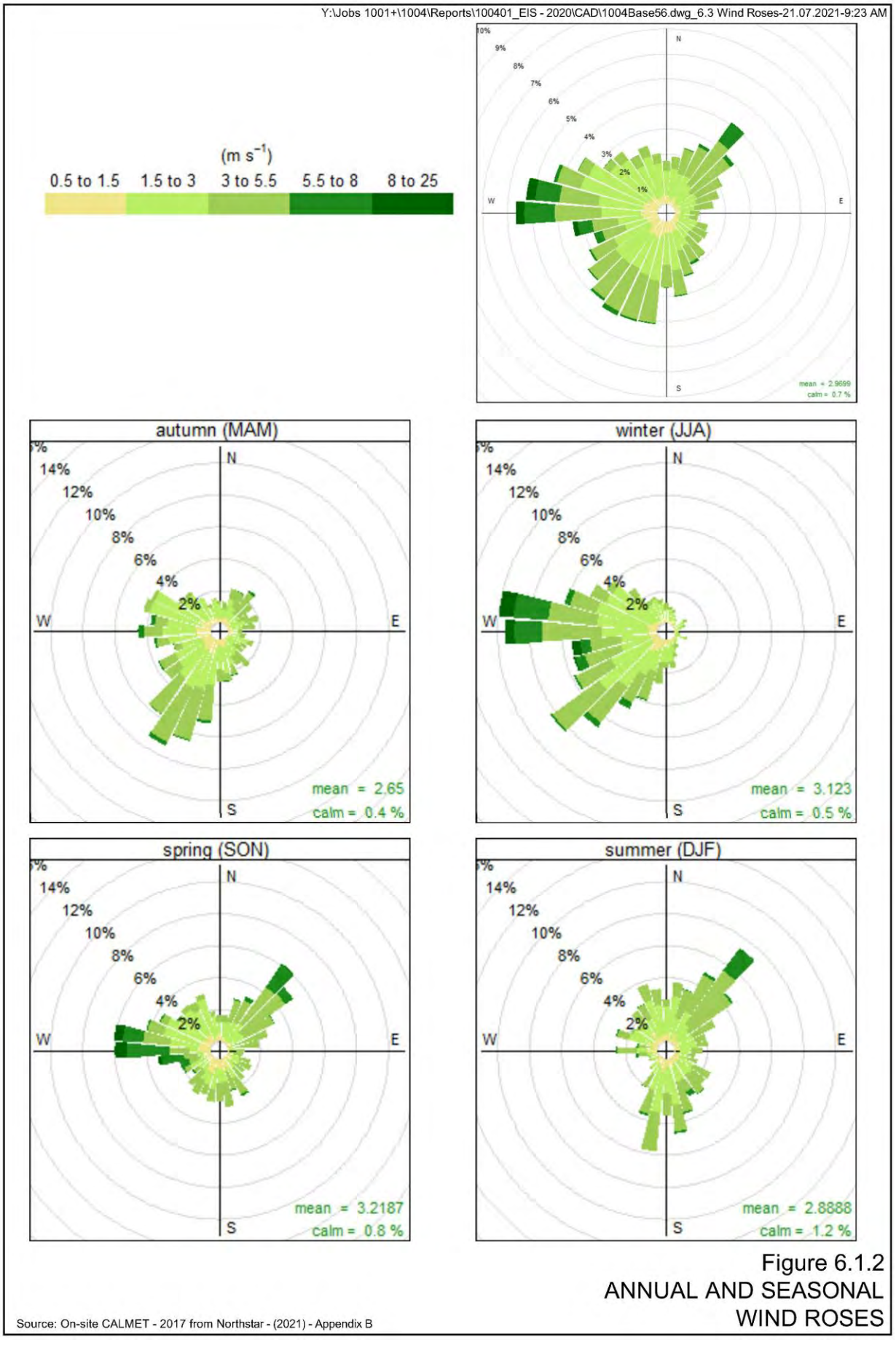


Figure 6.1.2
ANNUAL AND SEASONAL
WIND ROSES

Source: On-site CALMET - 2017 from Northstar - (2021) - Appendix B

6.2 Air Quality

6.2.1 Introduction

The SEARs for the Project require the EIS to include a detailed assessment of potential operational air quality impacts, in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, and with a particular focus on dust emissions including $PM_{2.5}$ and PM_{10} and having regard to the Voluntary Land Acquisition and Mitigation Policy.

The assessment requirements of the Environment Protection Authority (EPA) and Shellharbour City Council were also considered during the preparation of the air quality assessment. A summary of the SEARs and the requirements of the EPA and Shellharbour City Council are listed within **Table A.1** and **Table A.2** within **Appendix A**, together with a record of where each requirement is addressed in the EIS.

The Air Quality Impact Assessment (AQIA) for the Project was undertaken by Northstar Air Quality Pty Ltd (Northstar) and is presented as Part 1 of the *Specialist Consultant Studies Compendium* and hereafter referred to as Northstar (2022). The following subsections provide a summary of the AQIA and describe the operational safeguards and management measures that would be implemented by Cleary Bros. Reference is made, where appropriate, to the current *Air Quality Management Plan* (AQMP) for the current extraction area with all relevant mitigation measures included in the AQMP incorporated within this subsection.

6.2.2 Study Area

The Study Area for the AQIA generally covers the privately-owned residential properties on rural land within approximately 1.1km of the Project Area and to the east and south of the Princes Highway. **Figure 6.2.1** displays the locations of the nearby residences[1] whilst **Table 6.2.1** lists their distance and direction from the closest boundary of the Project Area.

The AQIA considered air quality impacts at residences R1 to R6. Demonstration of compliance with the relevant air quality criteria at these locations is anticipated to confirm compliance at all other locations further from the Project Area (e.g. R7 to R11, Shell Cove West and Greenmeadows Estate). Notwithstanding this, Cleary Bros has negotiated an agreement with the owners of Figtree Hill" (residences R1 to R3) that addresses air quality impacts. Under that agreement, the owners have agreed to accept Project-related impacts to the extent identified in the air quality assessment.

Table 6.2.1
Residences Surrounding the Project Area

Page 1 of 2

[1] The residences listed in **Table 6.2.1** are referred to as "sensitive receivers" in the air quality and noise assessments.

Residence	Details	Distance (m)	Direction
R1	“Figtree Hill” - “The Cottage”	260	Northeast
R2	“Figtree Hill” - "The Hill”	320	Northeast
R3	“Figtree Hill” - Approved Residence	250	East-northeast
R4	“St Ives Farm”	780	East
R5	“Deer Farm”	710	East
R6	“Kurrawong”	790	Southeast

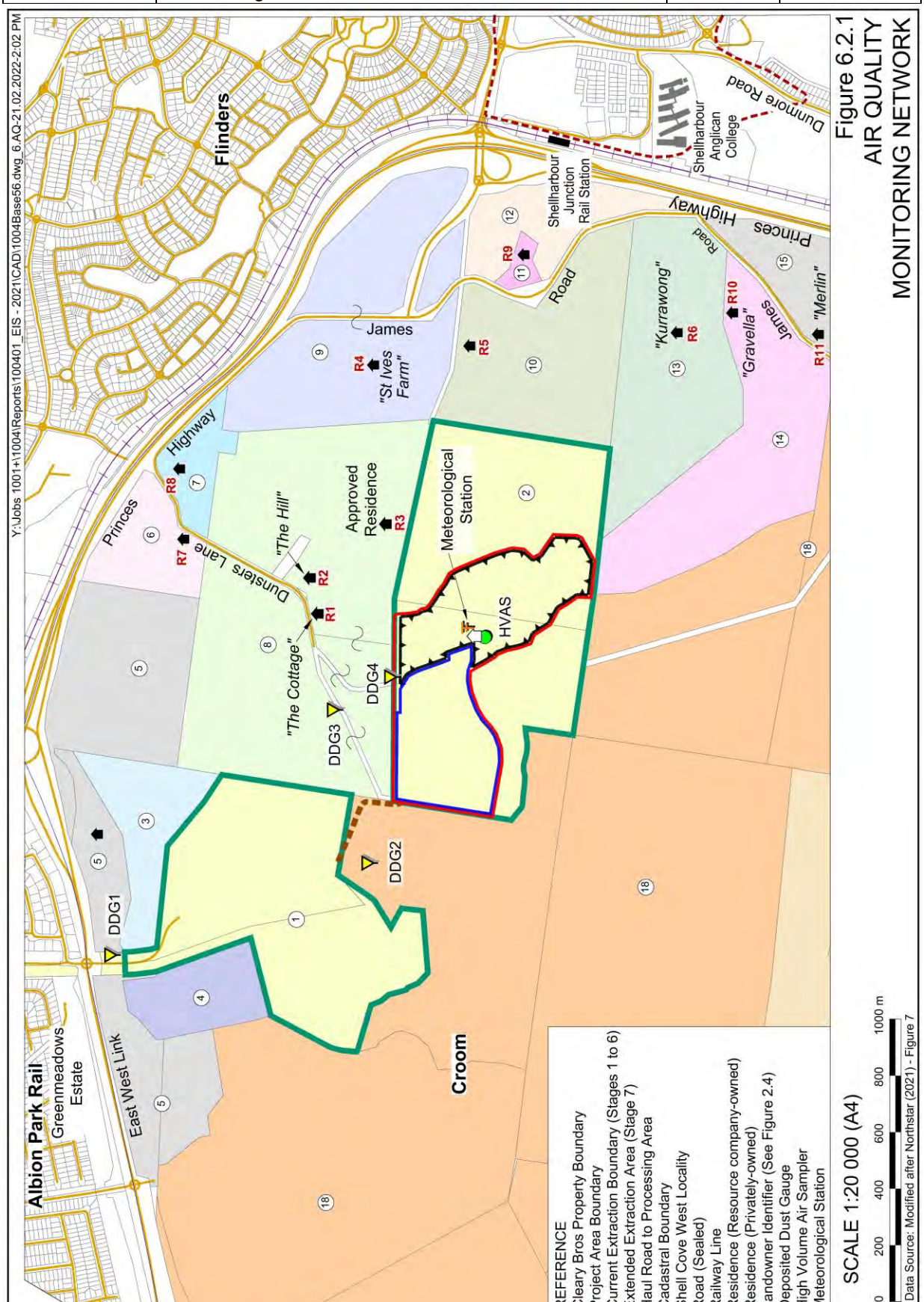


Table 6.2.1 (Cont'd)
Residences Surrounding the Project Area

Residence	Details	Distance (m)	Direction
R7	Rural residential dwelling	770	Northeast
R8	Rural residential dwelling	900	Northeast
R9	Rural residential dwelling	980	East
R10	"Gravella"	950	Southeast
R11	"Merlin"	1 080	Southeast
Shell Cove West	Receiver area covers residential dwellings to the east of Princes Highway (including Shell Cove West, Shellharbour Junction, Flinders)	1 100+	East
Greenmeadows Estate	Receiver area covers residential area to the north of East West Link in Albion Park Rail	1 370+	Northwest
Source: SLR (2022a) – Table 1			

6.2.3 The Existing Environment

6.2.3.1 Meteorological Environment

The meteorology experienced within a given area can influence the generation, dispersion, transport and eventual fate of pollutants in the atmosphere. The meteorological data used for the air quality assessment (Northstar, 2022) utilised data from the Australian Government Bureau of Meteorology-operated Albion Park (Shellharbour Airport) AWS which is located approximately 4.5km northwest of the Project Area. TAPM and CALMET modelling software were used to develop site-specific meteorological conditions. A full description of the modelling exercise, methods and input data used to establish site-specific meteorological conditions is presented as Appendix B of Northstar (2022).

A description of the meteorological data relied upon in this assessment is provided in Section 6.1.2.

6.2.3.2 Air Quality Environment

For compliance monitoring purposes under LEC consent No. 10639 of 2005, and as required under Condition M4 of EPL 299, Cleary Bros operates an air quality monitoring network at the Quarry consisting of:

- one high volume air sampler (HVAS) for periodic (one-day-in-six) measurements of 24-hour PM_{10} concentrations;
- four dust deposition gauges (DDG) for measurements of monthly dust deposition rates; and
- a meteorological monitoring station.

Figure 6.2.1 presents the locations of the air quality and meteorological monitoring equipment at the Quarry.

Table 6.2.2 presents a summary of PM_{10} monitoring results recorded for the period from 2010 to 2019. The number of days in each year that the cumulative 24-hour PM_{10} concentrations were recorded above the 50µg/m^3 incremental criterion value (as specified under LEC consent No. 10639 of 2005) are listed in **Table 6.2.2**. Exceedances were recorded during 5 years, namely 2011, 2015, 2017, 2018 and 2019 however, investigations into the elevated PM_{10} concentrations identified that the incremental impact due to the quarry was below the criterion value on each occasion. The annual average PM_{10} criterion (30µg/m^3) was achieved for all years of monitoring between 2010 and 2019.

Table 6.2.2
PM_{10} Monitoring Data – 2010 to 2019

Parameter	Measured Value									
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Maximum 24-hour PM_{10} (µg/m^3)	32.2	207.0	32.8	44.2	38.3	64.2	44.6	58.1	53.0	82.2
24-hour PM_{10} Measurements >50µg/m^3 (number)	0	1	0	0	0	1	0	4	2	9
Annual Average PM_{10} (µg/m^3)	9.9	13.8	9.3	9.7	12.2	11.6	13.8	20.2	20.5	24.8
Source: Northstar (2022) – modified after Table 8										

Table 6.2.3 presents a summary of dust deposition monitoring data recorded at the four DDGs surrounding the current extraction area between 2009 and 2019. Measurements of dust deposition are generally below NSW EPA annual average criterion (4g/m^2/month), with annual average dust deposition rates recorded at DDG2, DDG3 and DDG4 remaining below 3.1g/m^2/month between 2009 and 2019. Exceedances of the annual average dust deposition criterion have been recorded at DDG1 which is located close to the Quarry access road onto the East West Link Road. These elevated measurements of depositional dust are likely influenced by on-site activities, traffic outside of the Project Area and local construction projects (e.g. works associated with the Albion Park Rail Bypass).

Table 6.2.3
Dust Deposition Monitoring Data – 2009 to 2019

Year	Average Annual Dust Deposition Rate (g/m^2/month)				
	DDG1	**DDG2**	**DDG3**	**DDG4**	**Site Average**
2009	5.2	2.8	2.4	2.8	3.3
2010	2.8	2.7	2.0	1.8	2.3
2011	2.7	2.5	1.6	1.7	2.1
2012	4.4	1.6	1.6	2.2	2.4
2013	4.5	2.8	0.8	1.5	2.4
2014	3.1	2.8	0.9	1.8	2.2
2015	3.0	2.1	1.1	2.2	2.1
2016	3.2	2.3	2.7	1.6	2.4
2017	3.1	3.1	1.0	2.7	2.5
2018	5.0	2.2	1.0	1.4	2.4
2019	9.1	2.4	1.8	2.1	3.6
Source: Northstar (2022) – Table 9					

Based on the dust deposition monitoring results presented in **Table 6.2.3**, Northstar (2022) assumed a background dust deposition rate of 2.5g/m^2/month (expressed as an annual average) for the purposes of the AQIA. Given that this dust deposition rate includes current Quarry operations, adoption of this value is considered to be conservative.

It is noted that the current *Air Quality Management Plan* for the Quarry (Northstar, 2017) and the most recent Annual Review (Cleary Bros, 2020), explain the existing air quality monitoring network would be updated to incorporate real-time PM_{10} measurements which would allow Cleary Bros to adopt an adaptive approach to the management of air emissions.

Given that the HVAS is located close to the current extraction area and not near to a sensitive receptor or residence, and noting that the primary purpose of the air quality monitoring program was the demonstration of compliance with existing air quality criteria for the Quarry, Northstar (2022) do not consider the available historical monitoring data to be sufficient for use as background air quality data for the AQIA. Alternative background air quality data was sourced from the DPE-operated Albion Park South Air Quality Monitoring Station (AQMS) approximately 4km west of the Project Area to represent background conditions.

Northstar (2022) assessed the wind distribution for the period 2013 to 2017 and selected 2017 as being appropriate for further assessment, as it best represents the general trend across the 5-year period studied (see Appendix B of Northstar (2022))**. Table 6.2.4** provides a summary of the background air quality data used by Northstar (2022) to inform the AQIA.

Table 6.2.4
Regional Background Air Quality – Albion Park Air Quality Monitoring Station

Pollutant	Averaging Period	Value	Data Source
PM_{10}	24-hour	Daily varying	Albion Park South AQMS (2017) Maximum measured 24-hour average PM_{10} in 2017: 44.7µg/m^3
	Annual	15.3µg/m^3	Albion Park South AQMS (2017)
$PM_{2.5}$	24-hour	Daily varying	Albion Park South AQMS (2017) Maximum measured $PM_{2.5}$ in 2017: 19.3µg/m^3
	Annual	6.6µg/m^3	Albion Park South AQMS (2017)
TSP	Annual	33.9µg/m^3	Estimated based on TSP:PM_{10} ratio of 2.222:1 for Albion Park South AQMS (2017)
NO_2	1-hour	Hourly varying	Albion Park South AQMS (2017) Maximum measured 1-hour NO_2 in 2017: 77.9µg/m^3
	Annual	6.9µg/m^3	Albion Park South AQMS (2017)
Source: Northstar (2022) – Table 11			

6.2.4 Potential Sources of Air Contaminants

Key emissions to air during the operation of the Project would include the following.

- Particulate emissions from clearing and mulching of vegetation.
- Particulate emissions from the soil stripping, extraction (including drilling and blasting) (including ongoing extraction within Stages 1 to 6 as well as extraction within Stage 7) and in-pit crushing and screening.
- Wheel-generated particulate emissions from the haulage of materials on unpaved surfaces.

- Blasting emissions of particulates and gaseous products of combustion (principally NO_X). Particulates and gaseous products of combustion are typically referred to as "blast fume". In the event of a poorly managed blast, the high concentration of NO_2 can result in a reddish orange plume with a characteristic odour. It is noted that no reddish orange plumes have been generated from within the current extraction area.
- Wind erosion of exposed surfaces.

6.2.5 Criteria for Assessment

Table 6.2.5 presents the air quality criteria relevant to the Project all of which are based on reducing potential impacts to human health and amenity.

Table 6.2.5
Project-specific Air Quality Criteria

Pollutant	Averaging Period	Units	Criterion	Notes
Particulates (as PM_{10})	24 hours	µg/m³	50	Equivalent to the Ambient Air Quality National Environment Protection Measure (AAQ NEPM) standards and goals
	1 year	µg/m³	25	
Particulates (as $PM_{2.5}$)	24 hours	µg/m³	25	
	1 year	µg/m³	8	
Particulates (as Total Suspended Particulates (TSP))	1 year	µg/m³	90	-
Deposited Dust	1 year	g/m²/month	2[1]	Assessed as insoluble solids as defined by AS 3580.10.1
	1 year	g/m²/month	4[2]	
Nitrogen Dioxide	1 hour	µg/m³	246	Equivalent to the AAQ NEPM standards and goals
	1 year	µg/m³	62	
Note 1: Maximum increase in deposited dust level. Note 2: Maximum total deposited dust level.				
Source: Northstar (2022) – Table 3				

6.2.6 Assessment Methodology

6.2.6.1 Dispersion Modelling

A dispersion modelling assessment for the Project was undertaken by Northstar (2022) using the NSW EPA approved CALPUFF atmospheric dispersion modelling system which includes the following key components.

- CALMET – a meteorological model that develops hourly wind and temperature fields on a three-dimensional grid and also includes associated two-dimensional fields (e.g. mixing height, surface characteristics and dispersion properties).
- CALPUFF – a transport and dispersion model that advects "puffs" of material emitted from modelled sources to simulate dispersion and transformation processes.
- CALPOST – a post-processing package used to process CALPUFF files and summarises the results of the simulation.

Northstar (2022) undertook the assessment of potential impacts associated with proposed operations within the Project Area which characterises the likely day-to-day operations, approximating average operational characteristics when producing at the maximum annual production rate (900 000tpa), which are appropriate for assessment against longer term (annual average) criteria for particulate matter. The likely peak activities within the Project Area have also been characterised in order to permit assessment of potential impacts against shorter term (24-hour) criteria for particulate matter. Contrary to previous assessments for the Quarry which have assumed that daily peak emissions are equivalent to the average of annual emission rates, Northstar (2022) has adopted this approach in order to demonstrate compliance with short-term air quality criteria under worst case activity rates and emissions.

6.2.6.2 Emissions Estimation and Controls

Emission factors for materials handling processes, movement of trucks on unpaved site roads, processing and wind erosion have been adopted from those contained within the US EPA AP-42 emission factor compendium (US EPA, 1995). Potential emissions during operations were quantified and an emissions inventory developed for the average operational characteristics and peak operational characteristics for each scenario. A full description of the emission sources, emission factors and assumptions adopted for the AQIA are presented in Appendix D of Northstar (2022).

The AQMP for the Quarry indicates that Quarry operations would be modified to ensure that excessive dust is not experienced at surrounding residences during certain wind conditions. The quantification of emissions for the Project, especially during the 'worst-case' 24-hour scenarios, does not take into account these modifications, and therefore the modelled increments may be viewed as being highly conservative as operational controls implemented through the AQMP would have mitigated emissions and subsequent impacts. **Table 6.2.6** presents a summary of the key emission controls which would continue to be employed as part of the Project in order to reduce the quantity of particulate matter emitted during Project operations, and which have been adopted in the modelling assessment. The emission reductions associated with these emission control methods are outlined in the NPI EETM for Mining (NPI, 2012) and relevant AP-42 documentation (US EPA, 1995). It is noted that the outcomes from the modelling are considered to be highly conservative given the highlighted management and mitigation measures listed in Section 6.2.7 have not been incorporated into the model. This particularly relates to the benefits of:

- the relocation, modification and/or the cessation of specific activities within the Project Area at appropriate times; and/or
- the proposed real-time PM_{10} monitoring network.

A site-specific Best Management Practice (BMP) assessment, based on an annual extraction rate of 900 000tpa, was undertaken for the current extraction area as part of the AQMP (Northstar, 2017). The BMP assessment concluded that the primary source of particulate matter within the current extraction area was associated with material haulage. This conclusion is consistent with the emission inventories prepared by Northstar (2022) for the AQIA. In order to minimise emissions associated with material haulage, Cleary Bros operates a fleet of large capacity haul trucks (CAT 777 and CAT 773) which minimise vehicle kilometres travelled, undertakes watering of haul roads, and undertakes material haulage primarily at sub-ground level.

Table 6.2.6
Adopted Emission Control Methods

Emission Control Method	Control Efficiency (%)
Use of dust filters on drill rigs	99
Application of water on haulage routes (internal) at a rate of >2 L $m^{-2} \cdot hr^{-1}$ subject to the prevailing meteorological conditions	75
Limiting of on-site vehicle speeds to ≤30km/hr	50
Application of water during materials processing	77.7 (primary crushing) 91.2 (screening) 50 (movement of moist material to stockpiles immediately following processing)
Retention of particulate matter in sub-ground level areas (pit retention)	95 (TSP) 5 (PM_{10} and $PM_{2.5}$)
Source: Northstar (2022) – Table 12	

Furthermore, the implementation of the Trigger Action Response Plan (TARP) outlined within the AQMP reduces particulate matter generation during adverse conditions and minimises impacts at surrounding residences. Cleary Bros remains committed to demonstrating the suitability of the real-time monitoring equipment, combined with the TARP, as a tool for measuring particulate matter within the Project Area.

The distribution of controlled and uncontrolled particulate matter emissions under each scenario modelled is presented in Appendix D of Northstar (2022) and further discussion of control measures to be implemented within the Project Area is provided in Section 6.2.7.

6.2.6.3 Modelling Scenarios

Quantitative modelling has been undertaken for the following three stages of the Project.

- Stage 7a – representing potentially significant haulage distances from the central parts of the Stage 7 extraction area.
- Stage 7b – representing potentially significant haulage distances from the southern-most extent of the Stage 7 extraction area, closest to the "Kurrawong" Residence (R6).
- Stage 7d – representing activities in the northeastern-most extent of the Stage 7 extraction area, closest to "The Cottage" (R1), "The Hill" (R2) and the approved residence (R3). Two scenarios are considered within Stage 7d, namely when the primary crushing and screening plant are located closest to the residences on "Figtree Hill" (Scenario 1) and when the plant is operating in the centre of the Stage 7d extraction area (Scenario 2). It is noted that Scenario 1 would occur during the extraction within the Eastern Rim.

6.2.7 Management and Mitigation Measures

Cleary Bros would continue to employ a number of best practice management and mitigation measures on site to ensure that particulate matter impacts and greenhouse gas generation are minimised. These measures would be detailed in an updated Air Quality Management Plan for the Project and include:

- maintaining a real-time PM_{10} monitor at an agreed location within the "Figtree Hill" property as part of the overall real-time monitoring network (with annual calibration)*;
- relocating, modifying and/or halting specific activities within the Project Area at appropriate times*;
- implementing management measures outlined in the AQMP, including the Trigger Action Response Plan;
- maintaining dust filters on the drill rig;
- applying water to haul roads at a rate of >2L/m2/hr[2] subject to the prevailing meteorological conditions;
- use of spray bars with atomiser nozzles mounted over the crusher hopper, product conveyor and discharge points on both crushing and screening plants[3];
- limiting on-site vehicle speeds to ≤ 30km/hr;
- turning off all vehicles and plant when not in use, where practicable*;
- ensuring that all vehicles and plant are regularly serviced (including the optimisation of tyre pressures) to ensure efficient operation*;
- designing truck routes and loading capacities to reduce the haul distance and effort required by vehicles*;
- maintaining roads in good condition to avoid vehicle meandering*; and
- reducing gradients within the Project Area, where feasible*.

The effectiveness of the above measures would be established through a comparison of predicted and monitored air quality. Cleary Bros would endeavour to understand the nexus between on-site particulate matter generation and monitored levels, particularly to avoid any exceedances of the air quality criteria as extraction operations progress.

* The effectiveness of these measures have not been included within the modelling of predicted air quality parameters. Hence the predicted air quality is considered to be conservative.

[2] Based upon the on-site recorded use of water for dust suppression on the existing haul roads and an adjustment for the additional haul road lengths for operations in Stage 7, the maximum annual water usage would be approximately 110.1ML (Stages 7a and 7b), 102.6 (Stage 7c) and 100.0ML (Stage 7d).

[3] Based upon the on-site recorded use of water for the two crushing and screening plants, the annual water usage would be a maximum of 2ML.

6.2.8 Assessment of Impacts

6.2.8.1 Introduction

The results of the dispersion modelling assessment are presented using the following terminology.

- Incremental impact – concentrations predicted as a result of the operation of the Project in isolation.
- Cumulative impact – relates to the incremental concentrations predicted as a result of the operation of the Project plus the regional background air quality concentrations discussed in Section 6.2.3.2.

6.2.8.2 Particulate Matter

Table 6.2.7 presents the predicted annual incremental and cumulative concentrations of total suspended particles (TSP), PM_{10}, $PM_{2.5}$ and deposited dust under the modelled Stage 7a, 7b and 7d scenarios.

In summary, the annual average modelling results indicate the following at all surrounding residences during all stages of the Project operations.

- Incremental and cumulative TSP concentrations would be <5.9% and <44% of the annual average criterion value (90µg/m^3) respectively.
- Incremental and cumulative PM_{10} concentrations would be <19% and <80.2% of the annual average criterion value (25µg/m^3) respectively.
- Incremental and cumulative $PM_{2.5}$ concentrations would be <8.8% and <91.3% of the annual average criterion value (8µg/m^3) respectively.
- Maximum incremental dust deposition would be <5% of the incremental impact criterion value (2g/m^2/month) and maximum cumulative dust deposition would be 65% of the cumulative impact criterion value (4g/m^2/month).

Contour plots displaying the incremental contribution of the Project to 24-hour average PM_{10} and $PM_{2.5}$ during Stage 7d are shown on **Figure 6.2.2** and **Figure 6.2.3** respectively. **Table 6.2.8** and **Table 6.2.9** respectively present the predicted maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the Project. Results are presented for the stage during which the highest concentrations are predicted (Stage 7d-Scenario 1) and for the receptor at which the highest incremental and cumulative impacts have been predicted (R1 for incremental PM_{10}, R3 for cumulative PM_{10}, R2 for incremental $PM_{2.5}$ and R5 for cumulative $PM_{2.5}$).

Table 6.2.7
Predicted Annual Average TSP, PM_{10}, $PM_{2.5}$ and Deposited Dust Concentrations

Receptor	Annual Average Concentration											
	Stage 7a			Stage 7b			Stage 7d-Scenario 1			Stage 7d-Scenario 2		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
Annual Average TSP Concentration (µg/m³)												
R1	2.2	33.9	36.1	2.4	33.9	36.3	5.3	33.9	39.2	5.0	33.9	38.9
R2	1.8	33.9	35.7	2.0	33.9	35.9	4.1	33.9	38.0	4.0	33.9	37.9
R3	1.6	33.9	35.5	2.2	33.9	36.1	4.3	33.9	38.2	4.3	33.9	38.2
R4	0.2	33.9	34.1	0.5	33.9	34.4	0.5	33.9	34.4	0.5	33.9	34.4
R5	0.4	33.9	34.3	0.7	33.9	34.6	0.9	33.9	34.8	0.9	33.9	34.8
R6	0.1	33.9	34.0	0.3	33.9	34.2	0.3	33.9	34.2	0.3	33.9	34.2
Criterion	-	90		-	90		-	90		-	90	
Annual Average PM_{10} Concentration (µg/m³)												
R1	1.9	15.3	17.2	2.0	15.3	17.3	4.7	15.3	20.0	4.4	15.3	19.7
R2	1.5	15.3	16.8	1.7	15.3	17.0	3.7	15.3	19.0	3.6	15.3	18.9
R3	1.4	15.3	16.7	1.9	15.3	17.2	3.9	15.3	19.2	3.9	15.3	19.2
R4	0.2	15.3	15.5	0.3	15.3	15.6	0.5	15.3	15.8	0.4	15.3	15.7
R5	0.3	15.3	15.6	0.5	15.3	15.9	0.8	15.3	16.1	0.8	15.3	16.1
R6	0.1	15.3	15.4	0.2	15.3	15.5	0.3	15.3	15.6	0.3	15.3	15.6
Criterion	-	25		-	25		-	25		-	25	
Annual Average $PM_{2.5}$ Concentration (µg/m³)												
R1	0.3	6.6	6.9	0.3	6.6	6.9	0.7	6.6	7.3	0.3	6.6	6.9
R2	0.2	6.6	6.8	0.3	6.6	6.9	0.6	6.6	7.2	0.2	6.6	6.8
R3	0.2	6.6	6.8	0.3	6.6	6.9	0.6	6.6	7.2	0.2	6.6	6.8
R4	<0.1	6.6	6.7	<0.1	6.6	6.7	<0.1	6.6	6.7	<0.1	6.6	6.7
R5	<0.1	6.6	6.7	<0.1	6.6	6.7	0.1	6.6	6.7	<0.1	6.6	6.7
R6	<0.1	6.6	6.7	<0.1	6.6	6.7	<0.1	6.6	6.7	<0.1	6.6	6.7
Criterion	-	8		-	8		-	8		-	8	
Annual Average Dust Deposition (g/m²/month)												
R1	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6
R2	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6
R3	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6
R4	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6
R5	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6
R6	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6	<0.1	2.5	2.6
Criterion	2	-	4	2	-	4	2	-	4	2	-	4

Source: Northstar (2022) – modified after Tables 18, 19, 20 and 21

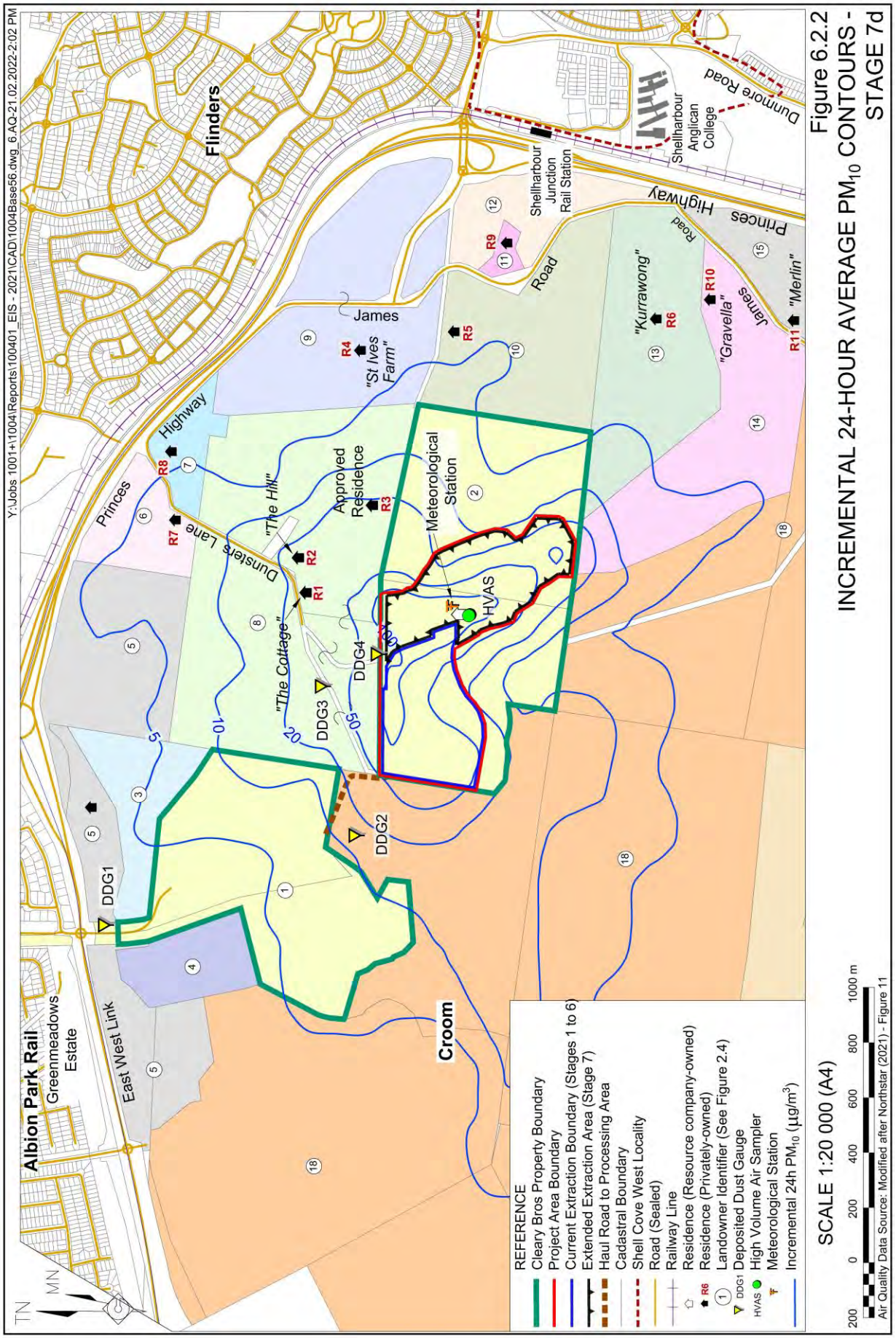


Figure 6.2.2
INCREMENTAL 24-HOUR AVERAGE PM10 CONTOURS - STAGE 7d
SCALE 1:20 000 (A4)
200 0 200 400 600 800 1000 m
Air Quality Data Source: Modified after Northstar (2021) - Figure 11
REFERENCE
Cleary Bros Property Boundary
Project Area Boundary
Current Extraction Boundary (Stages 1 to 6)
Extended Extraction Area (Stage 7)
Haul Road to Processing Area
Cadastral Boundary
Shell Cove West Locality
Road (Sealed)
Railway Line
Residence (Resource company-owned)
Residence (Privately-owned)
Landowner Identifier (See Figure 2.4)
Deposited Dust Gauge
High Volume Air Sampler
Meteorological Station
Incremental 24h PM10 (µg/m3)
Albion Park Rail
Greenmeadows Estate
East West Link
Flinders
Croom
James
Princes Highway
Dunsters Lane
"The Hill"
"The Cottage"
"St Ives Farm"
Approved Residence
Meteorological Station
HVAS
DDG1
DDG2
DDG3
DDG4
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
"Kurrawong"
"Gravella"
"Merlin"
Shellharbour Junction Rail Station
Shellharbour Anglican College
Dunmore Road
Princes Highway
James
5
10
20
50
100
TN
MN

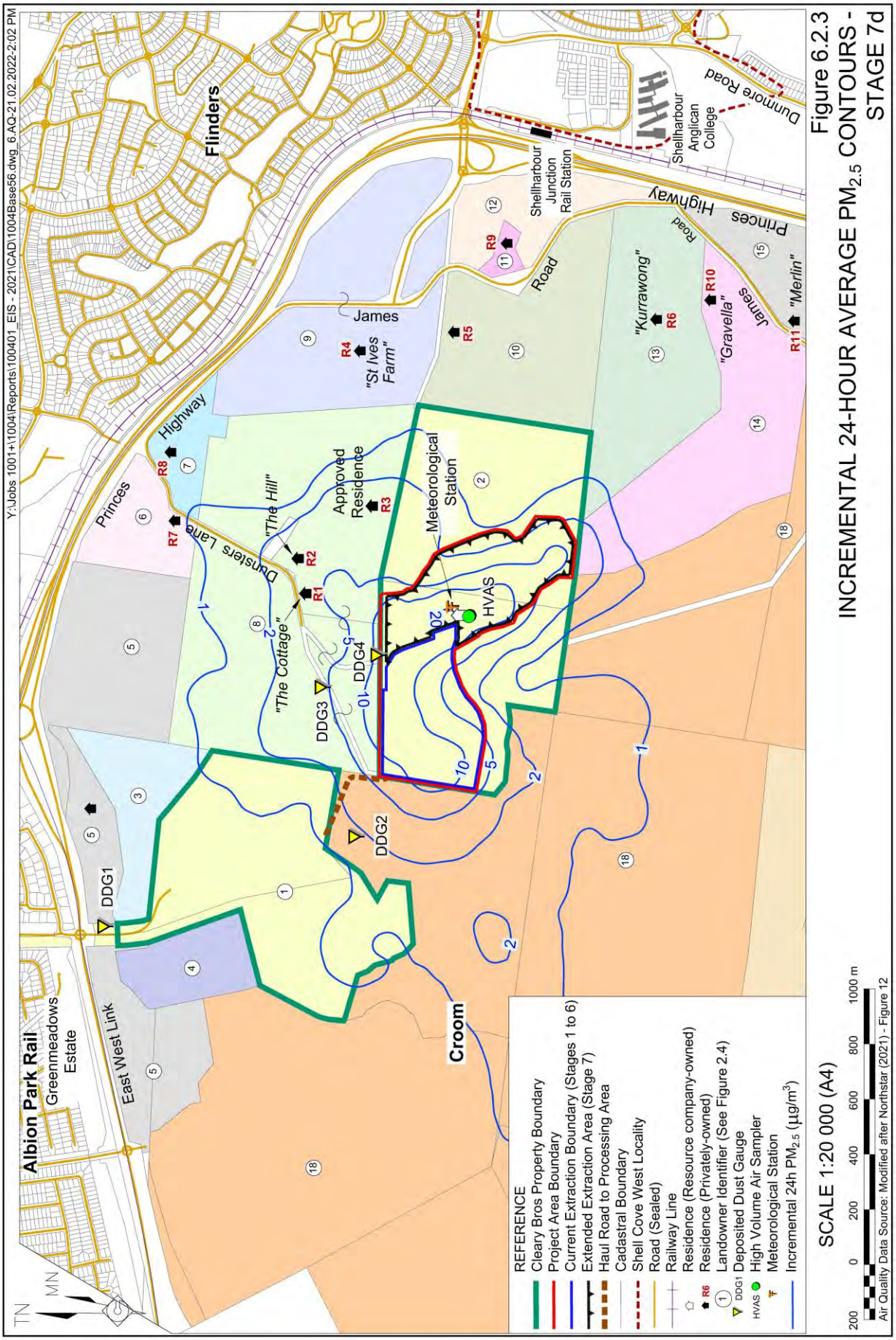


Figure 6.2.3
INCREMENTAL 24-HOUR AVERAGE PM2.5 CONTOURS - STAGE 7d
SCALE 1:20 000 (A4)
200 0 200 400 600 800 1000 m
Air Quality Data Source: Modified after Northstar (2021) - Figure 12
REFERENCE
Cleary Bros Property Boundary
Project Area Boundary
Current Extraction Boundary (Stages 1 to 6)
Extended Extraction Area (Stage 7)
Haul Road to Processing Area
Cadastral Boundary
Shell Cove West Locality
Road (Sealed)
Railway Line
Residence (Resource company-owned)
Residence (Privately-owned)
Landowner Identifier (See Figure 2.4)
Deposited Dust Gauge
High Volume Air Sampler
Meteorological Station
Incremental 24h PM2.5 (µg/m3)
Albion Park Rail
Greenmeadows Estate
East West Link
Flinders
Croom
Princes Highway
Dunsters Lane
"The Hill"
"The Cottage"
Approved Residence
Meteorological Station
HVAS
DDG1
DDG2
DDG3
DDG4
"St Ives Farm"
James
"Kurrawong"
"Gravella"
"Merlin"
James Road
Shellharbour Junction Rail Station
Shellharbour Anglican College
Dunmore Road
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
TN
MN
Y:\Jobs 1001+\1004\Reports\100401_EIS - 2021\CAD\1004Base56.dwg_6.AQ-21.02.2022-2:02 PM

Table 6.2.8
Predicted Maximum 24-hour Average PM_{10} Concentrations – Stage 7d-Scenario 1

Date	24-hour Average PM_{10} Concentration ($\mu g/m^3$) Residence R3			Date	24-hour Average PM_{10} Concentration ($\mu g/m^3$) Residence R1		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
15/01/2017	22.6	24.9	47.5	19/06/2017	33.4	10.4	43.8
14/12/2017	<0.1	44.6	44.7	9/03/2017	28.2	16.3	44.5
19/12/2017	0.7	43.4	44.1	10/06/2017	28.1	11.6	39.7
24/09/2017	2.0	40.6	42.6	21/05/2017	26.3	10.5	36.8
23/01/2017	<0.1	41.7	41.8	17/06/2017	25.3	14.3	39.6
13/01/2017	2.3	35.6	37.9	16/04/2017	25.1	15.6	40.7
25/01/2017	2.8	33.9	36.7	12/06/2017	24.9	9.1	34.0
11/05/2017	12.8	23.7	36.5	2/04/2017	24.8	14.7	39.5
17/01/2017	<0.1	36.4	36.5	13/06/2017	22.9	10.4	33.3
1/12/2017	<0.1	36.3	36.4	16/06/2017	21.4	10.5	31.9
Criterion	-	50		Criterion	-	50	

Cells shaded red represent the highest cumulative impact 24-hour PM_{10} predictions as a result of the Project.
Cells shaded blue represent the highest incremental impact 24-hour PM_{10} predictions as a result of the Project.

Source: Northstar (2022) – modified after Table 23

Table 6.2.9
Predicted Maximum 24-hour Average $PM_{2.5}$ Concentrations – Stage 7d-Scenario 1

Date	24-hour Average $PM_{2.5}$ Concentration ($\mu g/m^3$) Residence R5			Date	24-hour Average $PM_{2.5}$ Concentration ($\mu g/m^3$) Residence R2		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
19/12/2017	0.1	19.3	19.4	13/06/2017	4.7	5.5	10.2
12/05/2017	<0.1	16.6	16.7	1/07/2017	3.1	7.8	10.9
11/05/2017	0.2	15.8	16.0	15/01/2017	3.1	9.8	12.9
14/12/2017	<0.1	15.2	15.3	1/08/2017	2.9	5.1	8.0
23/09/2017	<0.1	14.4	14.5	8/06/2017	2.8	5.7	8.5
12/02/2017	0.2	14.1	14.3	16/06/2017	2.7	8.8	11.5
13/01/2017	0.1	14.0	14.1	17/06/2017	2.6	10.9	13.5
11/02/2017	<0.1	14.1	14.2	4/06/2017	2.3	5.7	8.0
3/09/2017	0.2	13.8	14.0	24/03/2017	2.3	5.3	7.6
17/01/2017	<0.1	13.0	13.1	26/01/2017	2.1	6.9	9.0
Criterion	-	25		Criterion	-	25	

Cells shaded red represent the highest cumulative impact 24-hour $PM_{2.5}$ predictions as a result of the Project.
Cells shaded blue represent the highest incremental impact 24-hour $PM_{2.5}$ predictions as a result of the Project.

Source: Northstar (2022) – modified after Table 24

In summary, the modelling indicates that the Project can be operated without any exceedances of the criterion values for 24-hour average PM_{10} (50µg/m^3) and $PM_{2.5}$ (25µg/m^3); annual average PM_{10} (25µg/m^3) and $PM_{2.5}$ (8µg/m^3); total suspended particulates (90µg/m^3); and deposited dust (2g/m^2/month). Northstar (2022) confirmed that given Stages 1 to 6 are located west of Stage 7 and the predicted air quality is acceptable when operations are underway in Stage 7, predicted particulate levels at all residences north and east of the Project Area would be less than those predicted for Stage 7 operations.

Northstar (2022) noted that air quality impacts at Shellharbour Anglican College and the residences east of the Princes Highway would also be acceptable given all air quality criteria would be satisfied at the assessed locations west of the highway.

6.2.8.3 Nitrogen Dioxide

Table 6.2.10 presents the predicted annual average and maximum 1-hour NO_2 concentrations resulting from blasting operations during Stage 7d-Scenario 1 when blasting would occur in closest proximity to residences. In summary, the results indicate that predicted NO_2 concentrations would be within the relevant annual criterion (62µg/m^3) and maximum 1-hour criterion (246µg/m^3) criterion values at all surrounding residences during Stage 7d.

Table 6.2.10
Predicted Annual Average and Maximum 1-hour NO_2 Concentrations – Stage 7d-Scenario 1

Receptor	Annual Average NO_2 Concentration (µg/m^3)			Maximum 1-hour NO_2 Concentration (µg/m^3)		
	Stage 7d			Stage 7d		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
R1	1.3	6.9	8.2	80.8	0.0	80.8
R2	1.0	6.9	7.9	74.7	3.2	77.9
R3	0.4	6.9	7.2	72.0	5.9	77.9
R4	0.2	6.9	7.0	30.3	47.6	77.9
R5	0.1	6.9	7.0	24.0	53.9	77.9
R6	<0.1	6.9	<7.0	12.6	65.3	77.9
Criterion	-	62		-	246	

Source: Northstar (2022) – Table 27

6.2.8.4 Cumulative Impact

Northstar (2022) established that the existing air quality data used in the assessment for the Project incorporates emissions from the three other quarries in the Dunmore/Bass Point/Albion Park area. Hence, the cumulative impact of all quarrying activities meets the criterion levels outlined in Section 6.2.5.

6.2.8.5 Voluntary Land Acquisition and Mitigation Policy Criteria Assessment

The NSW Voluntary Land Acquisition and Mitigation Policy (VLAMP) for State Significant Mining Petroleum and Extractive Industry Developments lists air quality criteria at which voluntary mitigation or acquisition rights should be considered to mitigate the residual impacts associated with a development once all reasonable and feasible avoidance measures have been incorporated into the project design.

The AQIA (Northstar, 2022) identified that none of the relevant air quality criteria would be exceeded and as such the VLAMP considerations in relation to air quality do not apply for the Project.

6.2.9 Greenhouse Gas Assessment

The geographical boundary established for the greenhouse gas assessment covers the Project Area and also includes the transportation of products from the Quarry. All Scope 1 and Scope 3 emissions within the defined boundary were identified and reported as far as possible. It is noted that electricity consumption, representing a Scope 2 emission, is not likely to represent a significant contribution to the total energy consumed as part of the Project and has therefore not been assessed further.

Table 6.2.11 presents the annual greenhouse gas emissions predicted to occur as a result of the Project based on anticipated activities and emission factors sourced from the National Greenhouse Accounts Factors Workbook (DISER, 2020). In summary, it is anticipated that the Project would result in 7 712.2t CO_2-equivalent (CO_2-e) per year of Scope 1 emissions and 396.2t CO_2-e per year of Scope 3 emissions.

Table 6.2.11
Annual Project Greenhouse Gas Emissions

Scope		Activity Rate	Units	Energy Content	Units	Emission Factor		CO_2 (t/yr)
1	Diesel fuel in plant and machinery on site	997.5	kL/year	38.6	GJ/kL	70.4	Kg CO_2-e/GJ	2 914.6
	Product transportation	1 768.8						4 806.6
Scope 1 (subtotal)								**7 712.2**
3	Diesel fuel in plant and machinery on site	997.5	kL/year	38.6	GJ/kL	3.6	Kg CO_2-e/GJ	149.0
	Product transportation	1 768.8						245.8
	Employee travel	12.4		34.2				1.4
Scope 3 (subtotal)								**396.2**
Source: Northstar (2022) –Table 29								

Table 6.2.12 provides a comparison of the Scope 1 greenhouse gas emissions that would be generated by the Project against total greenhouse gas emissions for NSW and Australia. In summary, the Project would contribute less than 0.0059% of total NSW greenhouse gas emissions and less than 0.00014% of total Australian greenhouse gas emissions based on 2018 emissions data.

Table 6.2.12
Project, NSW and Australian Greenhouse Gas Emissions

Project Phase	Project Emissions (tCO_2/year)	NSW (2018)	Australia (2018)
		Total (tCO_2)	
		131 685 000	537 447 000
		Project Emissions as a Proportion of Total Emissions	
Operations	7 712.2	Project: <0.0059%	Project: <0.00014%
Source: Northstar (2022) –Table 30			

6.2.10 Monitoring

The current program of air quality monitoring, undertaken in accordance with the Quarry's AQMP, would be continued together with the real-time air quality monitoring outlined in the AQMP.

Following the activation of Stage 7, the HVAS and meteorological monitoring station at the Quarry would need to be relocated. The updated locations of the HVAS, real-time monitors and meteorological station would be detailed in the AQMP. Following the successful implementation of the real-time monitoring system, the HVAS would be decommissioned as described in the AQMP.

6.2.11 Conclusion

The AQIA has assessed the potential incremental contribution of the Project as well as the cumulative impacts of the Project with other relevant sources and regional background conditions.

The results of the AQIA indicate the following.

- Based on the maximum material extraction, handling and haulage rates associated with the Project, all annual average particulate matter criteria are predicted to be achieved at all surrounding residences.
- Based on the maximum (i.e. worst case) daily (24-hour) material extraction, handling and haulage rates, and not accounting for existing management actions outlined under the Quarry's AQMP, no additional exceedances of the maximum 24-hour average PM_{10} or $PM_{2.5}$ criterion are predicted to occur.
- No exceedances of the 1-hour or annual average NO_2 concentrations are predicted at any surrounding residences.
- The greenhouse gas assessment concluded that the annual Scope 1 greenhouse gas emissions generated by the Project would represent <0.0059% and <0.00014% of total NSW and Australian greenhouse gas emissions respectively.

6.3 Noise and Blasting

6.3.1 Introduction

The SEARs for the Project require the EIS to include an assessment of the following potential impacts of the Project on noise and blasting.

- A detailed assessment of the likely operational noise impacts of the development.
- An assessment off- site transport noise impacts in accordance with the NSW Road Noise Policy.
- Proposed blasting hours, frequency and methods.[4]
- A detailed assessment of the likely blasting impacts of the development (including ground vibrations, airblast overpressure, fly-rock, visual and fumes/odour) on people, animals, buildings/structures, infrastructure and significant natural features.

The assessment requirements of the Environment Protection Authority (EPA) and Shellharbour City Council were also considered during the preparation of the noise and blasting assessment. A summary of the SEARs and the requirements of the EPA and Shellharbour City Council are listed within **Table A.1** and **Table A.2** within **Appendix A,** together with a record of where each requirement is addressed in the EIS.

A Noise and Blasting Assessment for the Project was undertaken by SLR Consulting Australia Pty Ltd (SLR) and is presented as Part 2a of the *Specialist Consultant Studies Compendium* and hereafter referred to as SLR (2022a). A subsequent assessment of the effect of not constructing the northern amenity barrier was also prepared by SLR, with that report presented as Part 2b of the *Specialist Consultant Studies Compendium* and hereafter referred to as SLR (2022b).

The Road Traffic Noise Assessment for the Project was undertaken by RW Corkery & Co Pty Limited, with extensive reliance placed upon the EIS prepared for the recently completed Albion Park Rail Bypass (Hyder and Cardno, 2015a) and supporting documentation, including the *Noise and Vibration Assessment* (Renzo Tonin, 2015).[5]

The following subsections provide a summary of the Noise and Blasting Assessment and describe the operational safeguards and management measures that would be implemented by Cleary Bros. Reference is made, where appropriate, to the current *Noise and Blast Management Plan* (NBMP) for the current extraction area with all relevant mitigation measures for the extended operations included in the NBMP incorporated within this subsection.

[4] Details of the proposed blasting hours are presented in Section 3.8 with information on the frequency and methods of blasting presented in Section 3.6.2.1.
[5] Documentation related to the Albion Park Rail Bypass, including Hyder and Cardno (2015a) and Renzo Tonin, (2015) is available at https://www.planningportal.nsw.gov.au/major-projects/projects/albion-park-rail-bypass.

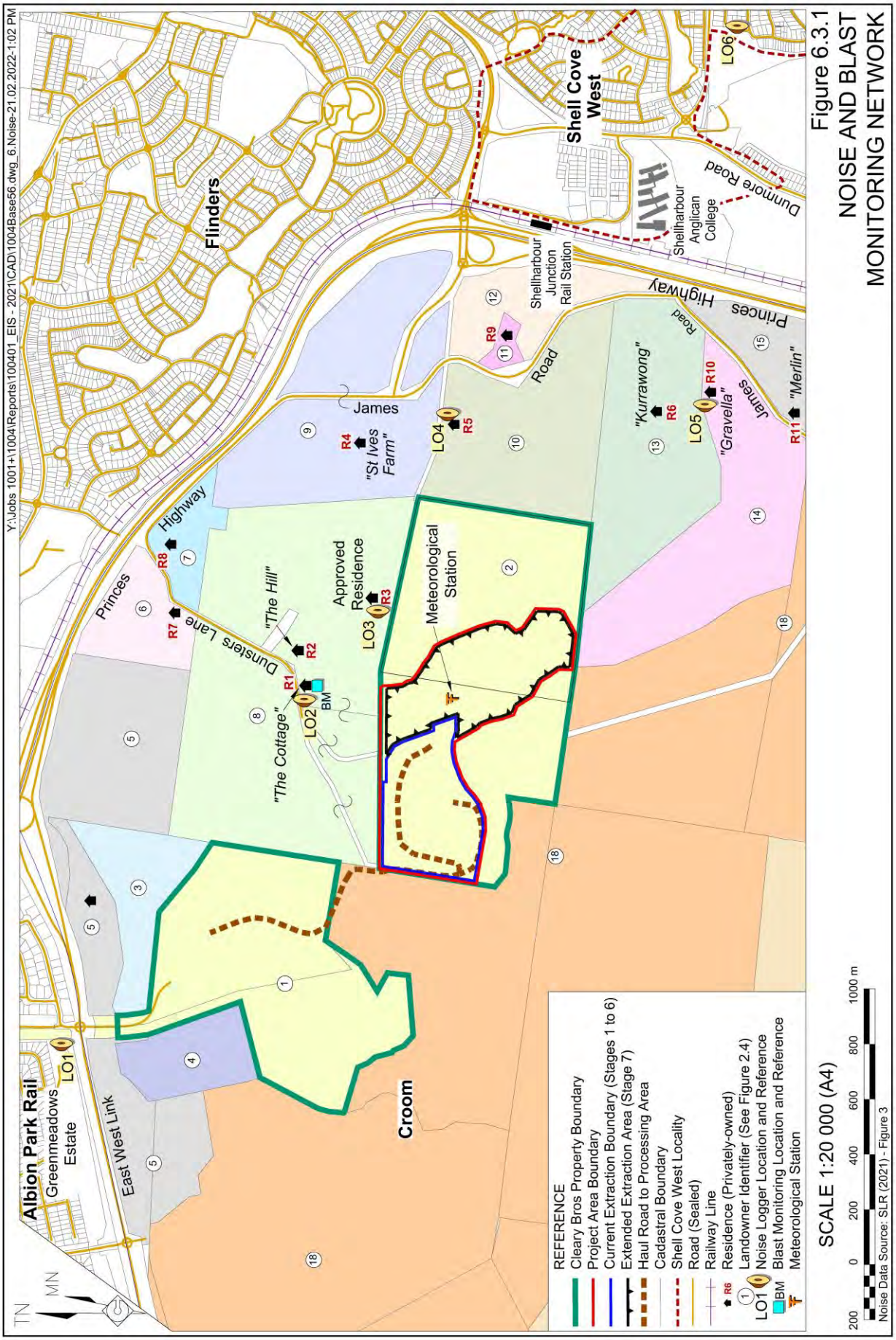


Figure 6.3.1
NOISE AND BLAST MONITORING NETWORK
Y:\Jobs 1001+\1004\Reports\100401_EIS - 2021\CAD\1004Base56.dwg_6.Noise-21.02.2022-1:02 PM
Albion Park Rail
Greenmeadows Estate
East West Link
Flinders
Shell Cove West
Shellharbour Anglican College
Dunmore Road
Shellharbour Junction Rail Station
Princes Highway
James Road
"St Ives Farm"
"Kurrawong"
"Gravella"
"Merlin"
"The Hill"
"The Cottage"
Approved Residence
Meteorological Station
Dunsters Lane
Croom
LO1
LO2
LO3
LO4
LO5
LO6
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
BM
REFERENCE
Cleary Bros Property Boundary
Project Area Boundary
Current Extraction Boundary (Stages 1 to 6)
Extended Extraction Area (Stage 7)
Haul Road to Processing Area
Cadastral Boundary
Shell Cove West Locality
Road (Sealed)
Railway Line
Residence (Privately-owned)
Landowner Identifier (See Figure 2.4)
Noise Logger Location and Reference
Blast Monitoring Location and Reference
Meteorological Station
SCALE 1:20 000 (A4)
200 0 200 400 600 800 1000 m
Noise Data Source: SLR (2021) - Figure 3
TN
MN

6.3.2 Study Area

The Study Area for the Noise and Blasting Assessment covers the privately-owned residential properties on rural land to the west and south of the Princes Highway within approximately 1.1km of the Project Area and two suburban localities at Shell Cove West, east of the Princes Highway and at the Greenmeadows Estate, north of the East-West Link in Albion Park Rail. The locations of the surrounding residences considered in the Noise and Blasting Assessment and background monitoring locations are displayed on **Figure 6.3.1**.

6.3.3 Existing Environment

6.3.3.1 Meteorology

Weather conditions can either increase or decrease noise levels by focusing noise towards or away from receivers. At times, wind blowing through vegetation can increase natural noise to levels well above normal background noise levels.

Noise-enhancing weather conditions can occur when light wind blows from the source to a receiver, or when temperature inversions occur (SLR, 2022a). The *Noise Policy for Industry* (NPfI) states that noise-enhancing weather conditions are to be assessed when they are anticipated to occur for 30% or more of the period of assessment (day, evening, or night) in any season.

The NPfI defines the following standard and noise-enhancing weather conditions.

- Standard:
  - All time periods: stability categories A to D with wind speeds up to 0.5m/s.
- Noise-enhancing:
  - Daytime/evening/night-time: stability categories A to D with wind speeds up to 3m/s.
  - Night time: stability category F with wind speeds up to 2m/s.

SLR determined the occurrence of noise-enhancing weather conditions by analysing meteorological data from the Bureau of Meteorology Station No. 068241 (Albion Park (Shellharbour Airport)) with the EPA Noise enhancing wind analysis program (NEWA). Results of the NEWA determined that noise-enhancing winds (0.5m/s to 3m/s) are not a significant feature (>30% occurrence) of the Project Area during the daytime period when extraction operations are intended to continue to occur, as shown in **Table 6.3.1**. No extraction or processing activities would be undertaken during the evening or night-time periods.

Table 6.3.1
Occurrence of Noise Enhancing Daytime Winds

Wind Direction	Occurrence of Noise-Enhancing Winds (0.5m/s to 3m/s) Winds Blowing From (%)							
	North	North East	East	South East	South	South West	West	North West
Summer	4.2	6.9	7.9	5.3	3.7	4.1	4	3.4
Autumn	6.9	8.9	10.3	7.1	6.8	10.3	9.5	6.2
Winter	5.8	7.9	8.1	5.5	6	11.7	12.1	6.9
Spring	4.5	6.3	7	4.4	3.2	4.2	3.9	3.4
Source: SLR (2022a) – Table 6								

Cleary Bros maintains an Automatic Weather Station (AWS) within the Project Area approximately 50m east of Stage 6 (**Figure 6.3.1**). The AWS continuously records a range of meteorological parameters, including wind speed and direction, rainfall, temperature, humidity, sigma-theta and solar radiation. This data is used by Cleary Bros to assist with the planning and timing of operational activities such as blasting.

6.3.3.2 Acoustic Environment

Ambient noise levels at the surrounding residences are dominated by noise from road traffic from the Princes Highway and East West Link. The Albion Park Rail Bypass opened in 2021 and is oriented parallel to the East West Link past Greenmeadows Estate and the Albion Park Quarry entrance.

In order to quantify the existing acoustic environment and establish noise criteria for this assessment, SLR deployed unattended noise loggers at the six locations displayed on **Figure 6.3.1** for periods of 12 to 14 days. The monitoring equipment was positioned to measure existing noise levels that are representative of residences that could potentially be affected by the Project, within constraints such as accessibility, security and landowner permission. **Table 6.3.2** presents the results of the unattended ambient noise monitoring.

Table 6.3.2
Unattended Ambient Noise Monitoring

Location	Logger	Measured Noise Levels dB(A)					
		Background Noise (RBL)			Average Noise (L_{Aeq})		
		Day[3]	Evening[4]	Night[5]	Day[3]	Evening[4]	Night[5]
R1	L02	36	35	28	48	43	44
R3	L03	36	34	27	49	46	46
R5	L04	45	40	30	52	49	47
R9	L05	48	44	34	56	53	51
SCW[1]	L06	37	38	33	49	46	47
GME[2]	L01	40	36	30	51	47	43
Note 1: SCW = Shell Cove West Note 2: GME = Greenmeadows Estate Note 3: 7:00am to 6:00pm Monday – Saturday and 8:00am to 6:00pm Sunday and public holidays Note 4: 6:00pm to 10:00pm Monday – Sunday Note 5: 10:00pm to 7:00am Monday – Sunday and 10:00pm to 8:00am Sunday and public holidays							
Source: SLR (2022a) – modified after Table 3							

Short term attended noise monitoring was also undertaken at each of the monitoring locations to assist in identifying the contributions of the various noise sources at each location. The detailed

observations of the attended noise monitoring are provided in Appendix B of SLR (2022a). A summary of observations for the periods of measurement is provided as follows.

- "Figtree Hill" "The Cottage" R1 – background noise was primarily road traffic noise from the Princes Highway and the East West Link. Birds, livestock, aircraft and wind noise in vegetation also contributed to the measured noise level. Mobile equipment operating within the current extraction area was intermittently audible at this location.
- "Figtree Hill" "Approved Residence" R3– background noise was primarily road traffic noise from the Princes Highway. Birds, livestock and wind noise in vegetation also contributed to the measured noise level. Mobile equipment operating within the current extraction area was intermittently audible at this location.
- "Deer Farm" R5 – background noise was primarily road traffic noise from the Princes Highway. Birds, livestock and wind noise in vegetation also contributed to the measured noise level. Activities within the Quarry were not audible at this location.
- Residence R9 – background noise was primarily road traffic noise from the Princes Highway. Birds, livestock and wind noise in vegetation also contributed to the measured noise level. Activities within the Quarry were not audible at this location.
- Shell Cove West - background noise was primarily road traffic noise from Princes Highway, with lesser contributions from road traffic on Dunmore Road and Bass Point Quarry Road and residential noise. Activities within the Quarry were not audible at this location.
- Greenmeadows Estate – background noise was a combination of road traffic noise from the East West Link and equipment noise from the Albion Park Rail Bypass construction. Birds, aircraft and a helicopter also contributed to the measured noise level. Activities within the Quarry were not audible at this location.

6.3.4 Assessment Criteria and Limits

6.3.4.1 Operational Noise Criteria

The NPfI sets out the procedure to determine the noise assessment criteria which are relevant to a particular development such as the Project. If it is predicted that any development is likely to cause the noise assessment criteria to be exceeded at existing or approved residences, feasible and reasonable noise management measures would be required to be considered to reduce the predicted noise level of the Project to a level below the relevant noise assessment criteria.

The following subsection describes the criteria identified under the NPfI and applicable to the noise assessment for the Project. Further detail on the criteria is provided in Section 5 of SLR (2022a).

The Project Noise Trigger Level (PNTL) provides a benchmark or objective for assessing the potential noise-related impacts associated with the Project. The PNTL is developed using two criteria.

- Intrusiveness Criterion: this criterion limits the degree of change that a new noise source introduces to the existing environment. The NPfI considers the intrusiveness of an industrial noise source to be acceptable if the noise generated by the new noise source does not exceed the rating background noise level (RBL) by 5dB(A).
- Amenity Criterion: this criterion limits continuing increases in noise levels from the application of the intrusiveness criterion in isolation (i.e. the combined industrial noise sources should remain below the recommended amenity noise level for a noise amenity area), as nominated by the NPfI.

The residences surrounding the Project Area (see **Figure 6.3.1**) are classified as either rural (residences R1 to R11) or suburban (Shell Cove West and Greenmeadows Estate) in accordance with the NPfI.

The PNTL is derived from the lower (that is, the more stringent) value of the intrusive noise level and the amenity noise level. The PNTLs are identified in **bold** in **Table 6.3.3**.

Table 6.3.3
Daytime Project Noise Trigger Levels

Location	Logger	Amenity Noise Level L_{Aeq} dB(A)	Measured Noise Level dB(A)		Project Noise Trigger Levels $L_{Aeq(15minute)}$ dB(A)	
			RBL[1]	$L_{Aeq(period)}$	Intrusiveness	Amenity[2,3]
R1, R2	L02	50	36	48	**41**	48
R3	L03	50	36	49	**41**	48
R4, R5, R7 to R9	L04	50	45	52	50	**48**
R6, R10, R11	L05	50	48	56	53	**48**
SCW[4]	L06	55	37	49	**42**	55
SAC[5]	n/a	45[7]	n/a	n/a	n/a	**43**[7]
GME[6]	L01	55	40	51	**45**	53

Note 1: RBL = Rating Background Level
Note 2: Amenity noise levels reduced by 5 dB due to other sources of industrial noise being present in the area.
Note 3: Project amenity noise levels are converted to a 15-minute level by adding 3 dB, in accordance with the NPfI.
Note 4: Shell Cove West
Note 5: Shellharbour Anglican College
Note 6: Greenmeadows Estate
Note 7: Table 2.2 of the NPfI specifies the recommended amenity noise level inside classrooms as 35L_{Aeq} dB(A). As the noise model predicts external noise levels, SLR (2022a) conservatively assumed that all school buildings have openable windows and external noise levels are therefore 10dB higher than the corresponding internal level.

Source: SLR (2022a) – modified after Table 9

Sources of industrial noise can cause greater annoyance when they contain certain characteristics, such as tonality, intermittency or dominant low-frequency content. The NPfI applies modifying factors for the assessment of noise impacts. Tonal, low-frequency and intermittent noise modifying factors were considered in the noise assessment by SLR (2022a).

Where the predicted noise levels are less than or equal to the PNTLs shown in bold in **Table 6.3.3,** it is envisaged the PNTLs would become the limits in the development consent for the Project. Where the predicted noise levels are greater than the PNTLs shown in bold in **Table 6.3.3**, it is

envisaged the NSW Government's Voluntary Land Acquisition and Mitigation Policy (VLAMP) would determine the approved noise limits in the development consent for the Project.

6.3.4.2 Blasting Limits

The existing airblast overpressure and ground vibration limits are specified in the Quarry's development consent, specifically in Conditions 10 and 11 of Schedule 4 of LEC Consent No. 10639 of 2005 – MOD 3. These conditional requirements are also included in the Quarry's Environment Protection Licence 299 as Conditions L3.1 and L3.2. The conditions state that blasting limits must not exceed the airblast overpressure and peak particle velocity criteria listed in **Table 6.3.4** at any point that is located at least 3.5m from any residence or other receiver on privately-owned land. The assessment of blasting impacts for the Project has been undertaken by applying these limits.

Table 6.3.4
Airblast and Ground Vibration Limits

Airblast Overpressure Level (dB(Lin Peak))	Ground Vibration Peak particle velocity (mm/s)	Allowable Exceedance
115	5	5% of the total number of blasts over any 12 month reporting period
120	10	0%
Source: Conditions 10 and 11 of Schedule 4 of LEC Consent No. 10639 of 2005 – MOD 3		

6.3.5 Assessment Methodology

6.3.5.1 Operational Noise Model

SLR (2022a) predicted the potential operational noise levels generated throughout the Project at the surrounding residences using the CONCAWE industrial noise algorithm in SoundPLAN V8. The resulting three-dimensional model includes ground topography, residence locations, and representative noise sources within the Project Area. Potential impacts were determined by comparing the predicted noise levels to the PNTLs in a 15-minute assessment period.

In order to verify that the noise model provides a reasonable estimate of noise propagation from the future Stage 7 operations to potentially impacted receivers, SLR (2022a) developed a validation model to represent the existing extraction operations in Stages 5 and 6. This model included the operation of equipment described in Section 6.3.5.2, recently acquired topographic data and the fixed processing plant to estimate existing noise levels at the closest residences.

The results of the verification model were compared with noise measurements undertaken in October 2020 and historical noise monitoring results. The comparison indicates an acceptable estimate of potential noise impacts with a slightly conservative impact prediction. Further details about the verification model are provided in Section 6.3 of SLR (2022a).

6.3.5.2 Operational Noise Sources

A summary of the significant noise sources associated with the operation of the Project is provided in **Table 6.3.5**. The sound power levels listed in **Table 6.3.5** are a combination of on-site measurements conducted in January 2021, historical measurements from the Quarry, and SLR's noise measurement database.

Table 6.3.5
Operational Noise Sources

Page 1 of 2

Equipment Type[1]	Make and Model	Fleet Quantity	Utilisation[2]	Main Function/Location	SPL[3] dB(A)
Excavator	Hitachi EX1200	1	75%	In pit material extraction	113
Haul truck	CAT 777D	1	50%	Material haulage	115
Haul truck	CAT 773D & 773E	4	50%	Material haulage	114
Water truck	CAT 773B	1	25%	Dust suppression	114
Excavator and hammer	CAT 330	1	50%	In pit material extraction and reduction of oversize blasted rock	115
Front-end loader	CAT 992K	1	75%	In pit material movement	115
Front-end loader	CAT 980C	1	75%	In pit feeding mobile crusher	108

Table 6.3.5 (Cont'd)
Operational Noise Sources

Equipment Type[1]	Make and Model	Fleet Quantity	Utilisation[2]	Main Function/Location	SPL[3] dB(A)
Blasthole drill rig	Furukawa HCR1500-EDII	1	75%	Blasthole drilling	118
Grader	CAT 16G	1	25%	Road maintenance	113
Excavator	Komatsu PC800	1	75%	Material extraction	113
Dewatering pump	8" pump	1	25%	Water pumping	109
Excavator	Kobelco 260B	1	75%	In pit loading mobile crusher	105
Primary mobile crusher/screen	Premiertrak 600[3]	1	100%	In-pit material crushing and screening (continuous)	121
Secondary mobile crusher/screen	Maxtrack/Warrior[3]	1	100%	In-pit material crushing and screening (campaign)	120
Scraper	CAT 637E	2	25%	Soil/overburden stripping	111
Dozer	CAT D11	1	75%	In pit material movement and soil/overburden stripping	120
Dozer	CAT D8	1	-[4]	In pit material movement and soil/overburden stripping	118
Mulching unit	Vermeer BC 1800XL	1	75%	Mulching vegetation	120
Articulated haul trucks	CAT 740 Moxy	2	50%	Soil/overburden stripping	113

Note 1: Equipment used in the extraction area that is not a significant noise source (such as light vehicles) have been excluded.
Note 2: Utilisation refers to the percentage of a 15-minute assessment period that the equipment operates at full capacity.
Note 3: SPL = Sound Power Level.
Note 4: Usually only one dozer in use.

Source: SLR (2022a) – modified after Table 12

6.3.5.3 Operational Noise Scenarios

SLR (2022a) assessed the Project's noise impacts with consideration given to distinguishing the impacts of the short-term activities and continuous extraction and processing activities.

The short-term activities would involve the following.

1. Amenity barrier works – confined to Stage 7a.
2. Vegetation mulching - most of which would be undertaken in Stages 7b, 7c and 7d.
3. Soil stripping – use of the D11 dozer for stripping soil at any location within each stage.
4. Drilling near surface – use of the drill rig for drilling blastholes from the near surface at any location within each stage.

The continuous activities would involve:

1. all extraction activities;
2. the operation of the mobile primary crushing and screening plant, typically positioned on the floor of the previously blasted bench. When operating on the floor of the upper bench, the equipment would be approximately 18m below natural ground level;
3. the operation of the secondary crushing and screening plant positioned on the extraction floor; and
4. the transportation of all crushed and screen products from the Project Area.

The assessment of the modelled scenarios progressively present the noise levels associated with extraction and mobile processing activities within Stage 5/6 and throughout Stages 7a, 7b and 7c/d. The layouts of the Project Area and typical location of the mobile equipment for each operational scenario are displayed in Figures 5 to 8 in SLR (2022a).

6.3.5.4 Cumulative Noise

SLR (2022a) undertook a cumulative operational noise assessment that included the typical extraction and processing operations within the Project Area and the activities undertaken within the existing approved fixed processing plant and product stockpiling area on the Cleary Bros' property.

In order to account for cumulative noise from the Project with existing industrial premises in the area, the NPfI recommended amenity noise level is reduced by 5dB(A) to give the Project amenity noise level. The Project amenity noise level is used in conjunction with the Project intrusiveness noise level to determine the PNTLs for operational noise for the Project, as shown in **Table 6.3.3**.

SLR (2022a) determined that cumulative noise impacts from the Project and existing industrial noise sources in the area have been accounted for with the adoption of the Project amenity noise levels listed in **Table 6.3.3**. Further details about the cumulative noise assessment are provided in Section 7.5 of SLR (2022a).

6.3.5.5 Blasting

Cleary Bros typically blasts between 12 and 35 times each year, fragmenting between 10 000t and 100 000t of rock with each blast. Cleary Bros relies upon the use of site laws developed from previous blasts to manage airblast overpressure and vibration. The site laws are regularly updated reflecting blast performance to ensure the design of each blast achieves compliance with the airblast overpressure and ground vibration limits nominated in **Table 6.3.4**. The use of the regularly updated site laws has enabled Cleary Bros to achieve compliance with the nominated blasting limits at "The Cottage" on "Figtree Hill" for all 266 blasts initiated since 2009. Section 8.3 of SLR (2022a) documents the blast history within the current extraction area. Cleary Bros intends to continue to use the regularly updated site laws for all future blasts within the Project Area and modifying the design, particularly as extraction approaches the boundary of the "Figtree Hill" property.

The near-field site law developed by SLR for airblast overpressure was based on offset distances of between 21m and 151m from blasts to assist with the blast design process to ensure that airblast overpressure levels do not exceed 135dB Linear at the Cleary Bros' property boundary. This criterion has been assigned to minimise the health risk to people and cattle on external properties. Similarly, SLR developed a near-field ground vibration site law to ensure that component peak particle velocity levels from blasts do not exceed 200mm/s at the Cleary Bros' property boundary. This criterion was established following a study assessing the impacts of vibration on the health of dairy cattle (including stress and contentment). The site laws which are presented in Appendix E of SLR (2022a) would continue to be relied upon for all future blasts initiated within Stage 7.

6.3.6 Operational Mitigation and Management Measures

6.3.6.1 Introduction

Cleary Bros proposes to adopt a range of measures to mitigate and manage the noise generated within the Project Area and experienced at the surrounding residences and the Shellharbour Anglican College.

6.3.6.2 Noise

The following noise mitigation and management measures would be implemented to reduce noise impacts from the Project.

- The design of the Stage 7 extraction area and the direction and sequence of extraction would maximise the use of extraction faces to attenuate noise from the mobile equipment operating within the extraction area. This includes the use of ramps with gradients not exceeding 1:10 (V:H) and located predominantly on the eastern and northern sides of the extraction area, thereby maximising noise attenuation from haul trucks within the extraction area.
- The crushing and screening plants would be positioned in locations that achieve maximum topographic protection from residences to the north and east. In the event that the measured noise level from the primary crushing and screening plant is greater than 41dB(A) at the closest non-Project related residence, the plant would be relocated to another position on the existing bench until noise levels are no greater than 41dB(A), or otherwise the plant would be relocated to a lower bench and the fragmented rock pushed by bulldozer to the bench below for processing.
- All mobile equipment would be fitted with standard noise suppression equipment such as engine cowling and mufflers as fitted by the original equipment manufacturer.
- All extraction and processing activities within the extraction area would be undertaken during the day within the hours of 7:00am to 5:30pm (Monday to Friday) and 7:00am to 1:00pm (Saturday),
- All mobile equipment would be regularly maintained and serviced within the Company's Albion Park workshop to ensure the original equipment manufacturer's specifications are maintained.
- The amenity barriers constructed on the surface at strategic locations within the extraction area would assist to attenuate noise from the mobile equipment.

Finally, SLR (2022a) assessed a range of "additional management and mitigation measures" to be implemented in the event that a negotiated agreement with the owners of "Figtree Hill" could not be reached. As a negotiated agreement was reached following finalisation of SLR (2022a) (see Section 2.5), those measures would not be required and are not described here or proposed as part of the Project.

The Quarry's Noise Management Plan would be updated for the Project and would include the noise mitigation and management measures to be adopted throughout the Project life.

6.3.6.3 Blasting

The key management and mitigation measure that has been adopted to minimise blasting impacts is to focus upon the thorough design of each blast drawing upon the experience of the results of all previous blasts. This approach has been successful over many years to ensure that the blast limits are satisfied at the "Figtree Hill" residences. Cleary Bros would continue to engage a specialist Blasting Contractor to design, drill, load, and fire all blasts within the Project Area. Each blast design would be reviewed by a specialist Blasting Engineer to ensure consistency with the requirements of the Quarry's *Noise and Blast Management Plan*. Prediction of the far- and near-field ground vibration and airblast overpressure levels would continue to be conducted prior to each blast by the Blasting Engineer to ensure the blast emissions are compliant with the limits set out in **Table 6.3.4** at the closest residence. The ground vibration and airblast site laws would be updated on a regular basis to reflect the blast results obtained.

Meteorological data from the on-site AWS described in Section 6.3.3.1 would be evaluated by the Blasting Contractor prior to blasting. The expected weather conditions and their effect(s) on the airblast and dust generated by the blasting would be considered and blast plans and/or timing altered, if necessary. In general, blasting would be avoided, where possible, under the following meteorological conditions.

- When winds are blowing from the blast site to the nearest receiver at a strength likely to enhance the impacts of blast emissions.
- Where there is heavy low-level cloud.
- Where a temperature inversion is indicated.

Deck charging is a method used to limit both airblast overpressure and ground vibration involving the loading of a blasthole whereby explosive charges are separated by an inert material, typically stemming material. Where practical, the front row of blastholes for each blast would be deck charged, with the blast initiated in a direction away from the closest residence and the boundary of the "Figtree Hill" property. The Maximum Instantaneous Charge (MIC) for the blast would not exceed the mass of explosives dictated by the current site laws. This would be designed to limit emissions from blasting in Stage 7 and ensure compliance with the airblast overpressure and the ground vibration limits listed in **Table 6.3.4**.

The blast design parameters for all blasts are presented in full in Section 8 of SLR (2022a). These parameters are consistent with the current *Noise and Blast Management Plan*.

Flyrock has the potential to be ejected from the blast face and the blasthole collar. In order to limit the potential impact of flyrock from blasting activities within the Project Area, the front row of blastholes would continue to be bore tracked (surveyed) to identify areas of sub-optimal burden where additional inert material would be placed to prevent flyrock ejection from the blast face. The nominal stemming length of 3m would totally contain and separate the explosives in the blasthole from the collar. Aggregate would be used as the stemming material as it "locks" at the collar upon blast initiation. This would limit the potential for flyrock ejection from the collar.

Cleary Bros currently notify interested stakeholders by telephone on the morning of each blast, advising of the expected time of firing and any other matter relevant to their property. This practice would continue in accordance with an updated *Noise and Blast Management Plan* that would be prepared for the Project. The planned day of the next blast would also be available on the Cleary Bros website typically 3 days prior to the blast. Stakeholders currently notified of blasts include.

- a contact from "Figtree Hill" (representing Residences R1 to R3);
- other landowners or occupiers requesting notification of blasts;
- the EPA; and
- the neighbouring quarry operator – Holcim.

Cleary Bros would also add additional landowners or occupiers to the list of consulted stakeholders on request. In addition, if Holcim is planning a blast on the same day, measures would continue to be undertaken to ensure that the blasts are adequately separated in time.

6.3.7 Assessment of Impacts

6.3.7.1 Operational Noise

Continuous Extraction and Processing Operations

Table 6.3.6 presents the predicted noise levels for the continuous extraction and processing operations for the operational scenarios in Stages 5/6, 7a, 7b and 7c/d. With the adoption of the noise mitigation and management measures the predicted noise levels show that compliance would be achieved at all residences and the Shellharbour Anglican College during all stages throughout the Project life. **Figures 6.3.2** to **6.3.5** display the noise contours for the proposed ongoing operations in Stage 5/6 and Stages 7a, 7b and 7c/d.

Further commentary on the predicted noise levels at all residences and the Shellharbour Anglican College is provided in Section 7.4.1.

Table 6.3.6
Predicted Noise Levels for Continuous Activities

Location	PNTL[3]	Predicted Noise Level (L_{Aeq} 15 min) dB(A)							
		Stages 5/6		Stage 7a		Stage 7b		Stage 7c/7d	
		Mobile Primary Processing Upper Level[1]	Mobile Primary Processing Lower Levels[2]	Mobile Primary Processing Upper Level[1]	Mobile Primary Processing Lower Levels[2]	Mobile Primary Processing Upper Level[1]	Mobile Primary Processing Lower Levels[2]	Mobile Primary Processing Upper Level[1]	Mobile Primary Processing Lower Levels[2]
R1	41	38	37	39	36	41	34	41	40
R2	41	36	35	38	34	41	33	41	38
R3	41	35	34	41	36	41	37	41	41
R4	48	<30	<30	33	<30	31	<30	<30	<30
R5	48	<30	<30	35	<30	36	<30	39	31
R6	48	<30	<30	32	<30	32	<30	38	38
R7	48	<30	<30	<30	<30	<30	<30	<30	<30
R8	48	<30	<30	<30	<30	<30	<30	<30	<30
R9	48	<30	<30	31	<30	<30	<30	36	<30
R10	48	<30	<30	<30	<30	<30	<30	33	<30
R11	48	<30	<30	<30	<30	<30	<30	34	34
SCW[4]	42	<30	<30	<30	<30	<30	<30	<30	<30
SAC[5]	43	<30	<30	<30	<30	<30	<30	<30	<30
GME[6]	45	<30	<30	30	30	<30	<30	31	31

Note 1: Typical extraction including mobile primary crushing and screening on uppermost bench i.e. one bench below natural ground level.

Note 2: Typical extraction including mobile primary crushing and screening on second bench and lower.

Note 3: Project Noise Trigger Level

Note 4: Shell Cove West

Note 5: Shellharbour Anglican College

Note 6: Greenmeadows Estate

Source: SLR (2022a) – modified after Tables 15, 16, 17 and 18

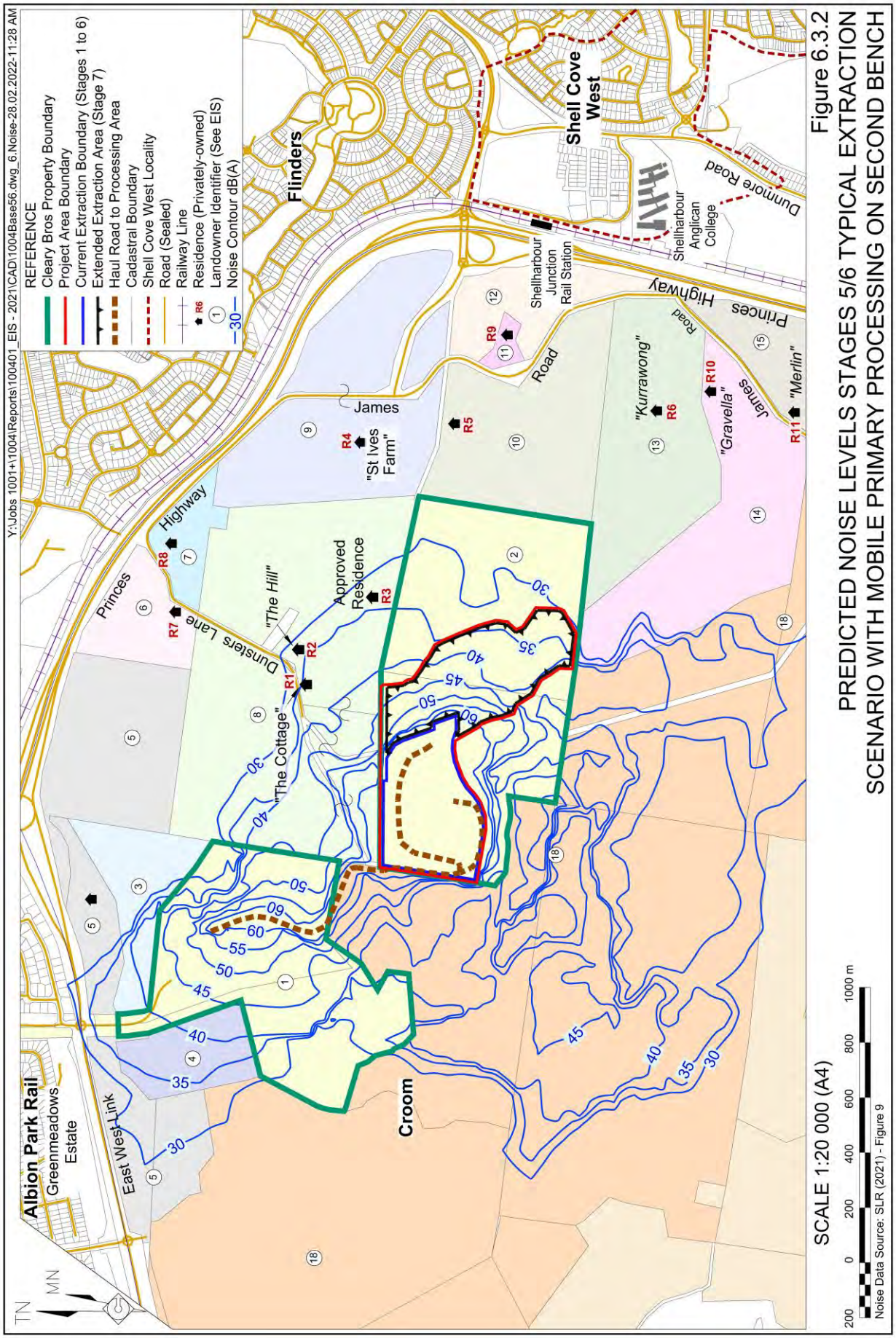
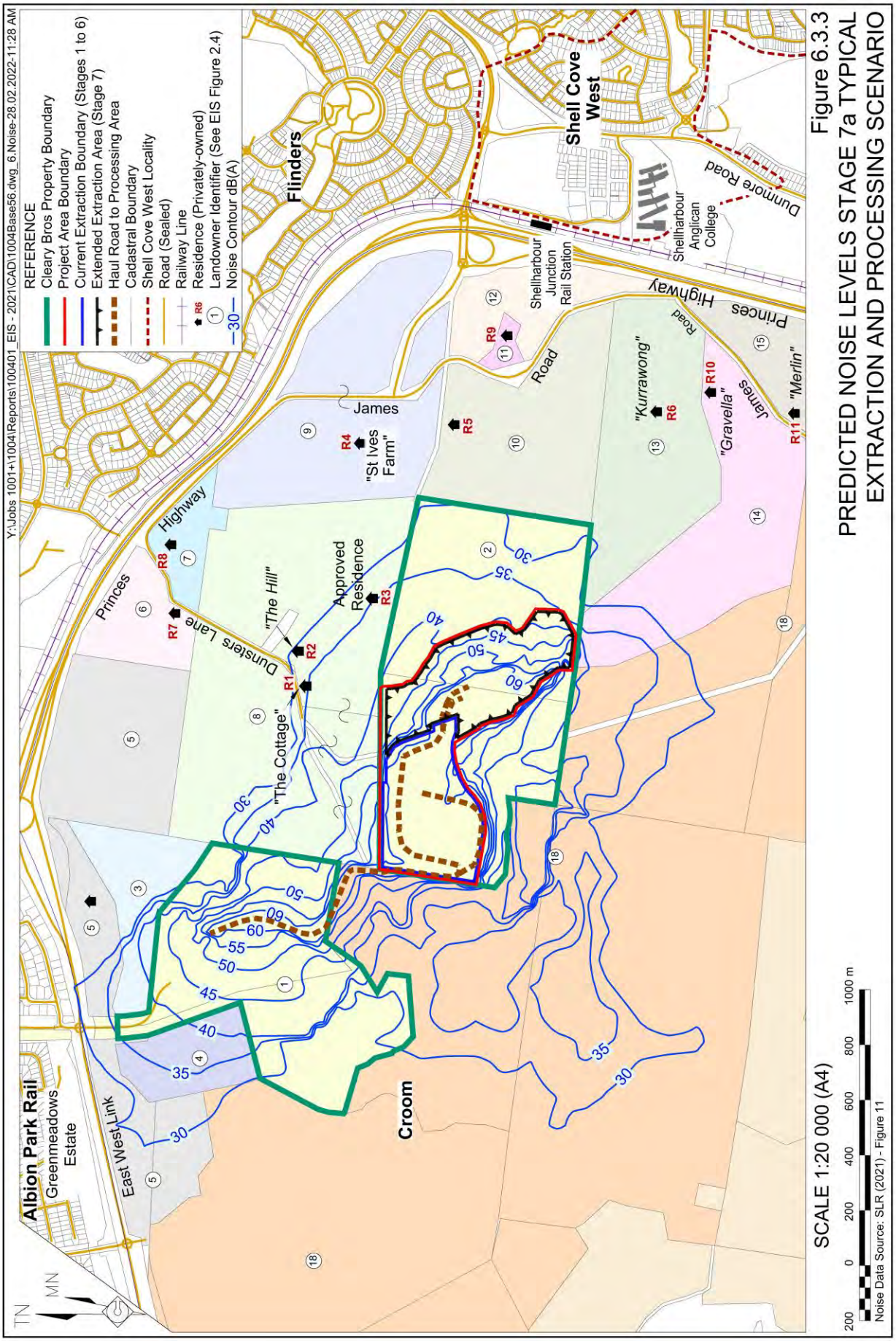


Figure 6.3.2
PREDICTED NOISE LEVELS STAGES 5/6 TYPICAL EXTRACTION SCENARIO WITH MOBILE PRIMARY PROCESSING ON SECOND BENCH


Y:\Jobs 1001+\1004\Reports\100401_EIS - 2021\CAD\1004Base56.dwg, 6.Noise-28.02.2022-11:28 AM
REFERENCE
Cleary Bros Property Boundary
Project Area Boundary
Current Extraction Boundary (Stages 1 to 6)
Extended Extraction Area (Stage 7)
Haul Road to Processing Area
Cadastral Boundary
Shell Cove West Locality
Road (Sealed)
Railway Line
Residence (Privately-owned)
Landowner Identifier (See EIS Figure 2.4)
Noise Contour dB(A)
Flinders
Shell Cove West
Shellharbour Anglican College
Dunmore Road
Shellharbour Junction Rail Station
Princes Highway
James Road
"St Ives Farm"
"Kurrawong"
"Gravella"
"Merlin"
Approved Residence
"The Hill"
"The Cottage"
Dunsters Lane
Albion Park Rail
Greenmeadows Estate
East West Link
Croom
TN
MN
SCALE 1:20 000 (A4)
200 0 200 400 600 800 1000 m
Noise Data Source: SLR (2021) - Figure 11
Figure 6.3.3
PREDICTED NOISE LEVELS STAGE 7a TYPICAL EXTRACTION AND PROCESSING SCENARIO

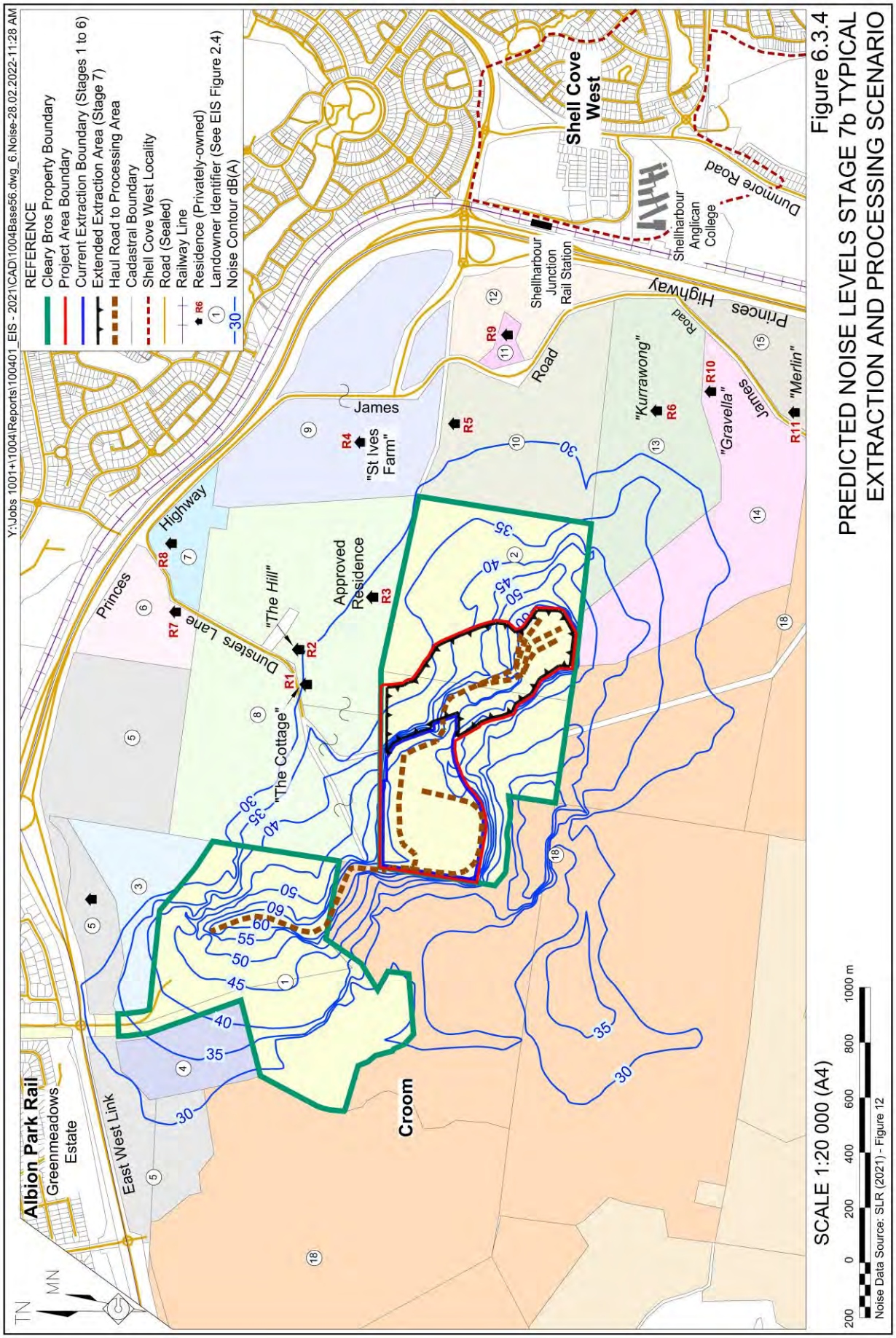


Figure 6.3.4
PREDICTED NOISE LEVELS STAGE 7b TYPICAL EXTRACTION AND PROCESSING SCENARIO

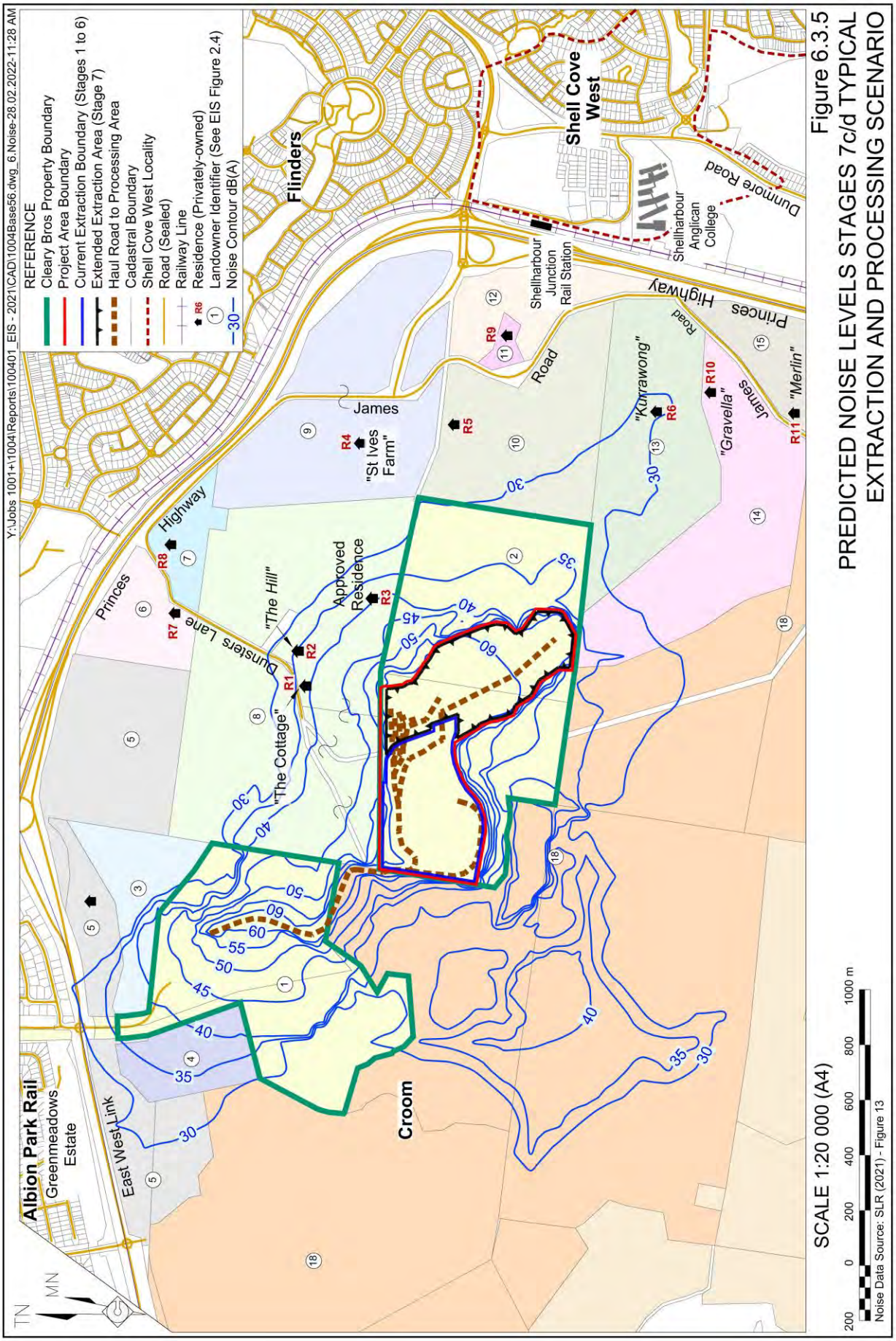


Figure 6.3.5
PREDICTED NOISE LEVELS STAGES 7c/d TYPICAL EXTRACTION AND PROCESSING SCENARIO

Short-term Operational Activities – with Northern Amenity Barrier

The predicted noise levels for each of the short-term operational activities with the adoption of the noise mitigation and management measures are presented in **Table 6.3.7**. Exceedances of the PTNLs by between 2dB(A) and 14dB(A) are noted for the residences on "Figtree Hill" and are highlighted in bold. Cleary Bros and the owners of "Figtree Hill" have negotiated an agreement whereby the predicted noise exceedances at R1 to R3 would be allowed to occur to the levels presented in **Table 6.3.7** (see Section 2.5).

Finally, it is noted that compliance with the PNTLs would be achieved at all other residences and the Shellharbour Anglican College during all short-term operational activities.

Figure 6.3.6 displays the predicted noise contours for the worst case short-term operational activities across the Project Area.

Table 6.3.7
Predicted Noise Levels for Short Term Activities[1]

Location	PNTL[2]	Predicted Noise Level $L_{Aeq(15minute)}$ dB(A)											
		Amenity Barrier Works			Vegetation Mulching			Soil Stripping			Drilling Near Surface		
		7a	7b	7c/d[3]	7a	7b	7c/d	7a	7b	7c/d	7a	7b	7c/d
R1	41	48	N/A	**55**	**48**	41	**55**	**48**	41	**55**	**45**	37	**52**
R2	41	46	N/A	**52**	**46**	40	**52**	**46**	40	**52**	**43**	37	**50**
R3	41	50	N/A	**54**	**50**	**46**	**54**	**50**	**46**	**54**	**47**	**43**	**52**
R4	48	38	N/A	<30	38	37	<30	38	37	<30	34	33	<30
R5	48	40	N/A	42	40	42	42	40	42	42	36	38	38
R6	48	39	N/A	38	39	39	38	39	39	38	36	36	34
R7	48	<30	N/A	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
R8	48	<30	N/A	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
R9	48	37	N/A	37	37	38	37	37	38	37	33	34	33
R10	48	37	N/A	31	37	37	31	37	37	31	33	33	<30
R11	48	35	N/A	34	35	36	34	35	36	34	31	31	<30
SCW[4]	42	31	N/A	30	31	31	30	31	31	30	<30	<30	<30
SAC[5]	43	31	N/A	30	31	31	30	31	31	30	<30	<30	<30
GME[6]	45	<30	N/A	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30

Note 1: Includes Amenity Barrier Works, Vegetation Mulching, Soil Stripping and Drilling Near Surface

Note 2: Project Noise Trigger Level

Note 3: Construction of the northern amenity barrier would be undertaken at the same time as the Stage 7a amenity barrier works, unless agreed otherwise with the owners of "Figtree Hill", in which case the northern amenity barrier would not be constructed. See discussion below.

Note 4: Shell Cove West

Note 5: Shellharbour Anglican College

Note 6: Greenmeadows Estate

Source: SLR (2022a) – modified after Tables 16, 17 and 18

SLR (2022a) assessed potential noise levels at the residences on "Figtree Hill" for each of the short-term operational activities with the adoption of a range of additional noise mitigation and management measures. As identified in Section 2.5, Cleary Bros and the owners of "Figtree Hill" have negotiated an agreement and therefore the assessment of short-term operational activities

with the additional noise mitigation and management measures is not relevant and is not presented here.

Further commentary on the predicted noise levels at all residences and the Shellharbour Anglican College is presented in Section 7.4.2.

Continuous and Short-term Operational Activities – No Northern Amenity Barrier

As identified in Section 2.5, Cleary Bros and the owners of "Figtree Hill" have negotiated an agreement that addresses noise impacts as described above. That agreement also provides for circumstances where the proposed northern amenity barrier and adjoining tree screen would not be constructed.

In order to quantify the effect of not constructing the northern amenity barrier, SLR (2022b) undertook a comparison of predicted noise levels with and without the barrier using the assessment methodology described in Sections 6.3.5.1 to 6.3.5.3. In summary, SLR (2022b) determined that:

- the maximum noise levels predicted by SLR (2022a) are predicted to be consistent (no change in predicted noise levels) at the Figtree Hill residences in the absence of the northern amenity bund and adjoining tree screen, and
- there would be no change in impact for any other sensitive receiver in the absence of the northern amenity bund and adjoining tree screen.

Cumulative Noise Impacts

Cumulative Impact with Existing Processing Area

Predicted cumulative noise levels from the typical extraction and processing activities within the Project Area and the existing fixed processing area and product stockpiling area to the north of the Project Area demonstrate compliance with the PNTLs at all receivers during all stages.

Predicted cumulative noise levels for the short-term amenity barrier works, vegetation mulching, soil stripping, and near-surface drilling, combined with the existing fixed processing area and product stockpiling area to the north of the Project Area indicate the PNTLs and cumulative noise criteria would be satisfied at all non-Project related residences and the Shellharbour Anglican College.

SLR (2022a) conclude cumulative noise impacts from the Project with existing industrial noise sources in the area have been accounted for with the adoption of the PNTLs in the assessment of operational noise impacts.

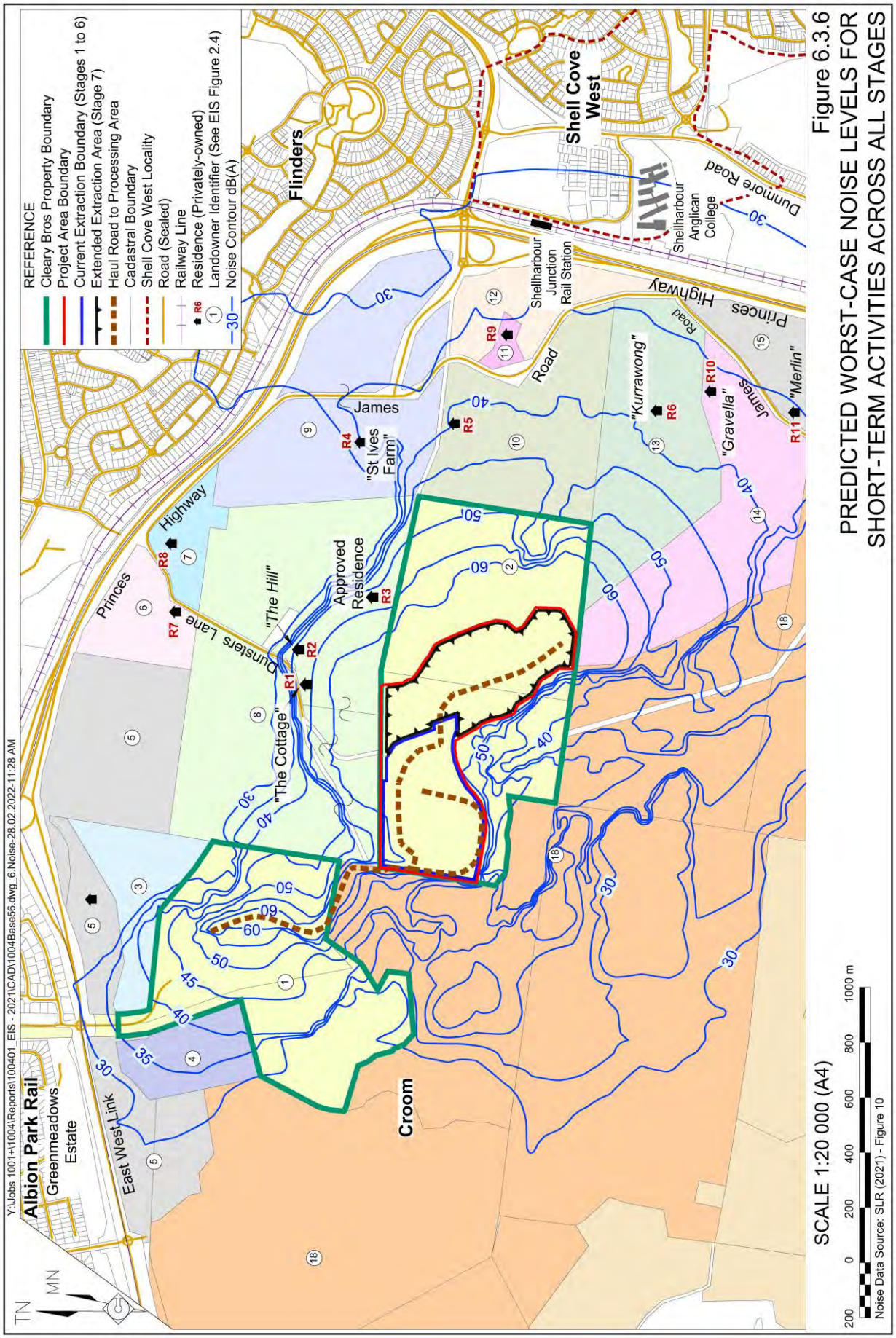


Figure 6.3.6
PREDICTED WORST-CASE NOISE LEVELS FOR SHORT-TERM ACTIVITIES ACROSS ALL STAGES

6.3.7.2 Road Traffic Noise Assessment

Justification of Assessment Methodology

In preparing this assessment of road traffic noise, reliance has been placed on the *Noise and Vibration Assessment* prepared for the Albion Park Rail Bypass (Renzo Tonin, 2015).[6] This approach is considered to be acceptable for the following reasons.

- Renzo Tonin (2015) assessed road traffic noise associated with the realigned East West Link and new Princes Motorway, which are used for the vast majority of truck movements from the Albion Park Quarry.
- The Albion Park Rail Bypass works have now been completed, with the realigned East West Link opened in late 2020 and Princes Motorway opened in late 2021.
- Renzo Tonin (2015) assessed road traffic levels including the operation of the Albion Park Quarry, as well as other road users.
- The Project would not result in an increase in the current approved extraction rate of 900 000tpa and, as a result, would not result in additional off-site heavy vehicle movements. Similarly, the Project would not result in a change in transportation routes.
- Renzo Tonin (2015) have therefore assessed road traffic noise impacts associated with the existing and proposed Project.

In undertaking the Noise and Vibration Assessment for the Albion Park Rail Bypass, Renzo Tonin (2015) considered a range of policies and guidelines, including the *NSW Road Noise Policy*.

Road Traffic Noise Catchment Areas

Renzo Tonin (2015) identified 16 Road Traffic Noise Catchment Areas (NCA), of which 2 are located in the vicinity of the Site Access Road and the Quarry's transportation route to the Princes Motorway/Princes Highway, as follows (**Figure 6.3.7**).

- NCA2 – comprising an agricultural shed erroneously identified by Renzo Tonin (2015) as a residence.
- NCA3 – comprising the Greenmeadows Estate.

As NCA2 is not a residential receiver, road traffic noise impacts at this site will not be examined further.

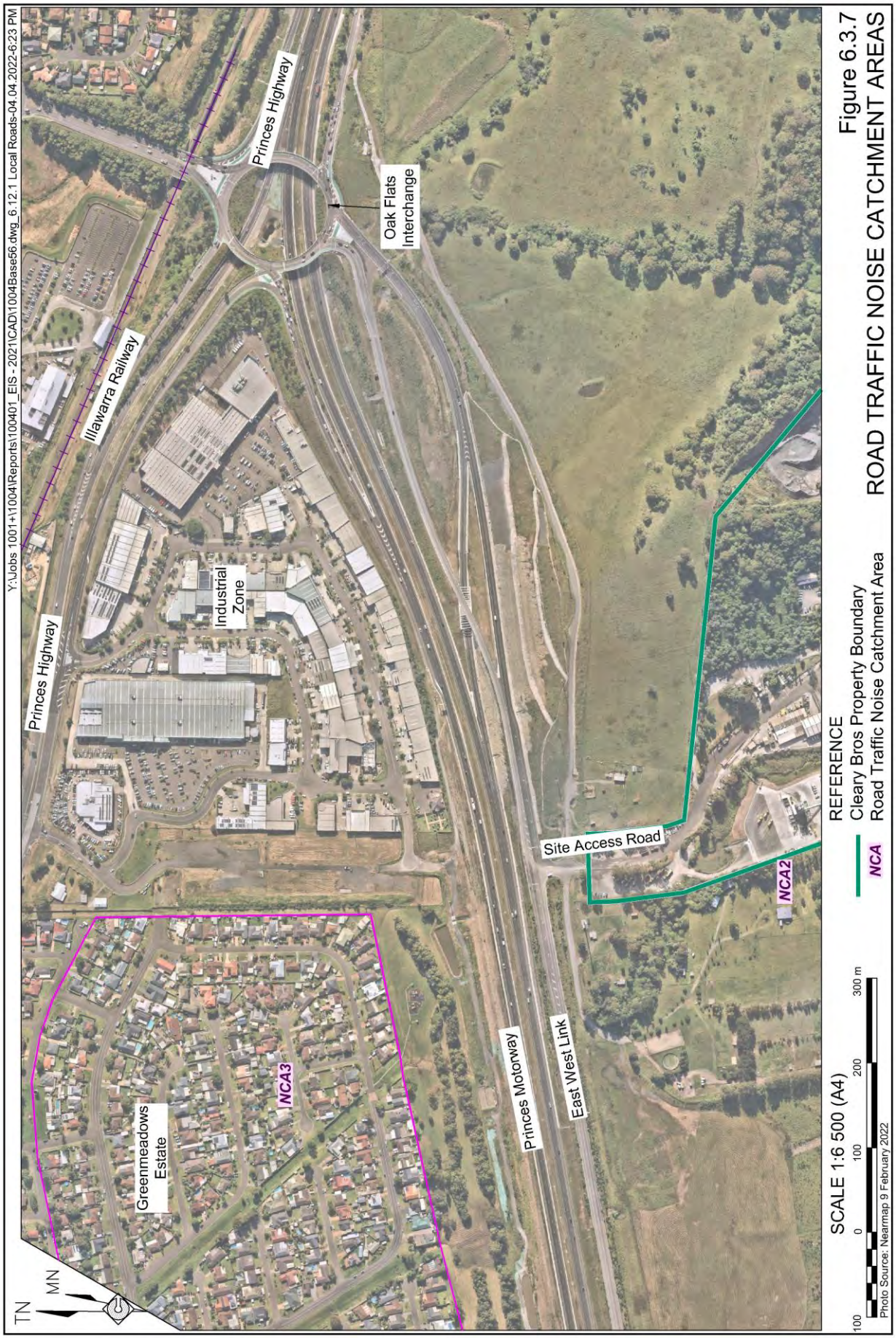
Road Traffic Noise Assessment Criteria

Renzo Tonin (2015) identified the following assessment criteria for residences within NCA3 in accordance with Table 3 of the *NSW Road Noise Policy.*

- Daytime (7:00am to 10:00pm) .....55dB(A)
- Night-time (10:00pm to 7:00am) .....50dB(A)

No criteria are identified for industrial land to the north of the East West Link and east of NCA3.

[6] Documentation related to the Albion Park Rail Bypass, including Renzo Tonin (2015) is available at https://www.planningportal.nsw.gov.au/major-projects/projects/albion-park-rail-bypass.


Y:\Jobs 1001+\1004\Reports\100401_EIS - 2021\CAD\1004Base56.dwg_6.12.1 Local Roads-04.04.2022-6:23 PM
Princes Highway
Oak Flats Interchange
Illawarra Railway
Princes Highway
Industrial Zone
Site Access Road
NCA2
NCA3
Greenmeadows Estate
Princes Motorway
East West Link
TN
MN
REFERENCE
Cleary Bros Property Boundary
NCA
Road Traffic Noise Catchment Area
SCALE 1:6 500 (A4)
100 0 100 200 300 m
Photo Source: Nearmap 9 February 2022
Figure 6.3.7
ROAD TRAFFIC NOISE CATCHMENT AREAS

Road Traffic Noise Assessment Methodology and Results

Road traffic noise levels for the above scenarios were modelled based on a method developed by the United Kingdom Department of Environment entitled *Calculation of Road Traffic Noise,* published in 1988, and adapted to Australian conditions by the Australian Road Research Board.

Renzo Tonin (2015) modelled road traffic noise associated with the now constructed Albion Park Rail Bypass in the absence of noise mitigation and determined for NCA3, that a total of 414 residences would experience road traffic noise in exceedance of the relevant criteria, with:

- 314 experiencing exceedances of between 1dB(A) and 5dB(A); and
- 100 experiencing exceedances of between 5dB(A) and 10dB(A).

Renzo Tonin (2015) recommended a range of noise mitigation measures, including the following.

- Use of low noise asphalt in selected sections of the Princes Motorway, including the section adjacent to Greenmeadows Estate.
- Use of noise barriers, including a 5m high barrier on the northern side of the Princes Motorway immediately south of the Greenmeadows Estate. **Plate 6.12.3** presents a view of the constructed noise barrier.
- Acoustic treatments of individual properties where noise levels would still be expected to exceed relevant assessment criteria.

With the proposed mitigation, Renzo Tonin (2015) determined that a total of 12 residences within NCA3 would require acoustic treatments, including:

- 10 experiencing exceedances of between 1dB(A) and 5dB(A); and
- 2 experiencing exceedances of between 5dB(A) and 10dB(A).

Renzo Tonin (2015) also assessed maximum predicted noise levels and determined that no residences within NCA3 would exceed the relevant maximum noise assessment criteria of 65dB(A).

The Department of Planning and Environment in its Assessment Report identified that it was satisfied feasible and reasonable mitigation measures had been considered for the Bypass and further noise assessment would be undertaken during detailed design to confirm the effectiveness of the proposed mitigation measures. This, the Department determined, was an appropriate approach and consistent with the approach taken for other major road projects.

Application to the Project

Clear Bros contends that road traffic noise impacts associated with the Project would be acceptable for the following reasons.

- The Project would not result in additional heavy vehicle movements on the East West Link or the Princes Motorway/Princes Highway.
- Road traffic noise associated with the predicted traffic on those roads, including traffic associated with the Quarry's approved transportation operations, have been assessed by Renzo Tonin (2015) and the Albion Park Rail Bypass has been approved and constructed based, in small part, on that assessment.

- The vast majority of heavy vehicle traffic on the East West Link travels between the Site Access Road and the Oak Flats Interchange, a 750m section of road with no neighbouring residences or sensitive receivers.

6.3.7.3 Blasting

Table 6.3.8 presents the maximum MIC that could be applied when blasting at the closest point to Residence R1 in each stage, and the subsequent predicted 95th percentile levels of airblast overpressure and ground vibration at Residences R1 and R2 in each of these instances, based on the current blast emissions site laws. When blasting further from the residences within each stage, a higher MIC than that listed in **Table 6.3.8** could be used, as dictated by the site laws.

By extending the blasting practices utilised for the existing extraction area into Stage 7, there would be no exceedances of the airblast overpressure and vibration criteria from Project blasting activities at Residences R1 to R3.

As all other residences are more distant from Stage 7 than Residences R1 to R3, those residences would experience lower levels of ground vibration and airblast overpressure from blasting in Stage 7. As a result, blasting and vibration at the Project would not have a significant impact at those residences.

Table 6.3.8
Blast Emissions Predictions Based on the Current Site Laws

Stages	Residence	Near Distance to Blasting (m)	Allowable MIC (kg) at near point	Ground Vibration (mm/s)	Airblast (dB Linear)
1 to 6	R1	375	51	4.8	115.0
	R2	475			
7a	R1	449	77	5.0	114.7
	R2	508			
7b	R1	741	210	5.0	113.3
	R2	765			
7c	R1	455	79	5.0	114.6
	R2	489			
7d	R1	280	21	3.9	115.0
	R2	330			
Source: SLR (2022a) – Table 22					

6.3.8 Voluntary Land Acquisition and Mitigation Policy Assessment

The NSW Voluntary Land Acquisition and Mitigation Policy (VLAMP) for State Significant Mining, Petroleum and Extraction Industry Developments lists five different levels of noise impact and recommended actions to ameliorate these impacts. The noise impact assessment undertaken by SLR (2022a) predicted noise levels above the PNTL at residences on "Figtree Hill". Cleary Bros and the owners of "Figtree Hill" have negotiated an agreement permitting the predicted noise levels (see Section 2.5) and, as a result, the requirements of the VLAMP are not triggered for those properties.

6.3.9 Monitoring

Ongoing monitoring of noise, airblast overpressure and ground vibration would continue to be managed in accordance with the procedures described in the Quarry's current *Noise and Blast Management Plan* (NBMP), which would be updated to include Stage 7 operations should the Project be approved.

Monitoring is to be undertaken for two purposes, namely:

1. to demonstrate compliance with the conditions imposed within the development consent for the Project and EPL299 for the overall Quarry; and
2. to guide the manner in which the range of operational activities within the Project Area are undertaken in order to meet the noise levels projected in the Noise and Blasting Assessment (SLR, 2022a).

In summary, the following monitoring would be undertaken throughout the life of the Project.

- Annual independent noise compliance monitoring would continue similar to the current program and include monitoring during the winter months inclusive of 7 days of unattended noise logging and 15 minute attended noise measurements with monitoring conducted within the Project Area boundary and at "The Cottage" on "Figtree Hill" – Residence R1. The monitoring data from within the Project Area would be utilised with a noise model to determine quarry noise levels attributable to activities in the Project Area at other residences and the Shellharbour Anglican College.
- The permanent blast emissions monitor (for airblast overpressure and ground vibration) at the closest inhabited residence to the Project Area, namely "The Cottage" (Residence R1) would continue to be used. In addition, a portable blast emissions monitor would be positioned at other potentially affected residences, if required, in response to community feedback. Monitoring instrumentation would continue to be operated by suitably qualified and trained personnel. Records would continue to be maintained for all blasts to assist in the design and optimisation of future blasts and to provide a traceable system of documentation in case of an incident or complaint.
- Meteorological data recorded at the on-site automatic weather station during the monitoring period would be accessed for use in the interpretation of the noise and blast monitoring results.

6.3.10 Conclusion

Detailed predictive models of the noise levels for the Project from both short-term and continuous activities at various stages of its development have been prepared. An analysis of the model results determined there would be exceedances of the Project Noise Trigger Levels at Residences R1 to R3 on the "Figtree Hill" property at various stages of the Project development, when equipment is operating at or near the surface within the Project Area. Cleary Bros and the owners of "Figtree Hill" have negotiated an agreement that addresses a range of matters, including noise impacts. Under that agreement, the owners of "Figtree Hill" have agreed to accept Project-related impacts to the extent identified in this sub-section. As such the requirements of the VLAMP are not triggered for the "Figtree Hill" residences.

Predicted residual noise impacts are less than the PNTLs for all other residences and the Shellharbour Anglican College, and as such the requirements of the VLAMP are not triggered for those properties.

The adopted Project amenity noise levels account for cumulative noise from the Project, the existing approved processing area and surrounding industrial premises.

Road traffic noise levels associated with the Project would remain unchanged from the existing noise levels.

Predicted airblast overpressure and ground vibration levels would continue to comply with the current limits at the closest residences (R1 to R3).

With the implementation of the respective blast management procedures and monitoring programs outlined in Section 6.3.6 and detailed in SLR (2022a), it is concluded that there will be no adverse impacts in relation to ground vibration, airblast overpressure and flyrock on people, animals, buildings, structures or infrastructure from blasting associated with the proposed operations in the Project Area.

6.4 Visibility

6.4.1 Introduction

The SEARs for the Project require the EIS to include a detailed assessment of the likely visual impacts of the development (before, during and post-quarrying) on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to any new landforms. The visual impacts of the Project were also raised as a key issue by the owners of the adjoining "Figtree Hill" property. In light of this, Cleary Bros and the owners of "Figtree Hill" have negotiated an agreement that addresses a range of matters, including visibility. Under that agreement, the owners of "Figtree Hill" have agreed to accept Project-related impacts to the extent identified in this sub-section.

A visual impacts assessment for the Project was undertaken by R.W. Corkery & Co. Pty Limited (RWC) and is presented as Part 3 of the *Specialist Consultant Studies Compendium* and hereafter referred to as RWC (2022). The following subsections provide a summary of the Visual Impacts Assessment, particularly the mitigation measures that Cleary Bros would implement to minimise the visual impacts of the Project.

6.4.2 The Existing Setting

The Project Area is located within the elevated rural land south and west of the Princes Highway (see **Figure 6.4.1**). The main ridge within the Project Area trends north-northwest to south-southeast and varies in elevation from approximately 125m AHD in the north to 65m AHD in the south. The centreline of the ridge traverses generally through Stage 7a. The land on the eastern side of the ridge falls steeply for the last 150m to elevations on the eastern boundary of between approximately 90m AHD in the north and 75m AHD in the south.

Features of the existing setting beyond the Project Area are as follows.

1. Elevations within Albion Park northwest of the Project Area vary from 10m AHD to 30m AHD. The Project Area is not visible from this area.
2. The land immediately to the north and northeast of the Project Area within "Figtree Hill" is topographically higher than the land within the Project Area. As a consequence, this land has a high to very high potential for visual impacts.
3. The land to the north of the Princes Highway in Flinders has elevations between 30m AHD and 90m AHD. The Project Area is not visible from most of Flinders.
4. The topography of the rural land east of the Project Area and west of the Princes Highway has elevations of approximately 30m AHD to 50m AHD. None of the residences in this area have views of the Project Area due to the intervening topography and vegetation.
5. The elevated land to the east of the Princes Highway in Shell Cove West, west of Dunmore Road has elevations of approximately 50m AHD to 55m AHD. The eastern side of the Project Area is visible from this area. It is noted that the area is topographically lower than the proposed Eastern Rim of the Project Area, however, the ridge within the Project Area effectively forms the skyline when viewed from the bulk of this area.

6. The elevated land in Shell Cove West has elevations of approximately 50m AHD to 70m AHD. This area would have similar views to the Project Area as the area west of Dunmore Road, however, the entire ridge within the Project Area is positioned below the skyline formed by the distant Illawarra escarpments.
7. Elevations within and surrounding Dunmore are typically between 10m AHD and 30m AHD. The level of visibility of the Project Area from this area is either low or not visible.

Figure 6.4.1 displays the potential level of visibility of the Project Area and the three key visibility catchments within the elevated areas to the north, northeast and east that currently have views of the land surface within the Project Area. Those areas without direct views of the Project Area have intervening topography and/or vegetation preventing or obscuring their views.

The three key visual catchments that have views facing the Project Area are described below. The Shell Cove West and West of Dunmore Road visual catchments are both within the Shell Cove West locality (**Figure 6.4.1**).

1. The "Figtree Hill" property to the north and northeast of the Project Area

   Elevations of the land where the two existing residences on "Figtree Hill" are located are 139m AHD ("The Cottage" – R1) and 140m AHD ("The Hill" – R2). The owners of "Figtree Hill" have a current development consent to construct a third residence on the property at a location approximately 350m southeast of "The Hill" at an elevation of approximately 117m AHD. The respective distance of the three residential locations on "Figtree Hill" from the closest boundary of the Stage 7 extraction area are 260m (R1 – "The Cottage"), 320m (R2 – "The Hill") and 250m (R3 – Approved Residence).

   Figure 6.4.1 also displays an area of moderate to very high level visibility on sections of the rural land within the "Figtree Hill" property extending onto the "Deer Farm" property.

2. Shell Cove West

   This area has been recently developed for housing and most of the residences have been constructed. Elevations within this key visibility catchment vary from 50m AHD near Glades Parkway and 52m AHD near Fairways Drive.

   Distances from this area to the closest boundary of the Project Area vary from approximately 2.2km to 2.4km.

3. West of Dunmore Road

   This area has also been recently subdivided for housing and considerable housing construction has already been completed. The proximity to the new Shellharbour Junction Railway Station has promoted residential growth in this area. The Shellharbour Anglican College is also located within this key visibility catchment.

   Elevations on the western side of Dunmore Road vary from 35m AHD to 50m AHD. Distances from this area to the closest boundary of the Project Area vary on its western side from approximately 1.5km to 1.7km. This entire key visibility catchment has views directly to the west towards the Project Area.

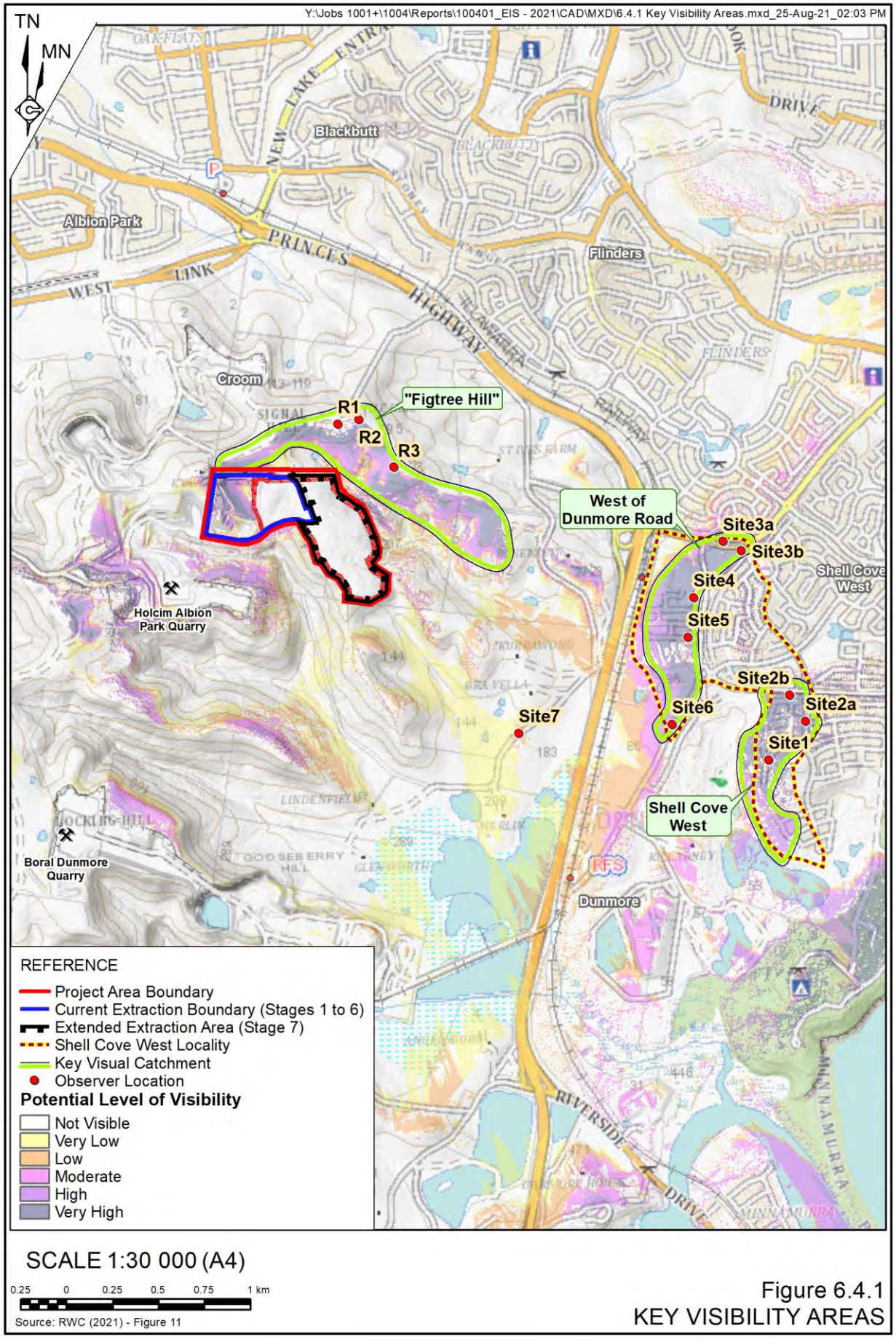


Figure 6.4.1
KEY VISIBILITY AREAS

Existing Views of the Project Area

Plate 6.4.1 displays views from the two residences within the "Figtree Hill" property and representative views from Shell Cove West and the western side of Dunmore Road towards the Project Area. The existing views from the two existing residences, "The Cottage" and "The Hill", are only partial views due to the perimeter vegetation around both residences although greater visibility occurs during the winter as some of the trees around "The Hill" are deciduous jacaranda. The "Belmont" residence within the Project Area is visible from both residences, albeit through breaks in the perimeter vegetation. Direct, unobstructed views are present from the site of the approved residence towards the Project Area including the "Belmont" residence.

The views from Observer Locations 1 and 4 to the east of the Princes Highway are similar, with the ridge within the Project Area in the foreground of more distant landforms on the skyline. It is noted that a number of residences within Shell Cove West already have views to the west and southwest of the extraction areas operated by Boral Resources (NSW) Pty Ltd (Boral) and Holcim (Australia) Pty Ltd (Holcim).

The Project Area is not visible from the Shellharbour Junction Railway Station nor most of the Princes Highway given their low elevation and the intervening topography and vegetation. Small sections of the southern side of the Project Area are visible from the northbound lanes of the Princes Highway near Tabbita Lane (2km from the Project Area) although the views are momentary for motorists due to the presence of roadside vegetation on the western side of the highway.

It is noted that visibility from the east looking westward towards the extraction activities and the rehabilitated benches within extraction areas within the Albion Park and Dunmore areas is invariably optimal in the morning. Visibility conditions, do however, change substantially and viewing clarity often decreases in the afternoon as the clarity is diminished by the presence of the afternoon sun. Reduced visibility also occurs during periods of low cloud and sea mist accompanied by northeasterly winds.

6.4.3 Potential Visual Impacts

The potential visual impacts generated by the Project are as follows.

1. Earthmoving equipment, principally a bulldozer, would periodically be visible on the eastern side of the ridge when constructing the amenity barrier on the northern and eastern sides of Stage 7a and when operating on the land surface during subsequent vegetation removal and soil stripping campaigns. A drilling rig would also be present at least 2m below the land surface for short periods prior to blasting the near-surface areas.
2. The amenity barriers within the Project Area would be constructed largely on the top of the ridge within Stage 7. Whilst the barriers are intended to provide visual protection in the medium to long term, they would themselves be discernible for a period up to 3 months until they are sufficiently vegetated.
3. As the eastern side of Stage 7 is progressively lowered, i.e. in Stages 7b, 7c and 7d, the upper extraction faces on sections of the western side of Stage 7 would be progressively exposed to views from the east. The top level of these faces would vary from approximately 100m AHD to 110m AHD, i.e. at elevations higher than all observer locations to the east.

Y:\Jobs 1001+\1004\Reports\100401_EIS - 2020\CAD\1004Base56.dwg_Plates-28.04.2021-10:42 AM

"The Cottage"

"The Hill"

Site 1

Site 4

Plate 6.4.1
EXISTING VIEWS
TOWARDS THE PROJECT AREA

4. Blasts initiated within the Project Area would generate a plume of dust and gases immediately following the blast. The extent to which the plumes are visible would depend on the quantity of rock blasted, direction and strength of the prevailing winds, the depth of the blast within the extraction area and composition of the gases generated.

6.4.4 Design Safeguards and Mitigation Measures

As a result of the visual assessment and the identification of those areas that would have views of the Project Area at some time during the Project Life and the extent of those views, the following mitigation measures are proposed to reduce and/or remove the visual impacts of the Project.

1. Extraction Staging

   The potential visibility of the completed upper benches in Stage 7 was recognised during the initial stage of the extraction area design. This enabled the substage boundaries within Stage 7 to be positioned to visually shield extraction activities as much as possible. Hence, the first substage of extraction (Stage 7a) would be confined largely to the western side of the central ridge within the Project Area, albeit with a strategically located amenity barrier and tree screens. Extraction in a north to south direction in Stage 7a would result in the creation of benches along the entire western side of Stage 7 before extraction then turns northwards towards the northern boundary of the Project Area.

2. Amenity Barriers and Tree Planting

   Cleary Bros proposes to construct a 170m long amenity barrier during the early stage of extraction in Stage 7 in the location north and northeast of Stage 7a as displayed on **Figure 3.5**. This barrier would be constructed irrespective of any agreement with the owners of "Figtree Hill" in relation to the northern amenity barrier and would assist to minimise noise and remove the opportunity for observers to view any extraction activities underway in Stage 7a. The barrier would be constructed to a height of approximately 5m and with vegetation growth conservatively extending the effective height to approximately 8m in 5 years and 10m in 10 years.

   The northern amenity barrier would, pending written agreement with the owners of the "Figtree Hill" property to the contrary, be constructed on the northern side of Stage 7d for a distance of approximately 160m from the existing amenity barrier. Beyond that point, the effectiveness of the barrier would diminish as the land falls relatively quickly towards the eastern side of Stage 7. In order to provide some visual shielding in that area, Cleary Bros would, pending written agreement with the owners of the "Figtree Hill" property to the contrary, plant a tree screen up to 10m wide for a distance of approximately 90m. It is conservatively estimated that the tree screen would attain an effective height of 3m, 5m and 10m in 5, 10 and 15 years respectively. The northern amenity barrier and associated tree screen do

not reduce the visibility of the Project from any residence on properties other than "Figtree Hill".

In order to reduce and/or remove the visibility of the upper western extraction faces when viewed from east of the Princes Highway, it is recommended that a tree screen is planted on the eastern side of Stage 7a from the southern end of the proposed amenity barrier discussed above and the southern end of Stage 7a. The tree screen on the eastern side of Stage 7a would cover a length of approximately 500m and width of approximately 10m and should attain effective heights of 3m, 5m and 10m in 5, 10 and 15 years respectively. Sections of the tree screen may be formed from existing vegetation. It is noted that the tree screen would comprise both trees and appropriate shrubs to ensure that the maximum visual protection is achieved by the screen.

3. Vegetation on the Upper Extraction Benches

Beyond the completion of Stage 7a, the progressive extraction of the eastern side of the ridge within Stages 7b and 7c would progressively expose the completed upper extraction faces and benches on the western side of Stage 7a to views from the east. In order to mitigate the visual impacts of these exposed extraction faces and benches, Cleary Bros would undertake the following vegetation treatments.

a) Once the 45° side slopes are created within the overburden, soil would be placed on the final surface and revegetated as described in Section 3.12.6.1.

b) The upper 14m extraction bench would be split into two 7m benches to allow vegetation to be grown on each final bench. The practice of establishing vegetation on benches would continue on lower benches to soften views from the "Figtree Hill" property and to improve the ecological outcomes for the final landform.

Details of the methodology for the revegetation of the benches is presented in Section 3.12.6.2.

4. Eastern Rim

Preliminary designs involved extracting Stages 7c and 7d in one strip from south to north. Initial photomontages prepared for Stage 7c identified considerable views of the active extraction areas would occur when viewed from east of the Princes Highway. The adoption of the Eastern Rim stage and extraction operations proceeding in an easterly direction across the rim would largely remove these views of the active extraction area, with only minor views of the active extraction faces during Stages 7c and 7d from those areas east of the Princes Highway.

5. Dust Plumes from Blasting

Cleary Bros' experience with blasting within Stages 1 to 6 would assist in minimising the visual impacts of blast plumes from blasts initiated in Stage 7. The key control apart from ensuring the blast design is appropriate is the avoidance of blasting during periods when strong winds are blowing towards the residences on

"Figtree Hill" and the adjustment of the time of blast initiation to a period when wind speeds are lower.

6.4.5 Assessment of Impacts

6.4.5.1 Visibility Extent

With the adoption of the mitigation measures outlined in Section 6.4.4, the extent of visual impact can be ascertained for each of the individual or representative locations both during and after the Project life. A series of cross-sections were generated from 17 observer locations within the three key visibility catchments towards the Project Area. A representative selection of the cross-sections are presented in Section 8.2 of RWC (2022) with areas visible from each observer location marked on each cross-section based on the line-of-sight during relevant substages. Examples of these cross-sections are displayed in **Figures 6.4.2** to **6.4.4**.

Cross-sections relating to the extent of visibility of the upper western benches in Stage 7a have been compiled based on the intervening vegetation which is comparable in height to the projected elevation of the proposed amenity barrier and/or tree screens after 15 years.

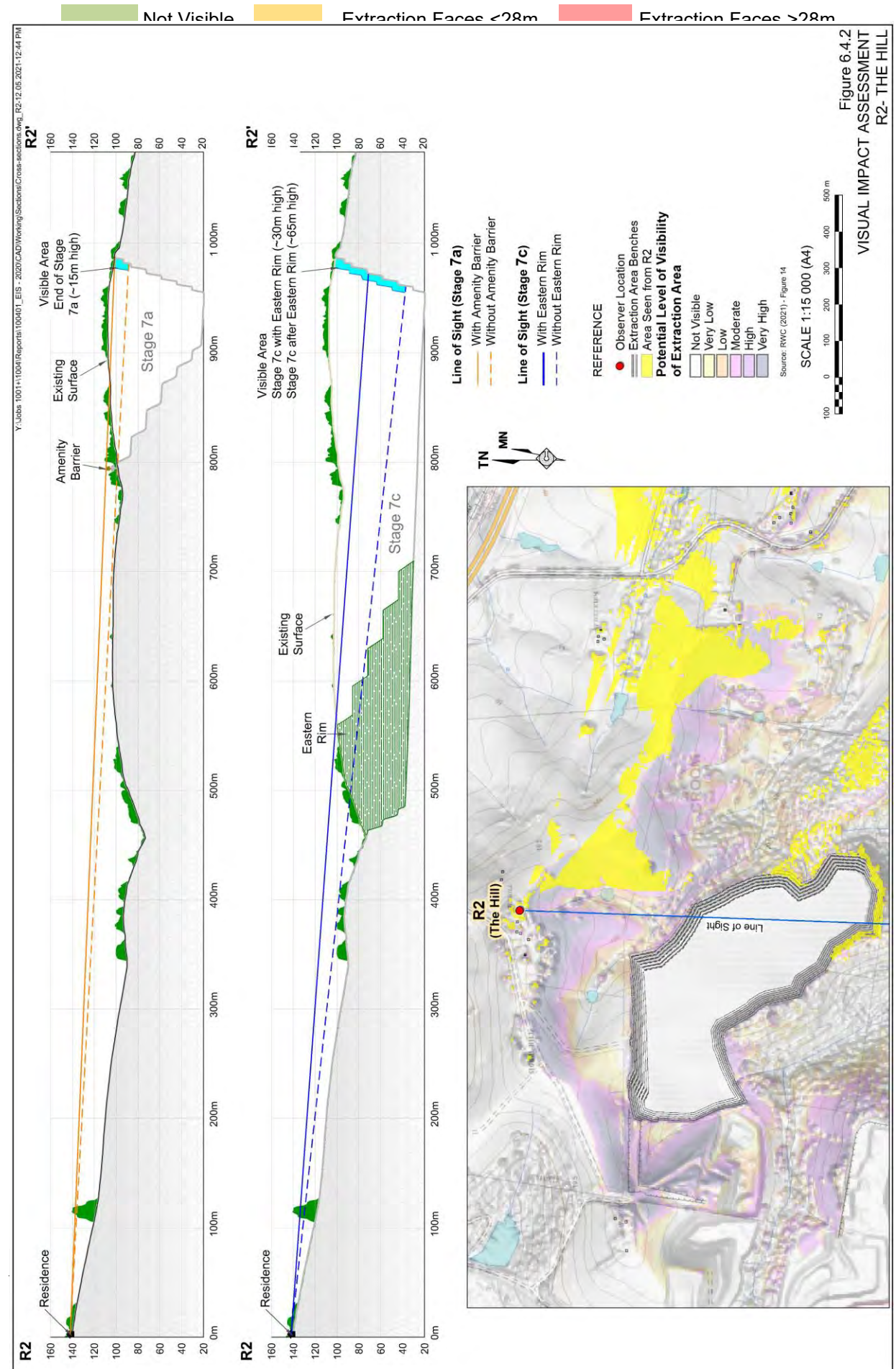
Table 6.4.1 summarises each of the assessed observer locations and the estimated height of visible faces during the respective substages. The estimated heights of visible extraction faces have been colour coded to assist with the impact assessment as follows.

- Not visible – no impact.
- <28m – minor visibility (<2 benches).
- >28m (>2 benches) – moderate to high visibility.

Table 6.4.1
Heights of Visible Extraction Faces from Representative Observer Locations[1] (m)

Location		Stage 7a	Stage 7b	Stage 7c[2]	Stage 4/5/6	Stage 7d[2]
"Figtree Hill"	R1	0	0	0	0	46
	R2	7	7	68	68	68
	R3a	0	0	0	0	20
	R3b	0	0	45	45	45
	R3c	0	8	42	42	42
Shell Cove West Locality	Site1	0	19	19	19	19
	Site2a	0	22	22	22	22
	Site2b	0	24	24	24	24
	Site3a	0	3	38	38	38
	Site3b	0	5	36	36	36
	Site4a	0	0	32	32	32
	Site4b	0	14	14	14	14
	Site5	0	0	45	45	22
	Site6a	0	0	16	16	16
	Site6b	7	12	12	12	12
James Road	Site7a	0	0	0	0	0
	Site7b	5	5	5	5	5

Note 1: Assuming the presence of either amenity barriers or tree screens
Note 2: Following extraction of the Eastern Rim.
Source: RWC (2022) – Table 2



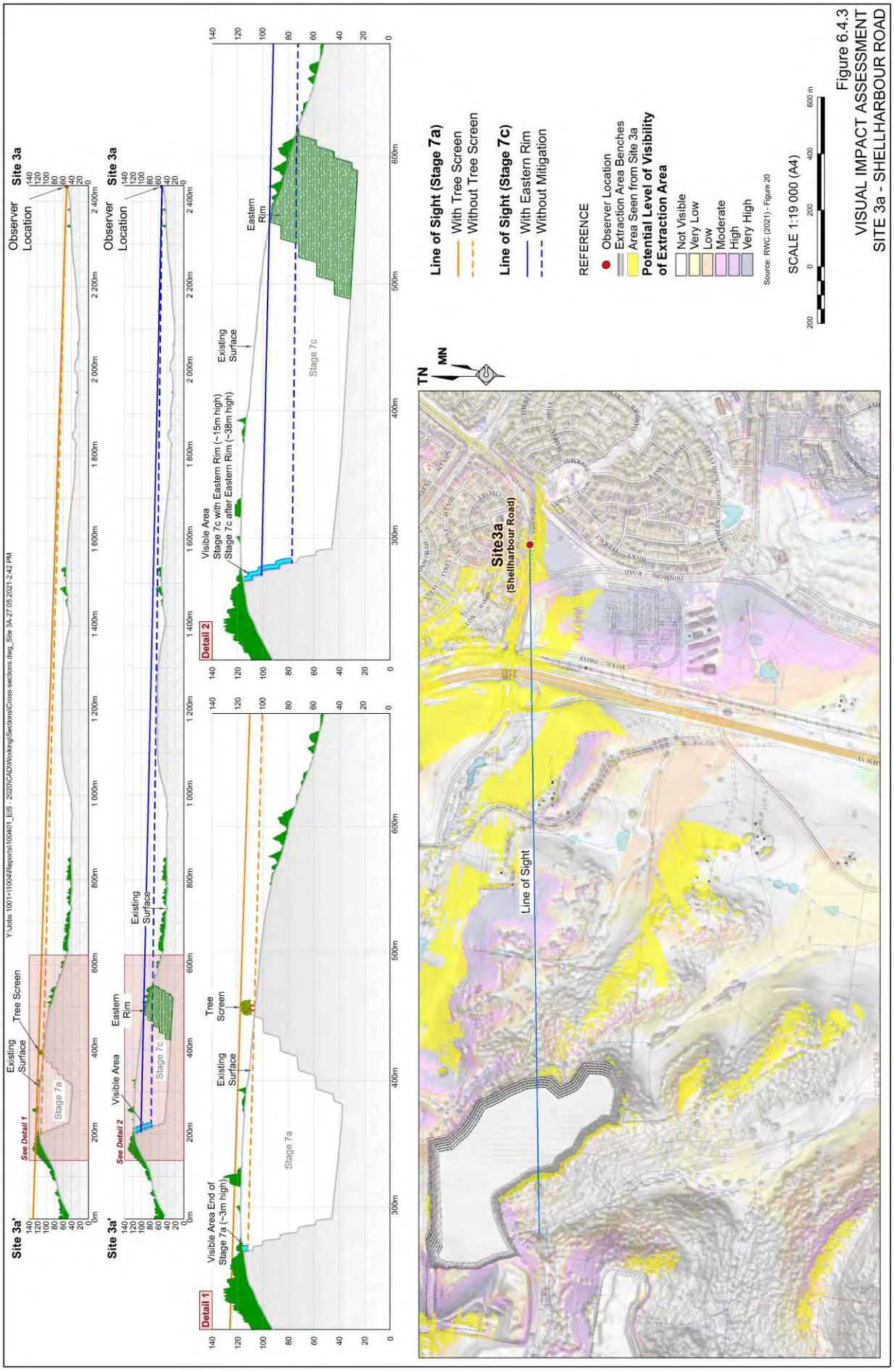


Figure 6.4.3
VISUAL IMPACT ASSESSMENT
SITE 3a - SHELLHARBOUR ROAD
SCALE 1:19 000 (A4)
Source: RWC (2021) - Figure 20
REFERENCE
Observer Location
Extraction Area Benches
Area Seen from Site 3a
Potential Level of Visibility of Extraction Area
Not Visible
Very Low
Low
Moderate
High
Very High
Line of Sight (Stage 7a)
With Tree Screen
Without Tree Screen
Line of Sight (Stage 7c)
With Eastern Rim
Without Mitigation
TN
MN
Site3a
(Shellharbour Road)
Line of Sight
Site 3a'
Site 3a
Observer Location
Existing Surface
Tree Screen
Eastern Rim
Visible Area
Visible Area End of Stage 7a (~3m high)
Stage 7a
Stage 7c
See Detail 1
See Detail 2
Detail 1
Detail 2
Stage 7c with Eastern Rim (~15m high)
Stage 7c after Eastern Rim (~38m high)

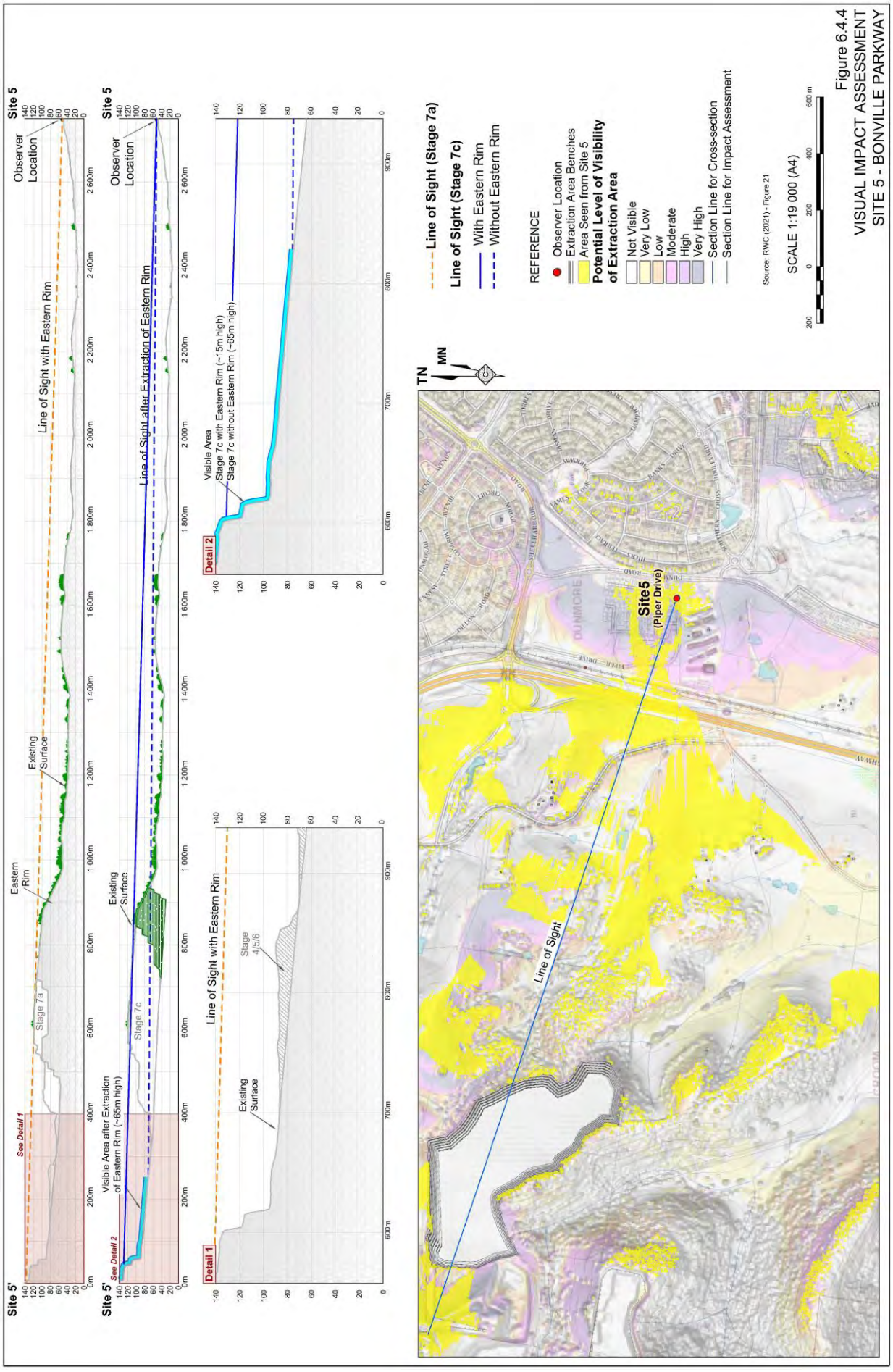


Figure 6.4.4
VISUAL IMPACT ASSESSMENT
SITE 5 - BONVILLE PARKWAY
SCALE 1:19 000 (A4)
Source: RWC (2021) - Figure 21
REFERENCE
Observer Location
Extraction Area Benches Area Seen from Site 5
Potential Level of Visibility of Extraction Area
Not Visible
Very Low
Low
Moderate
High
Very High
Section Line for Cross-section
Section Line for Impact Assessment
Line of Sight (Stage 7a)
Line of Sight (Stage 7c)
With Eastern Rim
Without Eastern Rim
TN
MN
Site5 (Piper Drive)
Line of Sight
Site 5'
Site 5
Observer Location
Line of Sight with Eastern Rim
Line of Sight after Extraction of Eastern Rim
Existing Surface
Eastern Rim
Stage 7a
Stage 7c
Visible Area after Extraction of Eastern Rim (~65m high)
See Detail 1
See Detail 2
Detail 1
Detail 2
Stage 4/5/6
Visible Area
Stage 7c with Eastern Rim (~15m high)
Stage 7c without Eastern Rim (~65m high)

At distances of 1.6km to 2.4km from observation areas within Shell Cove West and west of Dunmore Road, the vertical component of the observed rehabilitated extraction faces would appear comparatively small in the context of the overall view.

In order to assist with the understanding of what would be visible from the various observer locations, a series of photomontages have been prepared as follows.

Photomontage No. 1: displays the existing view and the proposed view from Observer Location Site 2b near the northern end of Shell Cove West (**Plates 6.4.2** and **6.4.3**).

Photomontage No. 2: displays the existing view and the proposed view from Observer Location Site 3a near the northern end of Dunmore Road (**Plates 6.4.4** and **6.4.5**).

Photomontage No. 3: displays the existing view and the proposed view from Observer Location Site 5 (**Plates 6.4.6** and **6.4.7**).

The key impacts drawn from the cross-sections, photomontages and **Table 6.4.1** are as follows.

"Figtree Hill" Property (R1, R2 and R3)

The extraction activities for the first approximately 15 years in Stages 7a and 7b would be substantially shielded from the residence locations on the "Figtree Hill" property. Small exposures of the overburden above the upper hard rock benches may be visible, however, their grassed appearance would generate little visual impacts from these locations, once revegetated.

The elevated location of the two existing residences within the "Figtree Hill" property (i.e. "The Cottage" and "The Hill") would provide occupants with obscured views during Stages 7c and 7d into the extraction area through the perimeter vegetation around the residences. It is acknowledged that the views towards the Project Area would change substantially, mainly in the second half of the Project life, i.e. from about Year 15.

Observers would view from "The Cottage" up to 65m vertical height of the western faces along an approximate 200m length of Stage 7a approximately 0.5km from the residence. Importantly, by the time these views occur, vegetation would be well established on the final benches. A similar view of the extraction area would occur from "The Hill" which would be able to observe the southern end of the extraction area, at a distance of approximately 0.9km. Whilst returning the near horizontal appearance of the benches, the overall views from both residences would be softened with the advanced vegetation.

The elevated area for the approved residence and the absence of surrounding vegetation would result in views from this location into the extraction area principally during Stages 7c and 7d. An observer at this location would ultimately be able to see between 35m and 45m of extraction faces in the latter half of the Project life again with vegetation growth well advanced.

In light of the above, Cleary Bros and the owners of "Figtree Hill" have negotiated an agreement that addresses a range of matters, including visibility. Under that agreement, the owners have agreed to accept Project-related impacts to the extent identified in this sub-section.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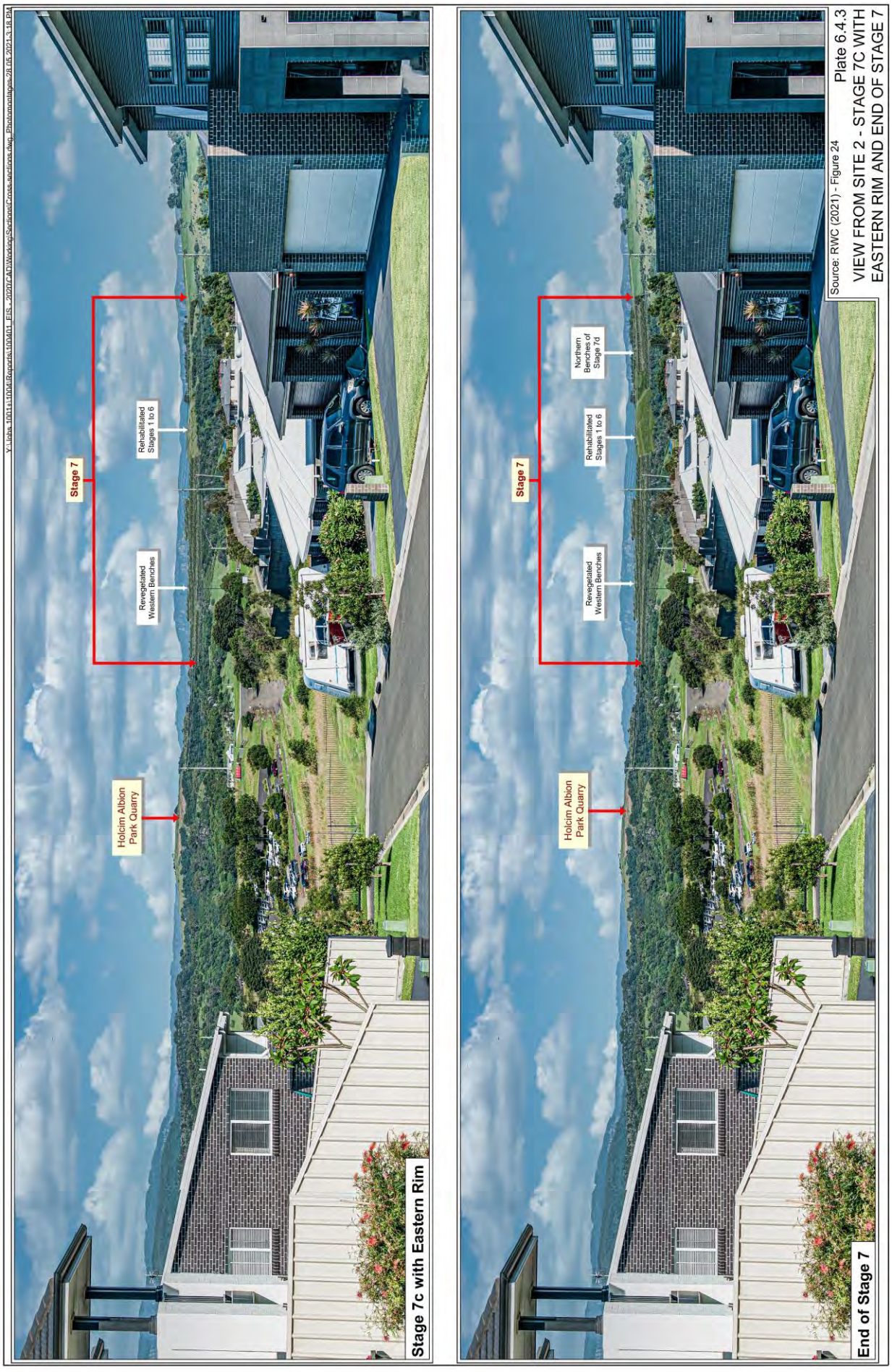
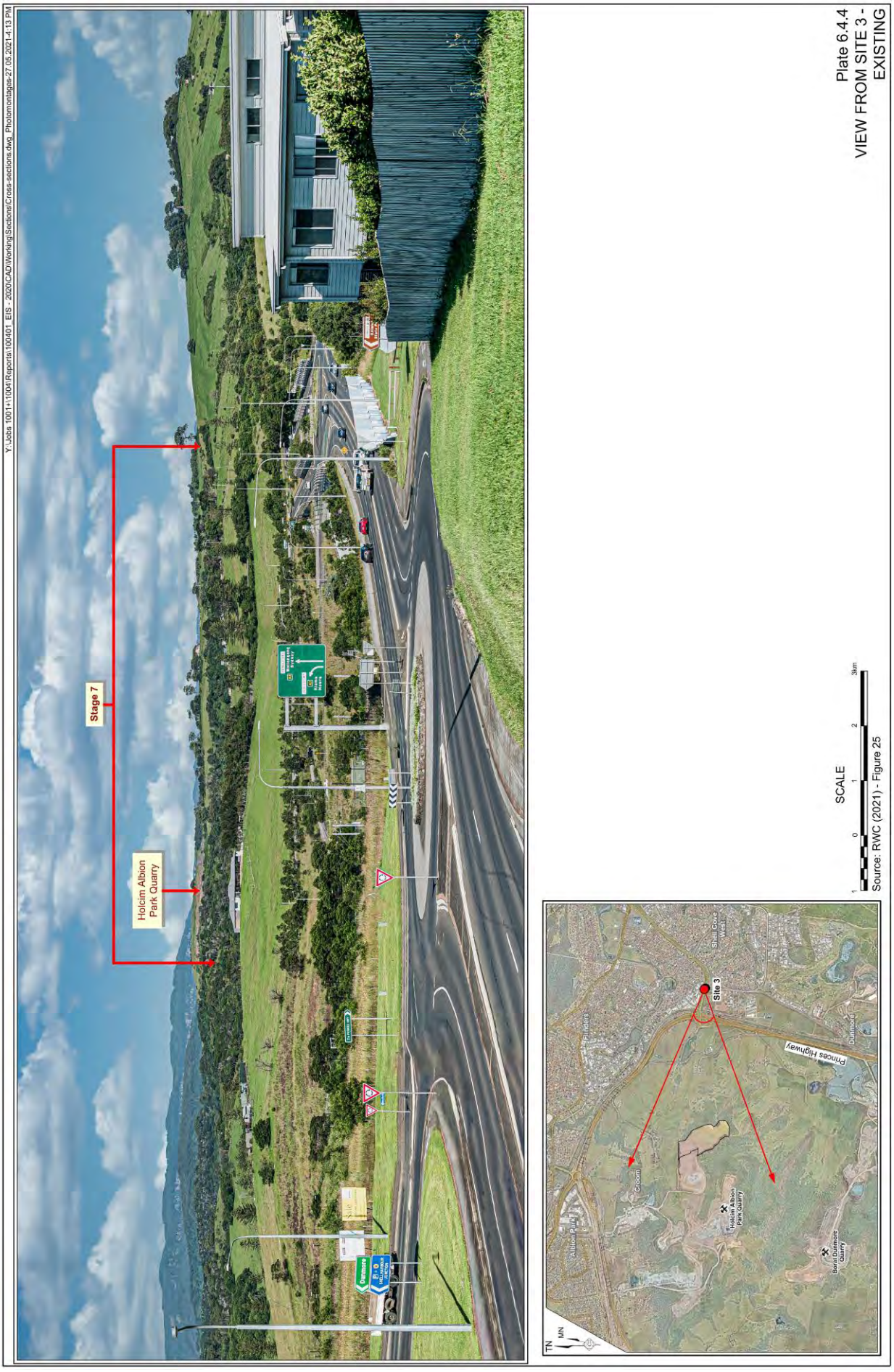
Stage 7
Holcim Albion Park Quarry
Plate 6.4.2
VIEW FROM SITE 2 - EXISTING
SCALE
0
1
2
3km
Source: RWC (2021) - Figure 23
Site 2
Princes Highway
Albion Park
Albion Park Rail
Shell Cove West
Dunmore
Flinders
Cloorn
Holcim Albion Park Quarry
Boral Dunmore Quarry
TN
MN



Source: RWC (2021) - Figure 24

Plate 6.4.3
VIEW FROM SITE 2 - STAGE 7C WITH EASTERN RIM AND END OF STAGE 7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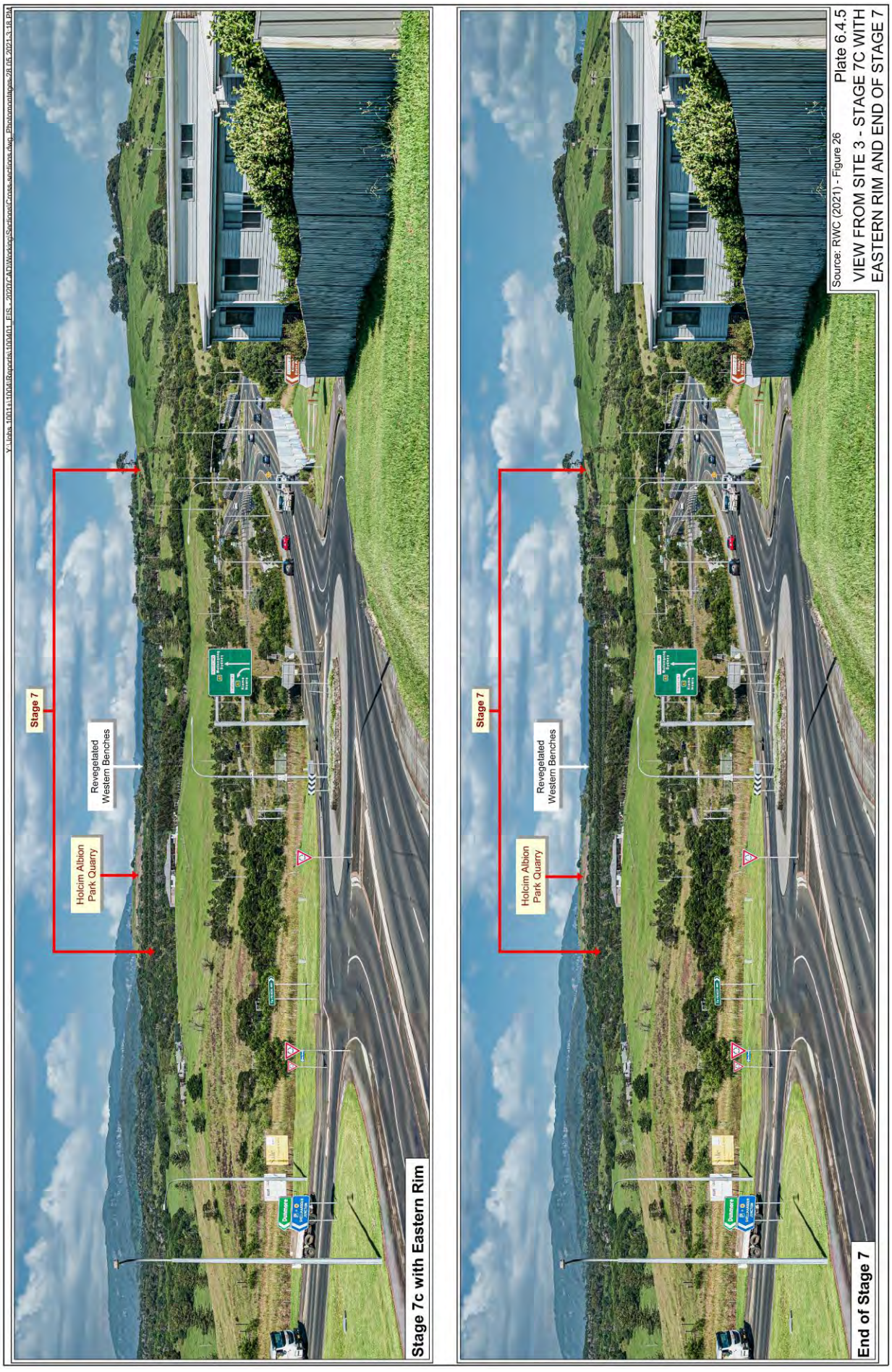
Stage 7
Holcim Albion Park Quarry
Plate 6.4.4
VIEW FROM SITE 3 - EXISTING
SCALE
0
1
2
3km
Source: RWC (2021) - Figure 25
Site 3
Princes Highway
Shell Cove West
Flinders
Dunmore
Groom
Albion Park
Albion Park Quarry
Boral Dunmore Quarry
TN
MN



Source: RWC (2021) - Figure 26

Plate 6.4.5
VIEW FROM SITE 3 - STAGE 7C WITH EASTERN RIM AND END OF STAGE 7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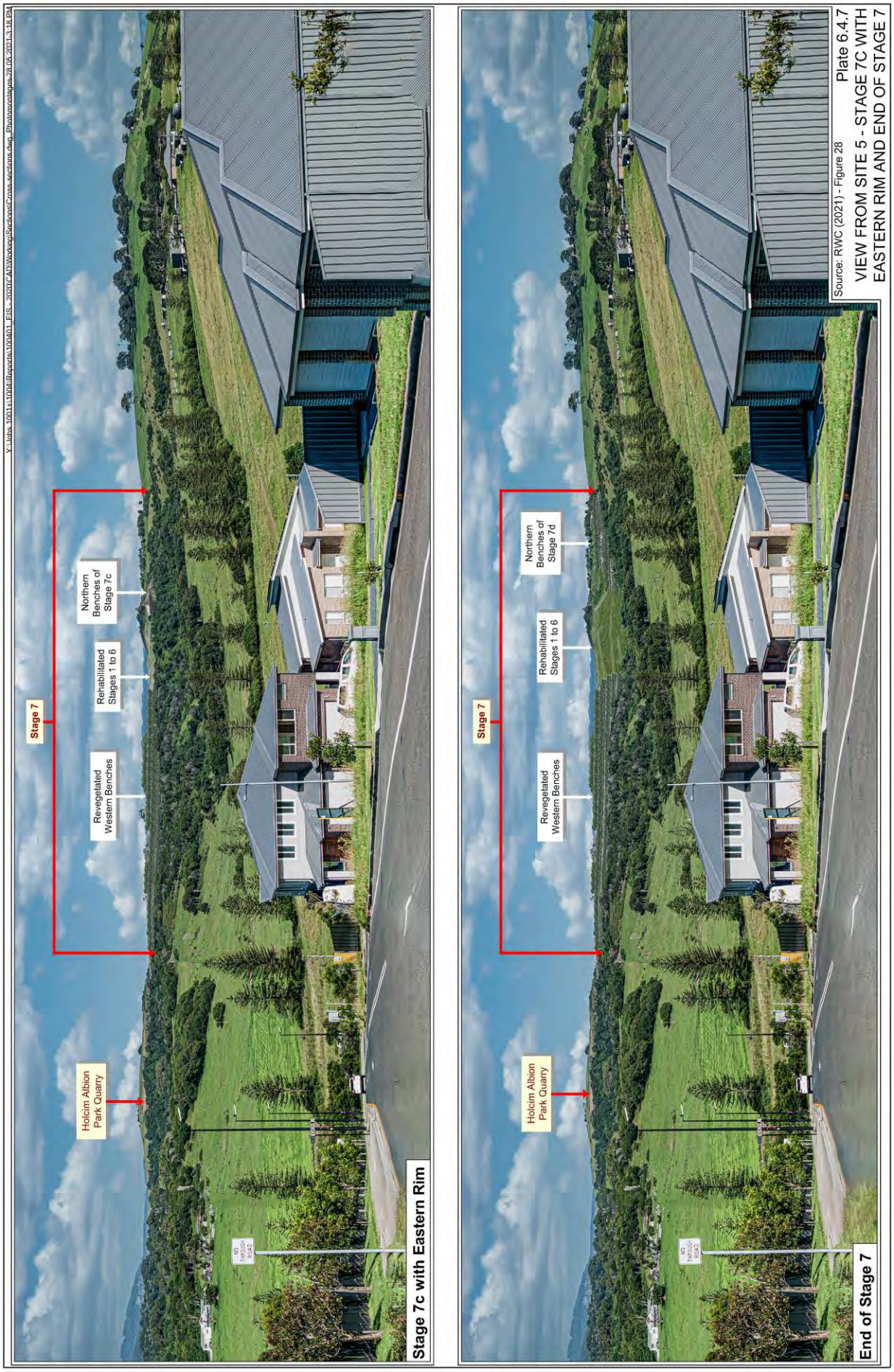
Stage 7
Holcim Albion Park Quarry
Plate 6.4.6
VIEW FROM SITE 5 - EXISTING
SCALE
0
1
2
3km
Source: RWC (2021) - Figure 27
Site 5
Princes Highway
Shell Cove
Albion Park
Albion Park Rail
Dunmore
Cloorn
Holcim Albion Park Quarry
Boral Dunmore Quarry
TN
MN



Source: RWC (2021) - Figure 28

Plate 6.4.7
VIEW FROM SITE 5 - STAGE 7C WITH EASTERN RIM AND END OF STAGE 7

Shell Cove West (Sites 1, 2a and 2b)

During Stage 7a, the existing vegetation, amenity barrier and tree screen on the eastern side of Stage 7 would minimise the extent of western faces within Stage 7a that would be visible. As extraction proceeds in Stage 7b, the lowering of the eastern section of the Project Area would expose the upper 20m to 25m of the western faces in Stage 7a. However, given the planned planting program on the western benches, the trees established by that time (approximately 15 years), would reduce the visual impacts as the view would be comparable to other nearby vegetation areas near the skyline.

Similar visual impacts are predicted for extraction operations later in Stages 7c and 7d, during extraction of the Eastern Rim, and by that time the vegetation on the upper benches would be well established.

West of Dunmore Road (Sites 3a, 3b, 4, 5 and 6)

During Stage 7a, the current topography, amenity barrier and tree screens on the eastern side of Stage 7a and revegetation of the overburden, would minimise the extent of the western faces within Stage 7a that would be visible. As extraction proceeds in Stage 7c, retention of the Eastern Rim would minimise the visibility of the western faces of the Stage 7 extraction area until the later part of the Project life. The exposure of these faces would be mitigated through the proposed revegetation of the benches within the extraction area, with those trees well established by the time the Eastern Rim is extracted.

6.4.5.2 Visibility of Earthmoving Equipment

The removal of vegetation, soil stripping and overburden extraction would be undertaken in short campaigns throughout the Project life principally through the use of a bulldozer and an articulated truck and excavator fleet. This equipment would be present during each campaign for comparatively short periods as these activities would be undertaken over a small area in readiness for the subsequent hard rock extraction in that area.

It is noted that, with the exception of some areas within the “Figtree Hill” property, the distance between the operating equipment and the observers would be sufficient for the equipment not to be visually obtrusive. Observers within the “Figtree Hill” property would be able to see the equipment at distances typically between 0.5km and 0.9km. The overall design of the Project Area focussed upon minimising the extent to which observers within the “Figtree Hill” residences could view hard rock extraction areas that would be in operation on a daily basis.

It is possible that the drilling rig used to drill holes for blasting the hard rock would periodically be visible for short periods following the removal of vegetation, soil stripping and overburden extraction campaigns. However, the extent of visibility would be limited as the drilling rig would be located between 2m and 8m below natural ground level as it would only be used after the removal of the overburden that does not require blasting.

It is recognised that quarrying operations in the Albion Park and Dunmore area west of the Princes Highway has been an ongoing activity for many decades and the periodic views of equipment is acknowledged as an appropriate activity in this important resource area.

6.4.5.3 Visibility of Amenity Barriers

The amenity barrier and tree screen on the eastern side of Stage 7a and northern side of Stage 7d (subject to agreement with the owners of "Figtree Hill") are proposed to assist with the attenuation of both noise and visual impacts. The barriers would be constructed so that they are themselves visually appealing with their outer face vegetated. The growth of trees and shrubs would soften the views of barriers and they would effectively become part of the landscape when viewed from outside the Project Area. Their appearance would be similar to the vegetation observed near the existing skyline.

For most viewing locations around the Project Area, the barriers and their vegetation would remain below the skyline. Where the barriers and their vegetation rise above the skyline, the change would be minor and unlikely to create any adverse visual impacts.

6.4.5.4 Blast Emissions

The experience gained by Cleary Bros to date with blasts initiated in Stage 1 to 6 would assist to limit the visual impacts of the dust plumes generated by blasting. Blast plumes would continue to be visible for short periods from "Figtree Hill" particularly when the blasts are initiated on the upper benches in Stage 7. Dust plumes from these blasts may be visible from Shell Cove West, however, the impact would be minor given the considerable separation distance and rapid dispersion of the plume.

6.4.5.5 Summary of Impacts

The visibility assessment has established that extraction activities within Stage 7a would not be visible from most surrounding residences or public land for the first 10 years of the Project life, with the exception of some short-term near-surface activities. The exposure of overburden may be visible from some locations during this period, however, stabilisation with grasses and shrubs/trees would effectively remove any adverse visual impacts.

The progression of extraction from Stages 7b to 7d would progressively expose various heights of extraction faces along the western side of Stages 7a. The western extraction faces of Stage 7a would be most visible from the existing residences on the nearby "Figtree Hill" property, albeit being partly obscured by existing vegetation around the residences. Whilst these faces would be progressively exposed, to varying degrees, the planned planting of vegetation on the benches would substantially reduce their visual impact(s). In effect, the vegetation established would soften the dark grey colour and introduce colours that would blend with the natural colours and textures of vegetation in the foreground adjacent to the Project Area and in the far distance. In light of this, Cleary Bros and the owners of "Figtree Hill" have negotiated an agreement that addresses a range of matters, including visibility. Under that agreement, the owners have agreed to accept Project-related impacts to the extent identified in this sub-section.

The impacts of the mobile equipment, principally a bulldozer and drill rig operating for comparatively short periods on the surface and within view from the key visibility catchments, are assessed as acceptable given the considerable distance between the observers and the equipment.

The impacts of the constructed amenity barriers are assessed to be acceptable given the manner in which they would be vegetated and become part of the overall landscape.

6.4.6 Conclusion

The staged design of the extraction operations within Stage 7, together with proposed amenity barriers and tree screens, would result in little visibility of the extraction activities during the first 10 to 15 years of operations. Beyond that time, parts of the upper extraction faces on the western side of Stage 7 would progressively become visible from the "Figtree Hill" property to the north and from elevated areas within Shell Cove West, east of the Princes Highway. However, the west to east progression through Stages 7c and 7d and the adoption of the Eastern Rim would minimise visual impacts during the latter half of the Project life. The establishment of vegetation on the upper western benches and the dark grey exposed extraction faces would effectively minimise contrasts and soften views of the exposed upper sections of the extraction area visible from the "Figtree Hill" residences and Shell Cove West. Cleary Bros and the owners of "Figtree Hill" have negotiated an agreement that addresses a range of matters, including visibility. Under that agreement, the owners have agreed to accept Project-related impacts to the extent identified in this sub-section.

Overall, the proposed visual impacts generated by the Project have been assessed to be acceptable given the extent of visual mitigation that would be adopted in the context of the quantity of resources that would be recovered to provide high quality raw materials for the ongoing development of the Illawarra-Shoalhaven and Greater Sydney Regions.

6.5 Biodiversity

6.5.1 Introduction

The SEARs for the Project require the EIS to include an assessment of the following potential impacts of the Project on biodiversity.

- Accurate predictions of any vegetation clearing 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.
- A strategy to offset any residual impacts of the development in accordance with the *Biodiversity Offsets Scheme*.

The assessment requirements of the Biodiversity & Conservation Division (BCD), the Commonwealth Department of Agriculture, Water and Environment (DAWE) and Shellharbour City Council were also considered during the preparation of the biodiversity assessment. A summary of the SEARs and the requirements of the above three agencies are listed within **Table A.1** and **Table A.2**, within **Appendix A** together with a record of where each requirement is addressed in the EIS.

A Biodiversity Development Assessment Report (BDAR) for the Project was prepared by Niche Environment and Heritage Pty Ltd (Niche) and is presented as Part 4 of the *Specialist Consultant Studies Compendium* and hereafter referred to as Niche (2022). The following subsections provide a summary of the BDAR and describe the operational safeguards and management measures that would be implemented by Cleary Bros. Reference is made, where appropriate, to the current *Vegetation Management Plan* (VMP) for the current extraction area with all relevant mitigation measures included in the VMP incorporated within this subsection.

6.5.2 Assessment Methodology

6.5.2.1 Landscape Assessment

A landscape assessment was initially undertaken by Niche (2022) in accordance with Section 4 of the Biodiversity Assessment Methodology (BAM) (DPIE, 2020). This assessment considered landscape value and the potential impacts associated with the Project through the consideration of factors including:

- native vegetation cover;
- rivers, streams and estuaries;
- areas of geological significance; and
- habitat connectivity.

6.5.2.2 Native Vegetation and Flora Assessment Methodology

Desktop Review

A desktop review of the following resources was undertaken by Niche (2022) to inform the field survey design and effort.

- NSW BioNet Atlas Database.
- EPBC Act Protected Matters Search Tool.
- BAM Calculator Tool.
- Vegetation Mapping – Illawarra Plant Community Type Vegetation Map (DPIE, 2016).

Field Survey

Niche (2022) undertook multiple rounds of field surveys within the identified Biodiversity Study Area (**Figure 6.5.1**) between April and December 2020, with the total survey effort for the Project totalling approximately 164 hours. A complete list of field survey activities and dates is provided in Table 4 of Niche (2022).

Plant Community Types (PCTs) within the Biodiversity Study Area were identified and mapped using a combination of BAM plots, transects and walking meanders (**Figure 6.5.1**).

Targeted Threatened Species Surveys

Requirements for targeted threatened species surveys for candidate species identified as potentially occurring within the Biodiversity Study Area were determined by Niche (2022) based on:

- a review of associated PCTs and comparison with PCTs present within the Biodiversity Study Area;
- the presence of habitat constraints within the Biodiversity Study Area; and
- the quality and suitability of habitat within the Biodiversity Study Area.

Where the presence of candidate species within the Biodiversity Study Area could not be ruled out based on the above factors, a conservative approach was adopted and targeted surveys were conducted.

Detailed surveys for *Zieria granulata* were undertaken within the Biodiversity Study Area to develop an understanding of the local population, with avoidance of adult plants, where practicable, through extraction area design and to inform offsetting requirements. As *Z. granulata* is listed as a 'count' species under the BAM, offsetting requirements are based on the number of mature plants impacted rather than the area disturbed. The following parameters were assessed by Niche (2022) for *Z. granulata* during targeted systematic surveys within the Study Area.

- Plant counts within quadrats.
- Approximate height of individual plants.
- Stem diameter at base of individual plants.
- Reproductive status based on observations of buds, flowers or fruit/seed.

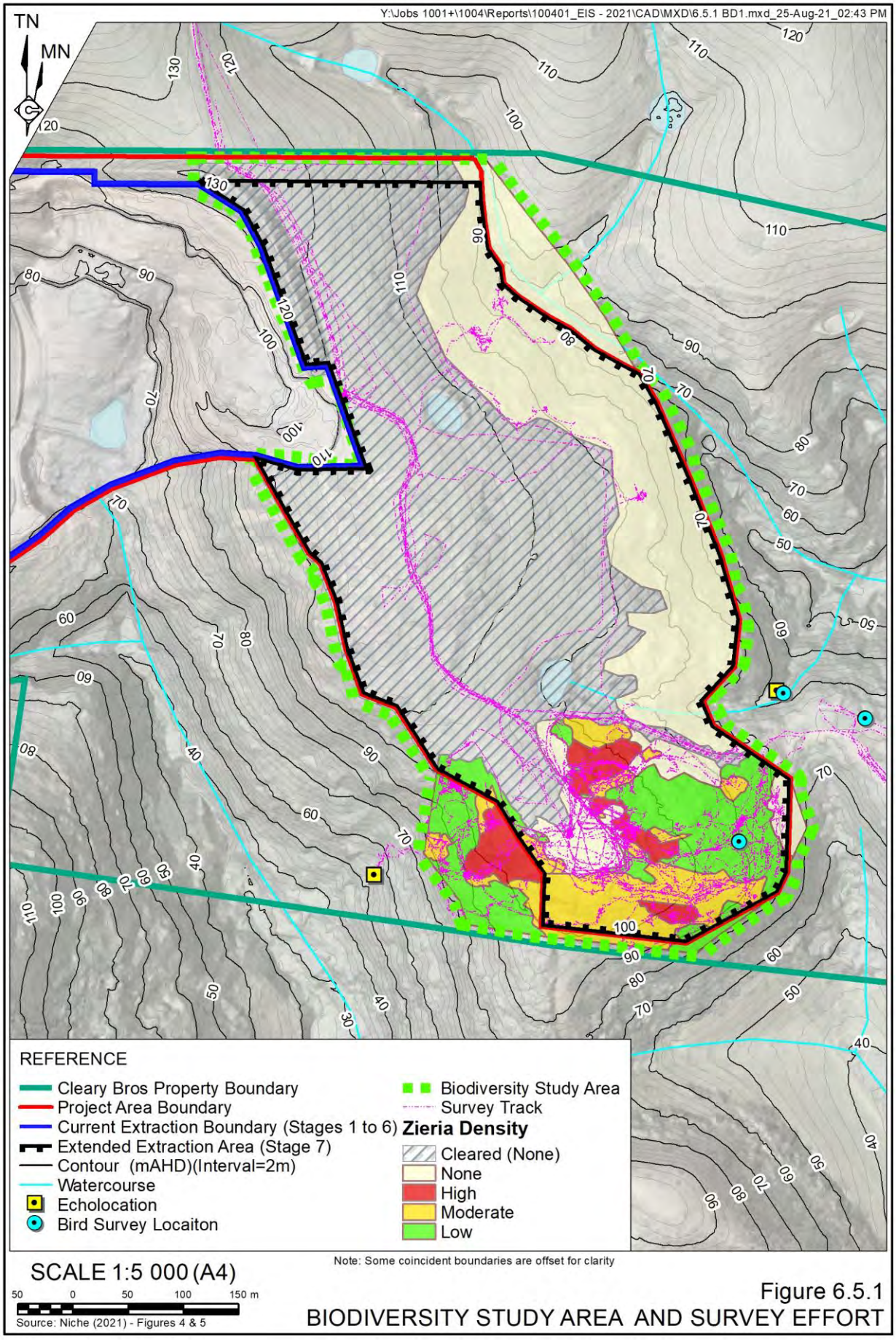


Figure 6.5.1
BIODIVERSITY STUDY AREA AND SURVEY EFFORT

Z. granulata counts and measurements were made for all individuals within two 10m x 10m subplots for each of the larger 50m x 50m plots used to subdivide the Biodiversity Study Area. Measurements completed between September and October 2020 were used for maturity analyses as these periods coincided with peak flowering periods for the species.

6.5.2.4 Fauna Assessment Methodology

Desktop Review

A desktop review of relevant literature, databases and vegetation mapping was undertaken by Niche (2022) to identify fauna habitats and threatened fauna species with the potential to occur within the Biodiversity Study Area.

Field Survey

The following habitat features were assessed within the Biodiversity Study Area to determine the likely presence of threatened fauna species.

- Type, condition and diversity of vegetation communities.
- Roosting / breeding / sheltering resource availability (e.g. hollow-bearing trees, rocky outcrops, caves, logs).
- Permanent and ephemeral aquatic habitat.

Targeted threatened fauna surveys were undertaken for those species identified as having a moderate to high likelihood of occurrence and identified as candidate species in the BAM Calculator. Further detail regarding the assessment of species likelihood of occurrence is provided in Annexure 6 of Niche (2022).

A total of 11 threatened fauna species were identified by the BAM Calculator as species credit species for the Project, none of which are listed as candidate species for serious or irreversible impacts.

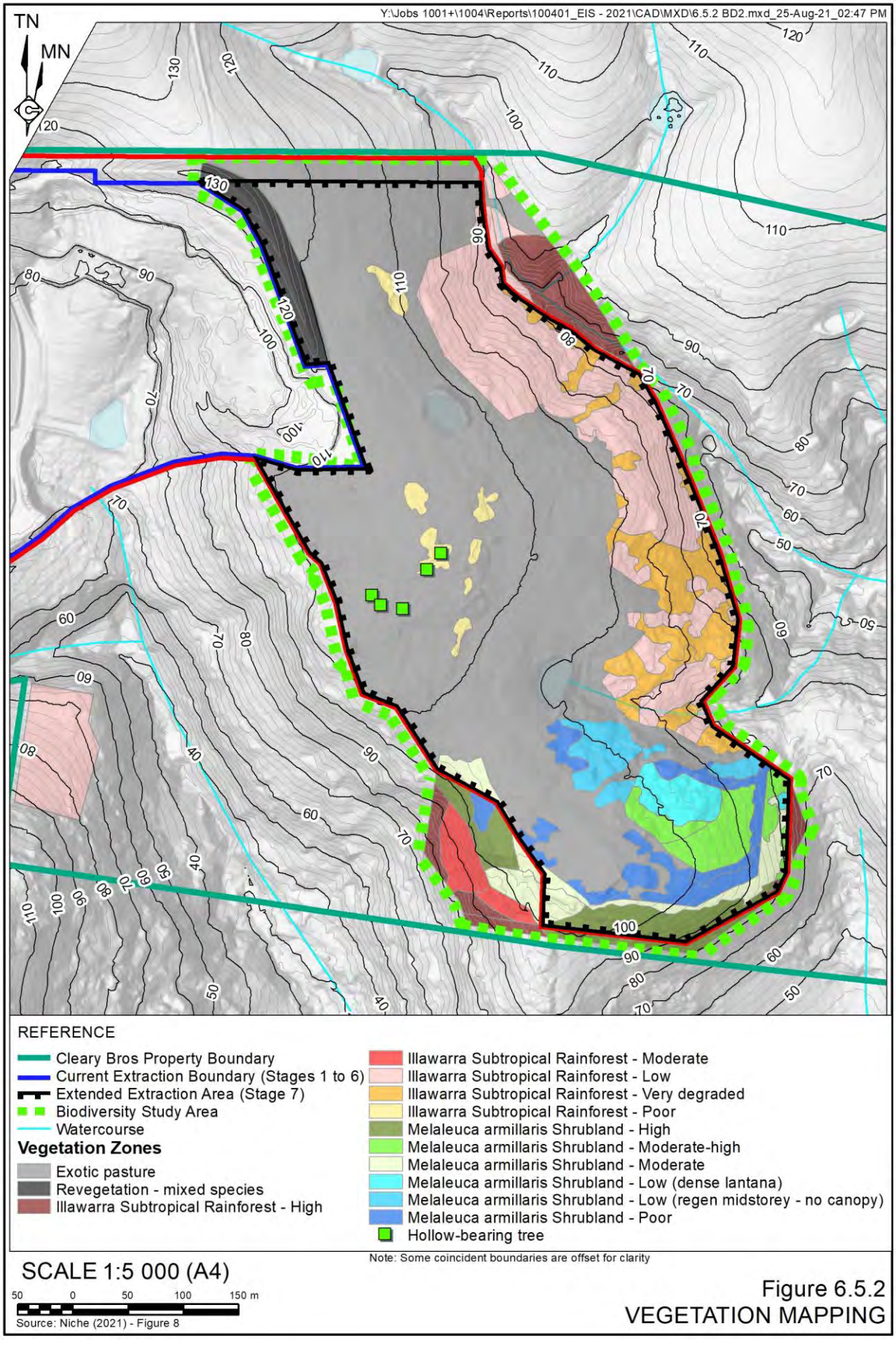
Details of the fauna survey methods, timing and effort employed during the assessment are presented in Table 11 of Niche (2022).

6.5.3 Survey Results

6.5.3.1 Native Vegetation and Flora

Figure 6.5.2 displays vegetation mapped by Niche (2022) within the Biodiversity Study Area and **Table 6.5.1** summarises the extent and condition of vegetation within the Project Area.

PCT 1300 is identified as a Threatened Ecological Community (TEC) in the BAM Calculator as it is listed as Endangered and Critically Endangered under the *BC Act* and the *EPBC Act* respectively. PCT 720 is also identified as a TEC in the BAM Calculator as it is listed as Critically Endangered under the BC Act.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TN
MN
REFERENCE
Cleary Bros Property Boundary
Current Extraction Boundary (Stages 1 to 6)
Extended Extraction Area (Stage 7)
Biodiversity Study Area
Watercourse
Vegetation Zones
Exotic pasture
Revegetation - mixed species
Illawarra Subtropical Rainforest - High
Illawarra Subtropical Rainforest - Moderate
Illawarra Subtropical Rainforest - Low
Illawarra Subtropical Rainforest - Very degraded
Illawarra Subtropical Rainforest - Poor
Melaleuca armillaris Shrubland - High
Melaleuca armillaris Shrubland - Moderate-high
Melaleuca armillaris Shrubland - Moderate
Melaleuca armillaris Shrubland - Low (dense lantana)
Melaleuca armillaris Shrubland - Low (regen midstorey - no canopy)
Melaleuca armillaris Shrubland - Poor
Hollow-bearing tree
Note: Some coincident boundaries are offset for clarity
SCALE 1:5 000 (A4)
50 0 50 100 150 m
Source: Niche (2021) - Figure 8
Figure 6.5.2
VEGETATION MAPPING

Table 6.5.1
PCTs and Vegetation Condition within the Biodiversity Study Area

Plant Community Type	Condition Class	Area within the Project Area (ha)
PCT 1300 – Whalebone Tree – Native Quince dry subtropical rainforest	High	0.01
	Low	3.14
	Poor	0.30
	Very Degraded	1.24
PCT 720 – *Melaleuca armillaris* Tall Shrubland	High	0.38
	Moderate – High	0.58
	Moderate	0.47
	Low (dense lantana)	0.29
	Low (regenerating midstorey – no canopy)	0.43
	Poor	0.77
	Total	**7.61**
Source: Niche (2022) – modified after Table 6 and Section 2.2.4.		

The BAM Calculator identified a total of eight threatened flora species as either species credit species or other threatened flora with a moderate to high likelihood of occurring within the Biodiversity Study Area. Based on the landscape assessment and the results of targeted surveys undertaken for each of the candidate species, Niche (2022) concluded that the two threatened species (*Zieria granulata* and *Cynanchum elegans)* were present within the Biodiversity Study Area and would therefore require offsetting as species credit species for the Project.

Zieria granulata (Illawarra Zieria)

Table 6.5.2 presents the *Z. granulata* calculations undertaken by Niche (2022) in order to determine the number of mature individuals which would be impacted by the Project. Based on an identified correlation between stem size and maturity, Niche (2022) determined that mature individuals included any plant with a stem diameter >13mm.

Table 6.5.2
***Z. granulata* Density and Count Calculations – Total and Mature Plants**

Page 1 of 2

Vegetation Zone[1]	Density		*Z. Granulata*		
	Category	Average Plants per ha	Area (ha)	Total Plant Count	Mature Plant Count
Exotic Pasture	High	5133.3	0.0671	693	333
	Moderate	1812.5	0.1801		
	Low	236.8	0.0922		
PCT 1300 – High	Low	236.8	0.0094	2	1
PCT 720 – High	High	5133.3	0.0373	714	343
	Moderate	1812.5	0.2796		
	Low	236.8	0.0643		
PCT 270 – Moderate – High	High	5133.3	0.0168	266	128
	Moderate	1812.5	0.0373		
	Low	236.8	0.4731		

Table 6.5.2 (Cont'd)
***Z. granulata* Density and Count Calculations – Total and Mature Plants**

Vegetation Zone[1]	Density		*Z. Granulata*		
	Category	Average Plants per ha	Area (ha)	Total Plant Count	Mature Plant Count
PCT 270 – Moderate	High	5133.3	0.0309	609	292
	Moderate	1812.5	0.2239		
	Low	236.8	0.1886		
PCT 720 – Low (dense lantana)	Low	236.8	0.2769	66	32
PCT 270 – Low (regenerating midstory – no canopy)	High	5133.3	0.1828	1 191	572
	Moderate	1812.5	0.1285		
	Low	236.8	0.0824		
PCT 270 - Poor	High	5133.3	0.0598	982	471
	Moderate	1812.5	0.3418		
	Low	236.8	0.2329		
			Total	**4 521[2]**	**2 172[2]**

Note 1 : Vegetation Zones reflect the PCT and condition class (see **Table 6.5.1**).

Note 2: Total number of mature *Z. granulata* to be disturbed has been calculated as 2 170 individuals, however when calculated at the vegetation zone category level as required under the BAM, the number is higher (2 172) due to rounding, and is the total used for calculating offset requirements.

Source: Niche (2022) – modified after Tables 10 and 11

Cynanchum elegans (White-flowered Wax Plant)

The identified species polygon (0.15ha) for *C. elegans* covers the area of a single plant identified within the Biodiversity Study Area plus a modelled area of potential habitat identified as an ecotone area between PCT 270 and PCT 1300 which has not been subject to recent clearing.

6.5.3.2 Fauna

A total of eight tree hollows, all less than 20cm in diameter within five hollow-bearing trees were recorded within the Biodiversity Study Area during field surveys. A single hollow stag tree was also recorded. The locations of the hollow-bearing trees are displayed on **Figure 6.5.2**.

Species recorded or potentially present within the Biodiversity Study Area included four species of threatened microbat (Eastern Bentwing Bat, Little Bentwing Bat, Greater Broad-nosed Bat and Yellow-bellied Sheath-tailed Bat), all of which are listed as vulnerable under the BC Act. The Grey-headed Flying-fox, listed as vulnerable under both the BC Act and the EPBC Act, is also known to use habitat within the Project Area.

Table 12 in Niche (2022) provides a complete list of the ecosystem credit species and species credit species identified for the Project. Despite the absence of significant habitat within the Biodiversity Study Area, all of the ecosystem credit species were assumed present for inclusion in the BAM Calculator. Ecosystem credit species included eight birds, five bats, and one terrestrial mammal. None of the 11 species credit species targeted for site surveys were identified within the Biodiversity Study Area.

6.5.4 Avoidance, Management and Mitigation Measures

The original boundary of the Stage 7 extraction area was determined by the occurrence of the suitable hard rock resource and its close proximity to existing processing infrastructure in order to avoid impacts associated with additional infrastructure establishment.

The Project design was developed and amended multiple times, taking into account the results of biodiversity surveys and the outcomes of consultation with BCD and DAWE. Avoidance areas totalling 2.05ha within land zoned for extraction under the Shellharbour LEP 2013 were subsequently incorporated into the Project design (see **Figure 1.4**). These avoidance areas included higher condition threatened ecological communities as well as areas supporting better condition habitat of the threatened plants *Z. granulata* and *C. elegans*. In order to compensate for the avoidance areas, additional areas consisting generally of cleared exotic pasture were incorporated into the Project Area.

Cleary Bros would implement the following management and mitigation measures during the construction and operational phases of the Project to further mitigate and manage biodiversity impacts.

- Prepare and implement a *Biodiversity Management Plan* detailing the biodiversity mitigation and management measures required at the Quarry. This plan would include procedures for the monitoring of rehabilitation outcomes and describe the implementation of the proposed staged biodiversity offsets described in Section 3.13.4.
- Delineate the boundaries of the proposed Stage 7 extraction area with clearly visible markers.
- Establish fencing around areas of native vegetation adjacent to the proposed disturbance areas and maintain fencing throughout the Project life.
- Ensure that topsoil resources stripped from the surface of the proposed extraction area are retained for use in rehabilitation activities – see Section 6.8.5.
- Implement adaptive dust management and monitoring programs to manage air quality in accordance with existing protocols for the Quarry.
- Communicate environmental features and requirements to protect threatened flora through staff inductions, training sessions and briefings.
- Establish and regularly maintain erosion and sediment controls until rehabilitation works have achieved vegetated final landforms.
- Avoid clearing of hollow-bearing trees during the breeding season for the majority of hollow-dwelling fauna (i.e. spring).
- Undertake pre-clearing inspections of hollow-bearing trees to confirm the absence of roosting/breeding threatened species and manage any vertebrate fauna identified during inspections to minimise the risk of mortality or injury.
- Undertake vegetation clearance and mulching in accordance with best practice principles.
- Ensure that all waste generated at the Quarry is managed appropriately.

6.5.5 Assessment of Impacts

DPIE (2020) categorises impacts on biodiversity in accordance with the following descriptions.

- Direct impacts: those that directly affect habitat and individuals (e.g. death through predation, trampling, poisoning of the animal/plant itself, removal of suitable habitat).
- Indirect impacts: occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss (e.g. starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes).

Table 6.5.3 presents a summary of the direct and indirect biodiversity impacts which would occur as a result of the Project, including a likelihood rating assigned by Niche (2022).

Table 6.5.3
Direct and Indirect Project-related Biodiversity Impacts

Impact	Extent of Impact as a Result of the Project
Direct Impacts	
Removal or modification of native vegetation.	Known: approximately 4.69ha of PCT 1300 and 2.92ha of PCT 720 would be removed.
Loss of individuals of a threatened species.	Known: an area of 3.01 ha of *Z. granulata* habitat, comprising an estimated 2 170 mature plants and 2 351 immature plants, would be removed. One known individual of *C. elegans* and an estimated additional habitat area for this species of 0.15ha would be removed.
Removal or modification of threatened species habitat other than native vegetation.	Low/moderate: the area contains limited tree hollows or other habitat features, however it does provide foraging habitat for a range of threatened fauna.
Death through trampling or vehicle strikes.	Low: limited increased risk as vegetation clearing represents the primary impact.
Death through poisoning.	Low: no poisons would be used as part of the Project other than as required to control exotic species to meet obligations under the *Biosecurity Act 2015*.
Fragmentation.	Moderate: clearing would impact already fragmented vegetation, with impacts occurring for lower quality remnant vegetation.
Indirect Impacts	
Predation by domestic and/or feral animals.	Low: the Project is located in a rural area and is unlikely to increase domestic or feral animal presence.
Loss of shade/shelter.	Low: the removal of 7.61ha of vegetation would result in the loss of shade and shelter, however similar habitat is available in the immediate vicinity of the Project Area.
Loss of individuals through starvation.	Low: the habitat removed is considered unlikely to result in loss through starvation.
Loss of individuals through exposure.	Low: habitat to be removed consists primarily of stands of previously disturbed vegetation. Nearby habitat would not be impacted by the Project.
Edge effects (noise, light, traffic).	Moderate: clearing of vegetation would increase light exposure in adjacent vegetation which may lead to weed invasion. Impacts would be monitored and managed through weed control.
Deleterious hydrological change.	Low: the Project has been designed to avoid the watercourse to the east of the Project Area, although minor flow reductions would occur.

Table 6.5.3 (Cont'd)
Direct and Indirect Project-related Biodiversity Impacts

Impact	Extent of Impact as a Result of the Project
Indirect Impacts (Cont'd)	
Weed invasions.	Moderate: clearing of vegetation would increase light exposure in adjacent vegetation which may lead to weed invasion. Impacts would be monitored and managed through weed control.
Increased human activity within or directly adjacent to sensitive habitat areas.	Known: the Project would increase human activity associated with Quarry activities. Management and mitigation measures are provided to minimise associated indirect impacts.
Source: Niche (2022) – modified after Table 14	

The BC Act and the *Local Land Services Act 2013* (LLS Act) require decision-makers to determine whether the residual impacts to biodiversity values that are at risk of serious and irreversible impacts from a proposed development, are serious and irreversible. The following TECs identified within the Biodiversity Study Area have the potential to experience serious and irreversible impacts as a result of the Project.

- Illawarra Subtropical Rainforest in the Sydney Basin Bioregion (EEC) – listed due to the ecological community's very small population size.
- *Melaleuca armillaris* Tall Shrubland in the Sydney Basin Bioregion (EEC) – listed as an ecological community with a very limited geographic distribution.

Detailed consideration of potential serious and irreversible impacts to these two TECs is provided in Annex 9 of Niche (2022).

A referral for the Project was lodged with DAWE due to potential impacts on Matters of National Environmental Significance (MNES). Assessments of significance undertaken by Niche (2022) for threatened flora identified within the Biodiversity Study Area (*Z. granulata* and *C. elegans*) concluded that a significant impact on *Z. granulata* as a result of the Project was likely due to the number of individuals that would be removed. Additionally, an assessment of significance was completed for the TEC Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion and it was concluded that a significant impact as a result of the Project was likely (Niche, 2022). DAWE has confirmed that the Project is a controlled action and as such requires assessment under the EPBC Act. DAWE considered the Project likely to impact on listed threatened species and communities.

Impacts from the Project on threatened species and communities that require offsetting under the Biodiversity Offset Scheme (BOS) would occur over an approximate 30-year period. Cleary Bros proposes to implement a staged offset approach to the offset requirement. Three broad project impact stages have been identified, with the offset credit requirement for each stage to be satisfied prior to disturbing any vegetation within the relevant stage. For further details, see Section 3.13.4 and **Table 3.7**.

6.5.6 Conclusion

The Project would result in the following impacts to biodiversity values.

- Direct removal of 7.61ha of native vegetation, comprising PCT1300 and PCT720, both threatened PCTs.
- Potential indirect impacts to adjacent native vegetation.
- Removal of fauna habitat including native vegetation and drainage lines.
- Removal of flora habitat associated with native vegetation.
- Removal of up to five hollow-bearing trees and one hollow stag.

Cleary Bros has aimed to avoid and minimise impacts to biodiversity values associated with the Project through avoidance, to the extent practicable, of the most significant areas of biodiversity value during the detailed design stage of the Project. Additionally, Cleary Bros has committed to a range of management and mitigation measures to further minimise the potential for impacts to biodiversity values associated with the Project.

Assessments of significance completed by Niche (2022) concluded that the Project would likely result in significant impacts to *Z. granulata* and the Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion. DAWE has confirmed that the Project is a controlled action and as such, requires assessment under the EPBC Act.

Given the level of predicted impacts upon the biodiversity values of the Project Area, Cleary Bros intends to offset the impacts, as discussed in Section 3.13.

A total of 101 ecosystem credits are required to offset impacts to native vegetation as a result of the Project.

- PCT 1300 Illawarra Subtropical Rainforest – 74 credits.
- PCT 720 *Melaleuca armillaris* Shrubland – 27 credits.

Two threatened species require offsetting as a result of the Project.

- *Cynanchum elegans* (White-flowered Wax Plant) – 4 credits.
- *Zieria granulata* (Illawarra Zieria) – 4 344 credits.

Cleary Bros intends to offset impacts from the Project in accordance with the credit requirements available under the BOS including:

- retiring credits based on the like-for-like rules via either:
  - establishment of a Stewardship Site; or
  - facilitating the establishment of a Stewardship Site; or
- making a payment to the Biodiversity Conservation Fund calculated using the offset payments calculator.

No application to vary the credit requirement or depart from a like-for-like credit obligation using the ancillary rules is presently anticipated.

6.6 Aboriginal Heritage

6.6.1 Introduction

The SEARs for the Project require the EIS to include an assessment of the potential impacts on Aboriginal heritage (cultural and archaeological), including evidence of appropriate consultation with relevant Aboriginal communities/parties and documentation of the views of these stakeholders regarding the likely impact of the development on their cultural heritage.

The assessment requirements of the Biodiversity & Conservation Division (BCD) and Shellharbour City Council were also considered during the preparation of the Aboriginal cultural heritage assessment. A summary of the SEARs and the requirements of the BCD and Shellharbour City Council are listed within **Table A.1** and **Table A.2**, within **Appendix A** together with a record of where each requirement is addressed in the EIS.

An Aboriginal Cultural Heritage Assessment (ACHA) for the Project was undertaken by Biosis Pty Ltd (Biosis) and the report and associated Archaeological Report are presented as Part 5 of the *Specialist Consultant Studies Compendium* and are hereafter referred to as Biosis (2021a) and Biosis (2021b) respectively.

The ACHA and Archaeological Report were prepared by Biosis in accordance with the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH, 2011) and the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010). The Aboriginal Heritage Study Area for the ACHA, hereafter referred to as the "Study Area", is shown in **Figure 6.6.1**.

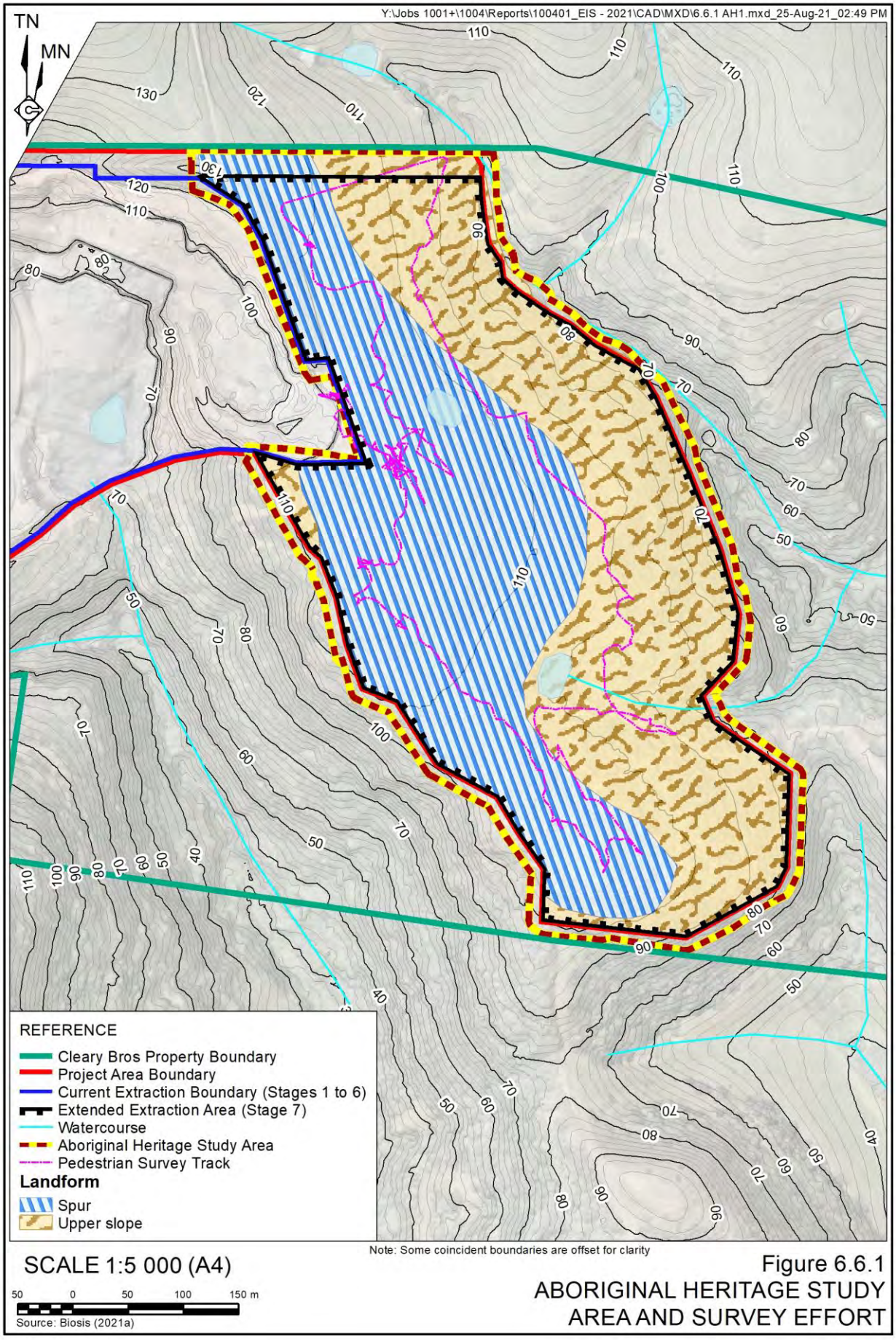
The following subsections provide a summary of the ACHA and describe the operational safeguards and management measures that would be implemented by Cleary Bros.

The arrival of European settlers resulted in the decline of existing hunter-gather lifestyles and cultures as movement became increasingly restricted. Competition for resources between European settlers and Aboriginals led to violence and conflict, whilst diseases such as smallpox also led to significant population declines. These disruptive factors contributed to the significant reduction of Aboriginal populations and re-organisation of Aboriginal communities following European contact (Biosis 2021a).

6.6.2 Aboriginal Cultural Heritage Context

6.6.2.1 Ethnohistory

Many of the recent archaeological investigations in areas surrounding the Project Area have been carried out in response to modern proposed developments. These investigations have furthered the understanding of local landscape, occupation and resource type exploitation in surrounding areas, supplementing the limited existing information from primary ethnographic sources. By the time formal records of the Aboriginal population were first completed in the late 19th century, existing Aboriginal groups had already been heavily affected by European colonisation, many of which were broken up and reconfigured (Biosis, 2021a).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TN
MN
REFERENCE
Cleary Bros Property Boundary
Project Area Boundary
Current Extraction Boundary (Stages 1 to 6)
Extended Extraction Area (Stage 7)
Watercourse
Aboriginal Heritage Study Area
Pedestrian Survey Track
Landform
Spur
Upper slope
Note: Some coincident boundaries are offset for clarity
SCALE 1:5 000 (A4)
50 0 50 100 150 m
Source: Biosis (2021a)
Figure 6.6.1
ABORIGINAL HERITAGE STUDY AREA AND SURVEY EFFORT

The Illawarra-Shoalhaven Region is the traditional land of the Wodi Wodi, a group of Aboriginal people who spoke a variant of the Dharawal language and occupied the land between Stanwell Park to the north and the northern bank of the Shoalhaven River to the south. Biosis (2021a) notes that boundaries between different groups would have changed over time and possibly in response to changing resource availability. Analyses of middens at Lake Illawarra and in surrounding coastal areas indicates Aboriginal occupation of these areas dating back 6 000 to 7 000 years, with occupation of the broader south coast region dated to around 20 000 years ago (Biosis, 2021a).

In the landscape surrounding the Project Area, the dominant vegetation cover would have been extensive sclerophyll forest community, with areas of rainforest growth scattered amongst the foothills. Some remnant and regrowth vegetation remains within the Project Area as small patches of forest across the landscape. Each ecological zone would have provided a different suite of natural resources, depending on ecosystem type and seasonal variability. The area would have provided a rich source of avian, terrestrial and aquatic fauna, with access driven by coastal proximity and repeated burns to allow for open travel between and through ecological zones.

Whilst the Project Area has been subject to historical vegetation clearing, some areas of remnant and re-generated forest remain. The Bumbo landscapes typically support Cabbage Tree Palm (*Livistona australis*), Bastard Rosewood (*Dysoxylum fraserianum*), Red Cedar (*Toona ciliata*), White Cedar (*Melia azedarach)*, Brush Cherry (*Syzygium panicilatum*), Moreton Bay Fig (*Ficus macrophylla*), Turpentine (*Syncarpia glomulifera*), Grey Ironbark (*Eucalyptus paniculata*), and Sydney Blue Gum (*E. saligna*). Floral resources would have been utilized for such uses as wood for tools and shelter, plant fibres for string and bark for shelter.

Biosis (2021a) notes that fauna species likely present within the Study Area today include the Eastern Spinebill (*Acanthorhychus tenuirostris*), Common Myna (*Acruditheres tristis*), Short Beaked Echidna (*Tachyglossus aculeatus*), Common Ringtailed Possum (*Pseudocheirus peregrinus*), Common Wombat (*Vombatus ursinus*), and Swamp Wallaby (*Wallabia bicolor*). Fauna resources would have provided both an important food source as well as a myriad of animal products for tools, clothing, and ceremonial uses.

6.6.2.2 AHIMS Site Analysis

A full summary of the results of previous archaeological investigation in both the Illawarra-Region and local (10km) area can be found in Section 3.2 of Biosis (2021a).

A search of the AHIMS database undertaken by Biosis (2021a) for a 6.5km by 6.5km area centred on the Project Area identified a total of 92 Aboriginal sites encompassing 122 individual elements. None of the identified sites are located withing the Project Area. **Table 6.6.1** provides a summary of the types and occurrence frequency of the identified elements.

6.6.2.3 Landscape Resources

Stream order is recognised as a factor which assists in the development of predictive modelling of historical Aboriginal occupation and is based on the concept that archaeological sites are more likely to be centred around areas with more permanent watercourses. Biosis (2021a) states that the hydrology of the Project Area features a number of non-perennial water sources, namely first and second order watercourses that are present in the northeastern and southeastern sections of the Project Area.

Table 6.6.1
AHIMS Database – Site Types within 6.5km of the Project Area

Site Type	Number of Occurrences	Frequency (%)
Artefact	78	63.93
Shell	32	26.23
PAD	8	6.56
Modified tree	1	0.82
Burial	1	0.82
Grinding Groove	1	0.82
Stone arrangement	1	0.82
Total	**122**	**100**
Source: Biosis (2021a) - Table 3		

6.6.3 Assessment Methodology

6.6.3.1 Predictive Model

Biosis (2021a) utilised a predictive model developed as part of the *Albion Park Quarry Extension: Aboriginal and Historical Heritage Scoping Report* (Biosis, 2019) to broadly predict the type and character of Aboriginal cultural heritage sites that are likely to exist within the Project Area. The predictive model was based on the following factors.

- Local and regional site distribution in relation to landform features identified within the Study Area.
- Consideration of site types, raw material types and site densities likely to be present within the Study Area.
- Findings of the ethnohistorical research and the potential for material traces to be present within the Study Area.
- Potential Aboriginal use of natural resources present (or once present) within the Study Area.
- Consideration of the temporal and spatial relationships of sites within the Study Area and surrounding region.

Based on the above, Biosis (2021a) predicted that potential archaeological deposits (PADs) and flaked stone artefact scatters and isolated find site types had moderate potential to occur within the Study Area. All other Aboriginal site types (e.g. modified trees, middens, burials) were predicted to have low potential to occur within the Study Area.

6.6.3.2 Stakeholder Consultation

Consultation with the Aboriginal community was undertaken in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (ACHCRs) (DECCW, 2010a). Consultation undertaken under each of the four stages of the ACHCRs is detailed in Section 4 of Biosis (2021a).

Stage 1 – Notification of Project Proposal of Registration of Interest

A preliminary list of potential Aboriginal stakeholders for the Project was identified through consultation with Heritage NSW. Additionally, searches were conducted by the Office of the Registrar and the National Native Title Tribunal for listed Aboriginal landowners, Registered Native Title Claims or Registered Indigenous land Use Agreements within the Study Area. One unregistered Claimant Application, South Coast Peoples (NC2017/008), was identified within the Study Area.

A public notification inviting Aboriginal groups or people with an interest in the Study Area to register their interest in the Project was placed in the Illawarra Mercury on 22 April 2020.

From the initial notifications, a total of 13 groups or individuals registered an interest in the Project and therefore represent the Registered Aboriginal Parties (RAPs) for the Project. Details of the groups and individuals are included in Biosis (2021a).

Stages 2 and 3 – Project Details of Aboriginal Cultural Significance

A copy of the proposed ACHA field survey methodology which also contained detailed Project information was circulated to the RAPs on 10 June 2020. RAPs were given 28 days to review the information and provide any feedback. Five of the RAPs responded and indicated their acceptance and support of the proposed methodology. No further information was provided by RAPs about the Project Area from their knowledge.

A representative from one RAP, the Illawarra Local Aboriginal Land Council (LALC), participated in the field survey. No comments on the Study Area were provided, although the representative indicated that the area was of high cultural value regardless of the lack of Aboriginal sites.

Stage 4 – Draft ACHA

A draft copy of the ACHA report detailing the results of the assessment was provided to the RAPs on 24 September 2020. Due to an error, the Illawarra LALC were not initially provided with the draft report and a copy of the draft ACHA was instead provided on 27 October 2020. All RAPs were given 28 days to respond to the draft ACHA. Responses were received from two RAPs.

6.6.3.3 Archaeological Survey

The field survey component of the ACHA was undertaken by Biosis in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010b) and the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (OEH, 2011).

The field survey was conducted on foot by Senior Archaeologist Samantha Keats (Biosis) and a representative of the Illawarra LALC RAP, and encompassed the entirety of the Study Area. The survey methodology included a meandering pedestrian transect walking approximately 2m apart (**Figure 6.6.1**). The pedestrian transect path was selected in order to sample all landforms within the Study Area whilst concentrating on landforms with the greatest archaeological potential.

6.6.4 Field Survey Results

Table 6.6.2 presents a summary of the survey coverage and results for each of the two identified landform survey units within the Study Area. In summary, no Aboriginal sites, PADs, artefacts or features were identified within the Study Area, with the entire area displaying low potential for Aboriginal sites.

Table 6.6.2
Field Survey Landform Coverage and Results

Landform	Survey Unit Area (m^2)	Visibility (%)	Exposure (%)	Effective Coverage		No. Aboriginal Sites	No. Artefacts or Features
				(%)	(m^2)		
Spur	91 677	20	20	8.86	8 119	0	0
Upper Slope	114 961	20	20	3.64	4 186	0	0
Source: Biosis (2021b) – Tables 7 and 8.							

Biosis (2021b) notes that visibility, exposure and disturbance represented the three primary constraints to the survey. The effective coverage in the Study Area was influenced by low visibility (20%) and exposure (20%) across the area primarily due to extensive grass and vegetation cover. Areas of higher visibility over the Study Area were largely afforded by fence lines, areas of exposed bedrock, along access tracks and areas of erosion and disturbance. Exposures within the Study Area were similarly afforded by access tracks and fence lines, as well as by areas around the base of mature trees. Disturbances from human action were prevalent and covered a large extent of the Study Area.

The results of the field survey are consistent with the predictive model used by Biosis (2021a), supporting the prediction that the soil landscape and geological formation present within the Study Area are not conducive to large numbers of Aboriginal sites or objects. The model predicted that there was only moderate potential for flaked stone artefacts scatters and isolated artifacts or isolated artefacts and a low potential for nine of the eleven types of Aboriginal sites.

Biosis (2021b) concluded that the erosional soil landscape within the Project Area, in combination with the long history of site disturbance via land clearance, construction of buildings and farm infrastructure and agricultural activity, would likely have displaced any surface cultural material and disturbed deeper buried archaeological deposits. Increased soil erosion from land clearance would have likely increased the possibility for the erosion of archaeological deposits. Additionally, and in accordance with previous investigations in the area, there is low to minimal subsurface archaeological potential due to the presence of shallow soils, steep slopes and the prevalence of exposed bedrock. Furthermore, the predictive model indicates that the highest number of Aboriginal sites would likely be situated around third and fourth order streams. The highest order steam that intersects the Study Area is a second order stream, and the closest fourth order steam is located approximately 2.7km to the southeast.

6.6.5 Significance Assessment

Appropriate management of Aboriginal cultural heritage sites and items is typically determined based on their significance as well as the likely impacts of the proposed development. Heritage assessment criteria in NSW generally correspond with the significance values outlined in the Australia International Council on Monuments and Sites (ICOMOS) Burra Charter (Australia

ICOMOS, 2013). Significance values considered for the purposes of the assessment of cultural and archaeological significance include historical significance (i.e. importance to a historically significant person, place, event or activity in an Aboriginal community), aesthetic significance (i.e. importance to location), social significance (i.e. importance to the Aboriginal community) and scientific significance (i.e. importance to archaeologists). A variety of factors including site integrity, structure, contents and rarity within the broader region are used to assess significance. It is acknowledged that Aboriginal people are the primary determiners of the social or cultural significance of the Aboriginal cultural heritage of an area.

Biosis (2021b) assessed the Study Area as having low scientific and historical value and moderate aesthetic value associated with the site's elevated landform and prominent position within the landscape. Although no Aboriginal sites were identified within the Study Area, the representative from Illawarra LALC considered the Study Area to have high cultural value.

6.6.6 Management and Mitigation Measures

No Aboriginal sites or areas of potential archaeological deposits were identified within the Study Area during the survey, and as such, Biosis (2021b) concluded that the Project Area has low potential to contain Aboriginal sites. No further archaeological investigations are required or recommended within the Project Area (Biosis, 2021b).

Cleary Bros would implement the following management and mitigation measures in order to avoid or mitigate any adverse impacts to Aboriginal cultural heritage values associated with the Project.

- Implement the following unexpected finds protocol in the event that a previously unknown Aboriginal site is identified within the proposed areas of disturbance.
  - Immediately cease all work in the vicinity of the site.
  - Temporarily fence the site to prevent further disturbance.
  - Engage a qualified archaeologist to provide further advice or to assess the site.
  - Should the site be determined to be an Aboriginal object, ensure that the site location is registered with AHIMS and that a site card is submitted.
  - Follow the advice of a qualified archaeologist.
- Implement the following protocol in the event that suspected human skeletal material is discovered within areas to be disturbed.
  - Cease all work in the vicinity of the site immediately.
  - Temporarily fence the site, ensuring that no further disturbance occurs to the skeletal remains or associated artefacts. If skeletal remains have been removed from the ground, these should be stored in a dry location on site.
  - Contact the NSW Police and Heritage NSW's Environmental Line (131 555) as soon as practicable and provide details of the remains and their location.
  - Ensure that work within the cordoned off area is not recommenced until authorisation is received in writing from Heritage NSW.

6.6.7 Assessment of Impacts

No Aboriginal sites or PADs were identified within the Study Area. Due to the low potential for the presence of Aboriginal sites, in combination with the long history of site disturbance from agricultural activity, it is not anticipated that the Project would impact any Aboriginal heritage values.

6.6.8 Conclusion

No Aboriginal sites, potential archaeological deposits, artefacts or features were identified during a survey of the Stage 7 area. The area was assessed as having low scientific and historical value, moderate aesthetic value and high cultural value. Due to the low potential for the presence of Aboriginal sites, in combination with the post-settlement history of disturbance from human activity, it is anticipated that the Project would not impact any Aboriginal heritage values.

6.7 Historic Heritage

6.7.1 Introduction

The SEARs for the Project require the EIS to include the identification of historic heritage in the vicinity of the development and an assessment of the likelihood and significance of impacts on heritage items.

The assessment requirements of the Biodiversity & Conservation Division (BCD) and Shellharbour City Council were also considered during the preparation of the historic heritage assessment. A summary of the SEARs and the requirements of the BCD and Shellharbour City Council are listed within **Table A.1** and **Table A.2**, within **Appendix A** together with a record of where each requirement is addressed in the EIS.

A Statement of Heritage Impact (SOHI) for the Project was undertaken by Biosis Pty Ltd (Biosis) and the report and associated Archival Report are presented as Part 6 of the *Specialist Consultant Studies Compendium* and are hereafter referred to as Biosis (2021c) and Biosis (2021d) respectively. The following subsections provide a summary of the SOHI and describe the operational safeguards and management measures that would be implemented by Cleary Bros.

6.7.2 Existing Environment

6.7.2.1 Historical Context

Aboriginal Past

The arrival of European colonists to the Illawarra area in the late 1700s brought drastic and catastrophic change to the Aboriginal people and the surrounding landscape. Land was cleared to support a local forestry industry in the early 1800s before the establishment of pastoral and dairying agricultural industries in the early to mid-nineteenth century. Colonial expansion and the rise of supporting industries encouraged an increase in the local population of European colonists, excluding Aboriginal people from their cultural lands and disrupting established cultural practices. Between 1820 and 1899, conflict, disease and dispossession reduced the population of Wodi Wodi and Dharawal people to around 1% of the initial population (Biosis 2021c).

Development of Peterborough Estate

The Project Area is situated within a 1 850 acre portion of the land granted to D'Arcy Wentworth on 9 January 1821. Wentworth, an Irish medical practitioner from County Armargh, arrived in Australia as a convict on 28 June 1791. Recognised for his medical skills, Wentworth was moved to Norfolk Island where he eventually became superintendent of the convicts on the island. Eventually, Wentworth became a leading medical practitioner in the early years of the colonies, moving between Norfolk Island, Sydney and Newcastle.

D'Arcy Wentworth over time acquired the 13 050 acres that would eventually become the Peterborough Estate. Upon his death in 1827, the Peterborough Estate was partitioned into five portions and distributed among his children Martha (Reddall), Sophia (Towns), Catherine (Bassett/Darley), Mary Ann (Addison/Hollings) and Robert. The Project Area is located within the land inherited by Catherine and formed part of a lease to the Dunster family, a prominent local dairying family, from around 1859 (Biosis 2021c).

The land encompassing the Project Area changed ownership in the years following the death of Benjamin Wentworth Darley in June 1892. The estate lands were subdivided along existing lease boundaries and sold off, beginning around 1897. Lot 6[7], containing the northwestern portion of the Study Area, was sold to Walter Dunster in March 1902. **Plate 6.7.1** displays the relationship between the former Lots 6 and 7[8] and the Historic Heritage Study Area.

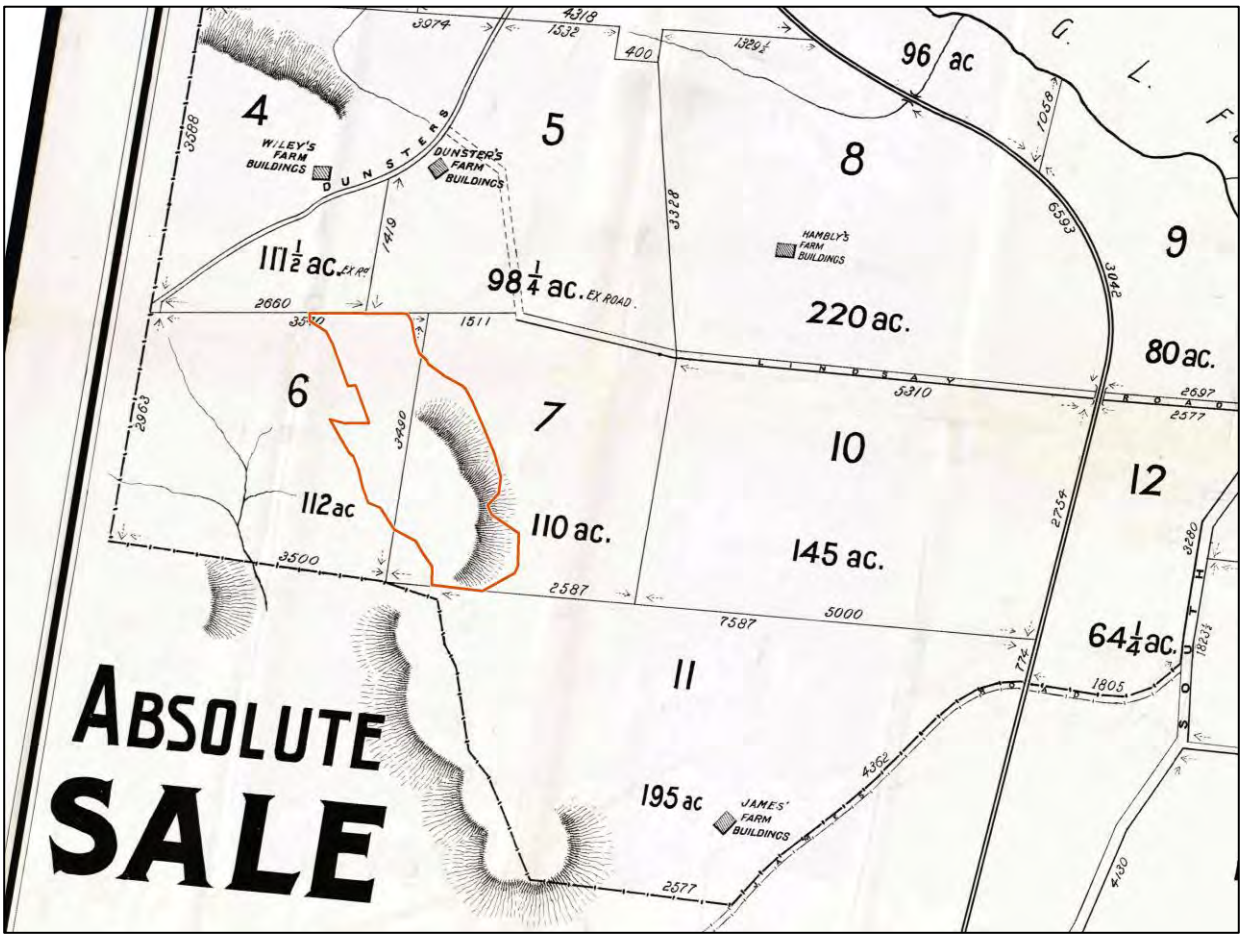


Plate 6.7.1 Auction advertisement for the Illawarra Bassett-Darley lands dating to 1900, with the Historic Heritage Study Area shown as a red line (Source: National Library of Australia, via Biosis (2021c))

Development of Belmont Estate

Lot 6 changed ownership again in 1906 to Samuel Hercules McDonald, a local farmer who became a prominent community member and councillor for the Shellharbour Municipal Council. McDonald was a leading campaigner for the surrounding lands to be called Indigo range, a name which appears on several 19th and 20th century maps. It was after this time that the land became known as the Belmont Estate.

Construction of the main house (Belmont Main House) was most likely around this time, with the house constructed in a typical Victorian and Edwardian Style (**Plate 6.7.2**). The dry stone walls on the property are believed to be dated to around 1912. A 1929 entry in the Shellharbour

[7] Lot 6 largely coincides with the land currently described as Lot 1 DP858245
[8] Lot 7 largely coincides with the land currently described as Lot 7 DP3709

Building Register 1923-1951 records a 'Milkroom, etc.' under S. N. McDonald within the neighbouring Oak Flats Estate. Biosis (2021c) notes that the milkroom could potentially have been incorrectly assigned to Oak Flats Estate, however the accuracy of this assumption was not verified. Other records in the Shellharbour Building Register 1923-1951 exist for buildings and infrastructure that were either located within or identified as being potentially located within Belmont Estate include a 1947 record of a storage shed belonging to S.R. McDonald on 'farm land'.

Plate 6.7.2 A photograph of the main house [1], Belmont, taken in 1964 (Source: Shellharbour Library)

Plate 6.7.3 A photograph of the main house [1], Belmont, taken 14 August 2020 (Source: Biosis – DSC_0738)

However, similar to the 1927 record, the location of the item remains uncertain, as Oak Flats Estate and Fuller's Estate are sometimes referred to together as Fuller's Estate. A 'Farm build. Silage pit' was however recorded in 1949 as belonging to J.W.B. McDonald at 'Albion Park, 'Belmont'. A full chronological summary of the Historic Heritage Study Area is presented in Table 2 of Appendix 5 in Biosis (2021c)**.**

During this period of development, the ownership of Lot 6 changed on two more occasions. Firstly in 1937, when the property was transferred to Mary Jane McDonald (wife of Samuel Hercules McDonald), then again in December 1948 to John Henry Bill McDonald and Samuel Richard McDonald. In April 1956, Belmont Estate was acquired by the Government. The property was occupied by R. J. Carpenter from 1961 until it was sold again in 1985 to Doris Lucy Cody. Between 1985 and 1996 the land was subdivided, however Biosis (2021c) was unable to identify the subdivision plan or the date of subdivision. In 1996, the most recent subdivision took place and established the current Lot boundaries (see **Figure 2.4**). Cleary Bros acquired the Belmont Estate property from the McDonald family in 1991. Lorna Brown, the daughter of Samuel Hercules McDonald, continued to live at the property until c.2003. **Plate 6.7.3** presents a view of the main house as it currently stands.

Research Themes

The *New South Wales Historical Themes* (NSW Heritage Council, 2001) outlines 38 State Historical Themes and nine National Historical Themes which are used to provide context to, and to assess the significance of, a site's historic heritage. These national and state themes can be used when developing sub-themes for the local area to ensure they remain within the wider thematic framework. Biosis (2021c) identifies three historical themes relating to the historical occupancy of the Study Area, which are listed in **Table 6.7.1**.

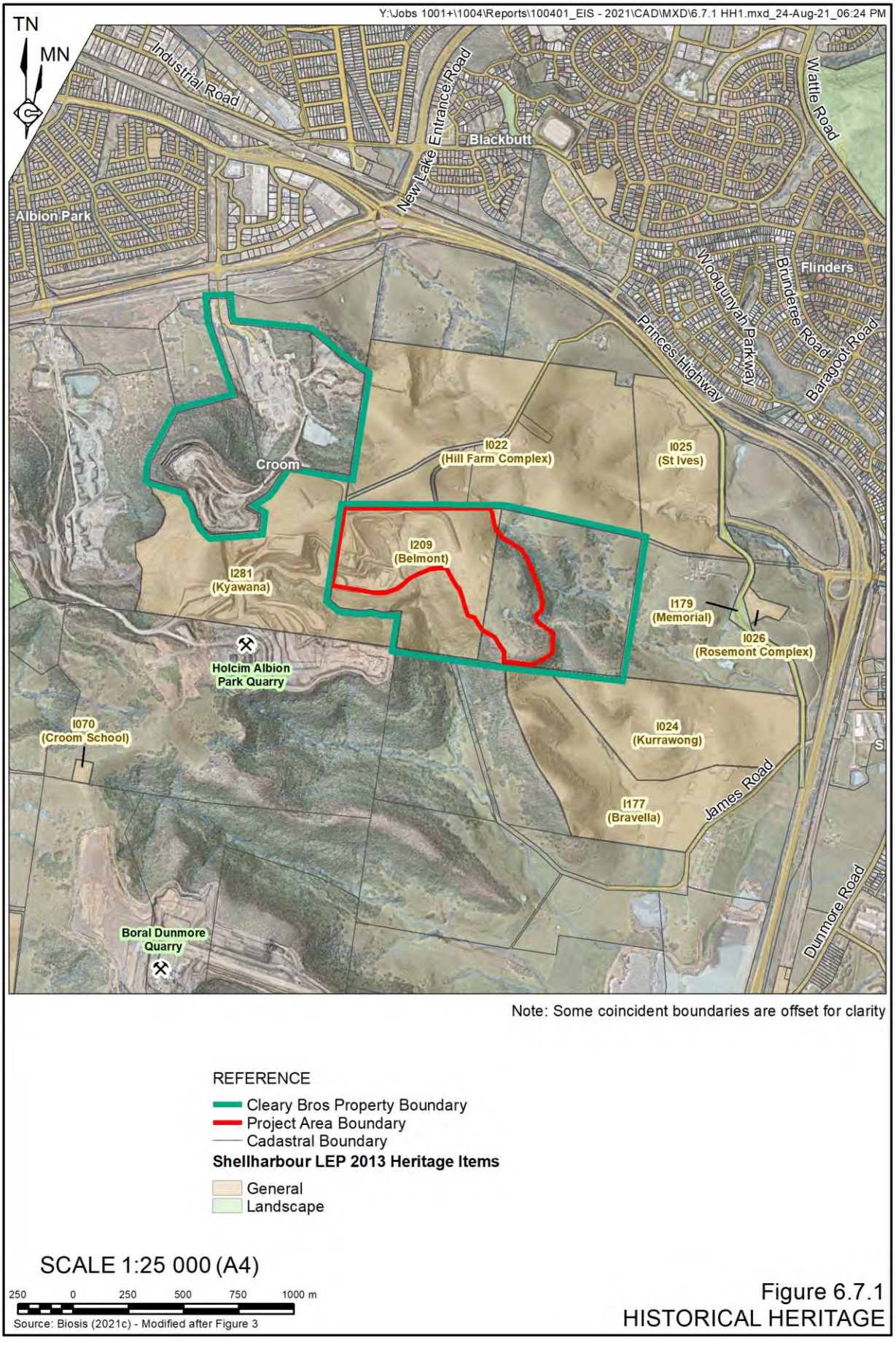
Table 6.7.1
Identified Historical Themes for the Study Area

Australian Theme	NSW Theme	Local Theme
Developing local, regional and national economies	Agriculture	From Forest to Farm
Building settlements, towns and cities	Land tenure	From Forest to Farm
	Accommodation	No associated local theme
Developing Australia's cultural life	Domestic life	No associated local theme
Source: Biosis (2021c) - Table 3		

6.7.3 Heritage Registers

Schedule 5 of the Shellharbour LEP 2013 contains a schedule of heritage items which are managed by the controls in the instrument and **Figure 6.7.1** shows the location of those listed heritage items. The following listed heritage item is located within the Project Area.

- "Belmont", stone walls, figs and coral tree avenue (Item No. I209), 207 Dunsters Lane, Croom NSW, Lot 1 DP 432289. Item of local heritage significance.


Y:\Jobs 1001+\1004\Reports\100401_EIS - 2021\CAD\MXD\6.7.1 HH1.mxd_24-Aug-21_06:24 PM
TN
MN
Industrial Road
New Lake Entrance Road
Blackbutt
Wattle Road
Albion Park
Flinders
Woodgunyah Parkway
Brunderee Road
Baragoot Road
Princes Highway
I022 (Hill Farm Complex)
I025 (St Ives)
Croom
I209 (Belmont)
I281 (Kyawana)
I179 (Memorial)
I026 (Rosemont Complex)
Holcim Albion Park Quarry
I070 (Croom School)
I024 (Kurrawong)
James Road
I177 (Bravella)
Dunmore Road
Boral Dunmore Quarry
Note: Some coincident boundaries are offset for clarity
REFERENCE
Cleary Bros Property Boundary
Project Area Boundary
Cadastral Boundary
Shellharbour LEP 2013 Heritage Items
General
Landscape
SCALE 1:25 000 (A4)
250 0 250 500 750 1000 m
Source: Biosis (2021c) - Modified after Figure 3
Figure 6.7.1
HISTORICAL HERITAGE

Additionally, the following heritage items listed under the Shellharbour LEP 2013 are located immediately adjacent to the Historic Heritage Study Area.

- The Hill Farm Complex (Item No. I022), 195 Dunsters Lane Croom NSW, Lot 1, DP 253007, Lot 4, DP 3709 and Lot 1, DP 432289. Item of local heritage significance.
- "Kyawana", (Item No. I281), 265 Dunsters Lane, Croom NSW, Lot 2, DP 858245. Item of local heritage significance, immediately west of the study area.
- Bravella site fig trees, (Item No. I177), 144 James Road, Croom NSW, Lot 2, DP 607560. Item of local heritage significance.
- "Kurrawong", trees, stone walls and silo, (Item No. I070), Croome Road termination, Croom NSW, Crown Land per. Occ 1987/2, Lot 1, DP 23618. Item of local heritage significance.

6.7.4 Heritage Assessment

6.7.4.1 Landscape Character Assessment

Landscape character assessments are used to provide a contextual setting of an area within its cultural landscape. Biosis (2021c) defines cultural landscapes as "*those areas which clearly represent or reflect the patterns of settlement or use of the landscape over a long time, as well as the evolution of cultural values, norms and attitudes toward the land*". The following three general categories of cultural landscapes are typically used by heritage organisations.

- **Designed landscapes –** Those that are created intentionally such as gardens, parks, garden suburbs, city landscapes, ornamental lakes, water storages and campuses.
- **Evolved landscapes** – Those that display an evolved land use in their form and features. They may be 'relict' such as former mining or rural landscapes. They may be 'continuing' such as modern active farms, vineyards, plantations or mines.
- **Associative cultural landscapes** – Those landscape features that represent religious, artistic, sacred or other cultural associations to individuals or communities.

Biosis (2021c) identifies the Project Area as both a Designed Landscape and a relic Evolved Landscape. A full description of these themes in relation to the Project is presented in Section 4.3.3 of Appendix 5 in Biosis (2021c).

6.7.4.2 Built Fabric Assessment

Biosis (2021c) identifies the following three main extant structures and or/features as remnants of historic land use in the vicinity of the Project Area and which contribute to the local heritage significance of the Project Area.

- Belmont Main House.
- Garage/storage shed.
- Landscape features such as informal outbuildings, fences, dry stone walls and gates.

Belmont Main House

A structural integrity report prepared by KF Williams and Associates Pty Ltd in November 2018 identified that the structural elements of the Belmont Main House are in substantial disrepair and do not meet the requirements of current and applicable building codes or Australian Standards. At the time of the SoHI assessment, Biosis (2021c) noted that the visual condition of Belmont Main House was in relatively fair to poor condition, with several areas displaying visual damage, including damage to the exterior weatherboard cladding, brick wall base and verandah, as well as interior walls, ceiling and doors.

Garage/Storage Shed

Biosis (2021c) assessed the garage/storage shed to be in a derelict state, being used at the time of the assessment as an informal storage for materials and waste.

Landscape Features

Landscape features including fences and gates of various ages were generally assessed by Biosis (2021c) to be in a fair condition whilst informal outbuildings consisting of timber frames and metal and plastic corrugated sheeting were found to be in a poor condition. A modern electricity pole was also identified adjacent to the Belmont Main House driveway.

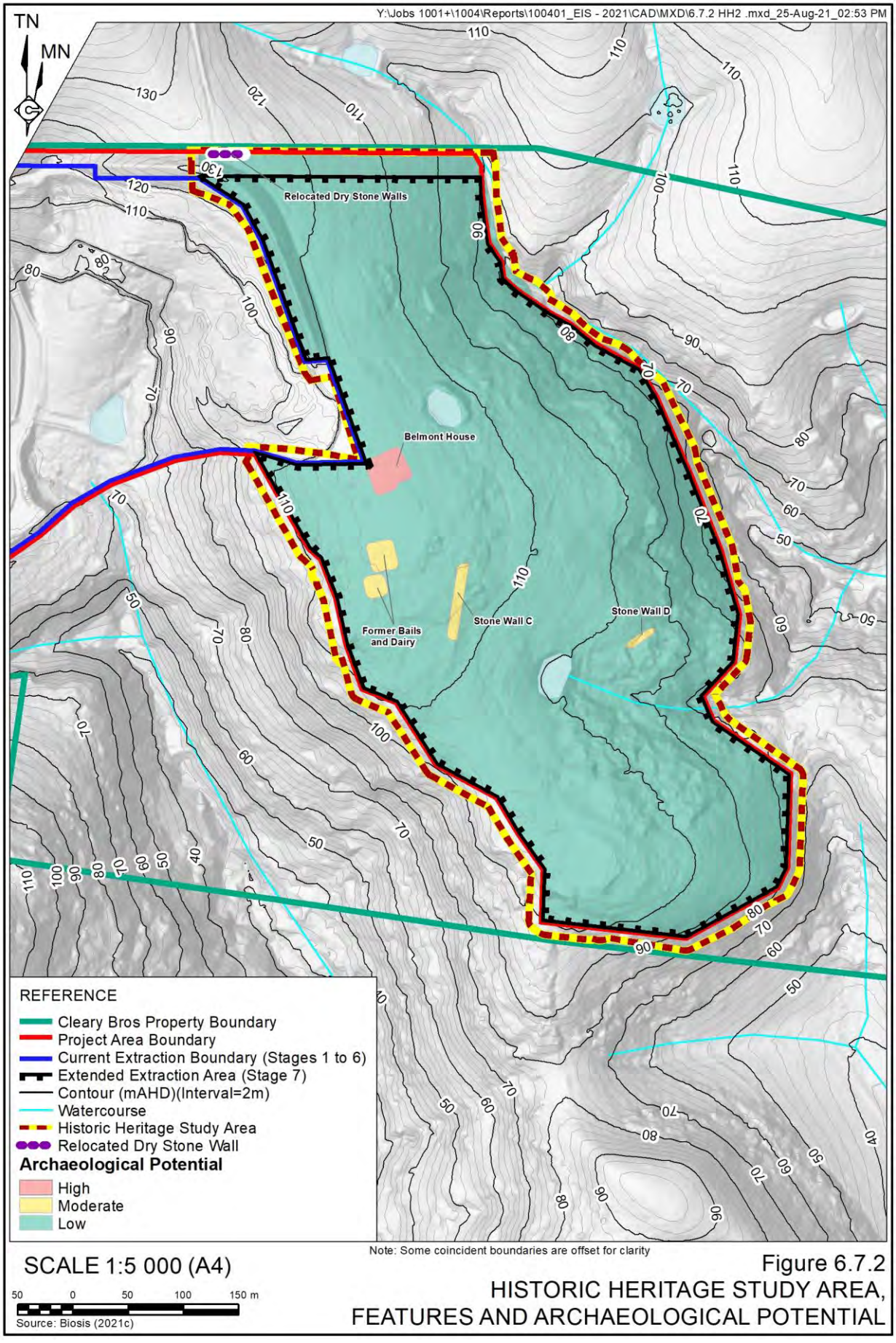
Dry Stone Walls

As part of the *Heritage Management Plan* for the existing Quarry, sections of existing dry stone walls were salvaged from the Stage 1 to 6 area and reconstructed at the entrance to the 'Belmont' property (**Figure 6.7.2**).

Biosis (2021c) identified two other dry stone walls, 'C' and 'D' (**Figure 6.7.2**), located within the Study Area both of which were assessed to be in a deteriorating condition, with vegetation invasion present and evidence of slumping and bellying observed.

6.7.4.3 Archaeological Assessment

Biosis (2021c) notes that it is likely that the Study Area contains deposits and features relating to the agricultural and domestic occupation of Belmont Estate. Whilst many of the structures and features that are known to have been present over the development of Belmont Estate are no longer present, archaeological material associated with the construction and use of these elements may be present within, around or beneath these known locations. In addition to these areas, Biosis (2021c) indicates that archaeological material may be present in the areas both within and surrounding the Belmont Main House, former dairy/bails and feeding stalls, garage/storage shed and the dry stone walls. Any subsurface deposits are likely to be in good condition, however the installation of services within and in the vicinity of the main house may have disturbed any underfloor occupation deposits and impacted any other deposits, stone foundations or building footings.


Y:\Jobs 1001+\1004\Reports\100401_EIS - 2021\CAD\MXD\6.7.2 HH2 .mxd_25-Aug-21_02:53 PM
TN
MN
Relocated Dry Stone Walls
Belmont House
Former Bails and Dairy
Stone Wall C
Stone Wall D
REFERENCE
Cleary Bros Property Boundary
Project Area Boundary
Current Extraction Boundary (Stages 1 to 6)
Extended Extraction Area (Stage 7)
Contour (mAHD)(Interval=2m)
Watercourse
Historic Heritage Study Area
Relocated Dry Stone Wall
Archaeological Potential
High
Moderate
Low
SCALE 1:5 000 (A4)
50 0 50 100 150 m
Source: Biosis (2021c)
Note: Some coincident boundaries are offset for clarity
Figure 6.7.2
HISTORIC HERITAGE STUDY AREA,
FEATURES AND ARCHAEOLOGICAL POTENTIAL

The heritage research potential identified by Biosis (2021c) encompasses the existing documentation and developed research framework for Belmont Estate and associated sites. A full discussion of the research potential of the site is presented in Section 4.3.3 of Appendix 5 in Biosis (2021c). In summary, the main research potential would be associated with any archaeological remains that date to the development and ownership of the land by the Dunster and McDonald families from the late 19th century to the late 20th century. Such potential remains would contribute to the understanding of local dairying and domestic cultural practices over these time periods and could facilitate comparison across a greater local, regional and national context. Existing evidence dates one of the previously relocated dry stone walls to circa 1912. In the event that the remaining walls date to an earlier time period, this information could be used to improve understandings of the agricultural use of the landscape during the 19th century.

Archaeological potential associated with other parts of the Study Area is likely to be limited to material associated with the original property boundaries and evidence of farming practices during the 19th century. Such material is unlikely to contribute to further knowledge about the Study Area as similar material has been extensively documented elsewhere (Biosis, 2021c).

Table 6.7.2 and **Figure 6.7.2** summarise the archaeological potential of the Historic Heritage Study Area as identified by Biosis (2021c). The assessment of archaeological potential has been divided into the following three categories.

- **High archaeological potential** – high degree of certainty that archaeologically significant remains relating to this period, theme or event will occur within the Study Area.
- **Moderate archaeological potential** – probable that archaeological significant remains relating to this period, theme or event could be present within the Study Area.
- **Low archaeological potential** – unlikely that archaeological significant remains relating to this period, theme or event will occur within the Study Area.

Table 6.7.2
Assessment of Archaeological Potential

Page 1 of 2

Designation	Description	Probable Features	Possible Construction Date	Archaeological Potential
1	Belmont Main House	Building footings or foundations, cut and fill deposits, secondary deposits (rubbish pits, cesspits, cisterns, privies), underfloor occupation deposits, yard surfaces, fencing post holes, remains of timber posts and fencing wire.	c.1900	High
2	Stone walls A and B	Wall foundations, associated cut and fill deposits.	c.1912	Nil – removed and reconstructed
3	Farm building	Building footings or foundations, fencing or structural postholes and associated remnant timber posts, cut and fill deposits, compacted floor surfaces, artefact scatters.	Pre-1949	Low – location unknown
4	Silo pit	Timber and metal structural remains, cut and fill deposits, postholes, organic materials, artefact scatters.	Pre-1949	Low – location unknown

Table 6.7.2 (Cont'd)
Assessment of Archaeological Potential

Designation	Description	Probable Features	Possible Construction Date	Archaeological Potential
5	Garage	Building footings or foundations, fencing or structural postholes and associated remnant timber posts, cut and fill deposits, compacted floor surfaces, artefact scatters, deposits, compacted floor surfaces, artefact scatters.	Pre-1947	Low
6	Bails and dairy	Building footings or foundations, fencing or structural postholes and associated remnant timber posts, cuts and fill deposits, compacted floor surfaces, artefact scatters, rubbish pits, yard surfaces, fencing post holes, remains of timber posts and fencing wire.	Pre-1948	Moderate
7	Feeding stalls	Building footings or foundations, fencing or structural postholes and associated remnant timber posts, cut and fill deposits, compacted floor surfaces, artefact scatters, rubbish pits, yard surfaces, fencing post holes, remains of timber posts and fencing wire.	Pre-1948	Low
8	Engine room	Building footings or foundations, fencing or structural postholes and associated remnant timber posts, cut and fill deposits, compacted floor surfaces, artefact scatters, rubbish pits, yard surfaces, fencing post holes, remains of timber posts and fencing wire.	Pre-1956	Low
9	Dam	Cut and fill deposits.	Pre-1956	Nil
10	Water piping	Drainage cut and fill deposits, remnant metal piping.	Pre-1956	Low
11	Paddock fence-lines	Fencing post holes, remains of timber posts and fencing wire.	Pre-1956	Low
12	Stone wall C	Wall foundations, associated cut and fill deposits.	Pre-1996	Moderate
13	Stone walls (outside of the Study Area)	Wall foundations, associated cut and fill deposits.	Pre-1996	Moderate
14	Stone wall D	Wall foundations, associated cut and fill deposits.	Pre-1996	Moderate
Source: Biosis (2021c) – Table 4				

6.7.5 Comparative Analysis

There are several heritage sites or places within the surrounding Croom and Dunmore localities with similar cultural heritage values to the Belmont Estate. A comparative analysis of these sites is provided in Section 5 of Appendix 5 in Biosis (2021c).

6.7.6 Significance Assessment

Evaluations and statements of significance were completed for those heritage items identified within the Historic Heritage Study Area which are considered by Biosis (2021c) to hold some archaeological potential. The assessments were made with the assumption that the sites contain intact or partially intact archaeological deposits. As no historical or archaeological information

was identified which alters the significance of the *"Belmont", stone walls, figs and coral tree avenue* item, it is not necessary to reassess its significance and the statement of significance presented in the Shellharbour Heritage Inventory is still applicable.

> *"The Victorian Edwardian cusp era weatherboard farm house and adjoining yard complex of Belmont demonstrate how farm homesteads were deliberately sited to have sight lines to Shellharbour port, Kiama, other hilltop homesteads and within the wider cultural landscape. The house, its entry avenue of Coral trees, dry stone walls and isolated fig have local historic, aesthetic, technical and social values.*
>
> *Belmont, Stone Walls, Figs and Coral tree Avenue is considered to be significant at a local level"*

An evaluation and subsequent statements of significance of all other items identified within the Study Area are summarised in **Table 6.7.3**.

Table 6.7.3
Assessment of Local or State Heritage Significance of Other Items

	Site (No.)	
Historic Significance Criterion	**Bails and Dairy (6)**	**Garage (5), Feeding Stalls (7), Engine Room (8), Water Piping (10), Paddock Fence-lines (11)**
An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area)	No Significance	No Significance
An item has a strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)	No Significance	No Significance
An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area)	No Significance	No Significance
An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons	No Significance	No Significance
An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area)	Potential for Local Historical Significance	No Significance
An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area)	No Significance	No Significance
An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments (or a class of the local area's cultural or natural places; or cultural or natural environments).	No Significance	No Significance
Source: Biosis (2021c) – modified after Table 5 and Table 6		

In summary, Biosis (2021c) states that if archaeological remains are identified associated with the 'Bails and Dairy' (**Figure 6.7.2**) they would also hold heritage significance at a local level. No other identified heritage items were determined to hold heritage significance with regard to the relevant significance criteria.

6.7.7 Management and Mitigation Measures

In accordance with recommendations made by Biosis (2021c), an Archival Report (Biosis, 2021d) including a digital photographic archival recording of the Belmont Main House was undertaken and is presented in Part 6 of the *Specialist Consultant Studies Compendium*. The Archival report was prepared in accordance with the NSW Heritage Council guidelines *How to Prepare Archival Records of Heritage Items* and *Photographic Recording of Heritage Items Using Film* or *Digital Capture 2006*. Based on further recommendations made by Biosis (2021c), Cleary Bros would implement the following management and mitigation measures in order to avoid any unnecessary adverse impacts on items and sites of historic heritage value.

- Undertake further archaeological investigations, including monitoring for the presence of archaeological deposits or remains during demolition and ground disturbance works in the immediate vicinity of the heritage items. Depending on the nature of the uncovered remains, further excavations may be required. These investigations would:
  - follow the intent of the Heritage Act;
  - be conducted by a suitably qualified heritage consultant who meets the NSW Heritage Council's Excavation Director criteria; and
  - be supported by an archaeological assessment (i.e. Biosis (2021c)) and an Archaeological Research Design.
- Engage an experienced dry stone waller to undertake salvage and reconstruction works for dry stone walls C and D.
- Update the current *Albion Park Quarry Heritage Management Plan* to include the archaeological investigations, archival recording of the Belmont Main House and the salvage and reconstruction method and location of dry stone walls C and D.

6.7.8 Assessment of Impacts

The Project would involve the demolition of the Belmont Main House and all other adjacent structures and landforms that are situated within the Project Area. The historic significance of the Project has been outlined in the previous sections. In summary, the Belmont Main House is a significant component of the locally listed heritage item in the Shellharbour LEP 2013 (Item 1207, "Belmont", stone walls, figs and coral tree avenue). Belmont Main House presents a high historic heritage value, and the dry stone walls and potential Bails and Dairy deposits would present a moderate level of historic heritage value.

Belmont Main House and its immediate vicinity is considered to hold high archaeological potential while the remainder of the Historic Heritage Study Area is considered to have a medium or low archaeological potential. The Project would have a direct impact on the heritage significance of the Belmont Estate through the demolition of the Belmont Main House and associated structures and landscape features.

The structural integrity report identified that the structural elements of the Belmont Main House are in substantial disrepair and do not meet the requirements of current and applicable building codes or Australian Standards. Repairing the existing structure to acceptable levels is impractical, unfeasible and would likely lead to the damage of the existing structure as well as the potential for the damage and disturbance of any existing archaeological deposits.

The Project would also have a visual impact on surrounding heritage listed items, specifically the Hill Farm Complex (Item No. I022). Parts of the Project Area would be visible from this heritage item i.e. "Figtree Hill" and measures are described in the Visual Impacts Assessment (presented as Part 3 of the *Specialist Consultant Studies Compendium*) to minimise visual impacts to the Hill Farm Complex. Finally, it is acknowledged that the relationship of the Belmont Estate and the heritage-listed Hill Farm Complex (Item I022) would be removed as a result of the Project. It is concluded that the demolition of these items is permissible from a heritage perspective given Cleary Bros is committed to the adoption of the management and mitigation measures recommended by Biosis (2021c).

6.7.9 Conclusion

The heritage items and associated deposits and features within the Belmont Estate in the Stage 7 area contribute to the understanding of local agricultural dairying and domestic cultural practices from the late 19th century to the late 20th century. An assessment of the historic heritage items within the Stage 7 area concluded that Belmont Main House has high archaeological potential, the associated former bails and dairy and dry stone walls have moderate archaeological potential and all other items have low archaeological potential. Both Belmont Main House and the former bails and dairy were determined to have local significance, whilst all other items hold no heritage significance.

The Project would directly impact the heritage significance of the Belmont Estate through the demolition of Belmont Main House and associated structures. It is concluded that the demolition of these items is permissible from a heritage perspective given Cleary Bros is committed to the adoption of the management and mitigation measures recommended by Biosis (2021c).

6.8 Soil and Land Capability

6.8.1 Introduction

The SEARs for the Project require the EIS to include an assessment of the following potential impacts of the Project on soil and land capability.

- Potential impacts on soils and land capability.
- Potential impacts on landforms (topography), paying particular attention to the long-term geotechnical stability of any new landforms.
- The compatibility of the development with other land uses in the vicinity of the development.

The assessment requirements of the Biodiversity & Conservation Division (BCD) were also considered during the preparation of the soil and land capability assessment. A summary of the SEARs and the requirements of the BCD are listed in **Table A.1** and **Table A.2**, within **Appendix A** together with a record of where each requirement is addressed in the EIS.

A soil and water assessment for the Project was undertaken by Strategic Environmental and Engineering Consulting (SEEC) and the report is presented as Part 7 of the *Specialist Consultant Studies Compendium* and hereafter referred to as SEEC (2021). The following subsections provide a summary of the soil and land capability components of the assessment and describe the operational safeguards and management measures that would be implemented by Cleary Bros.

6.8.2 Soil Characteristics

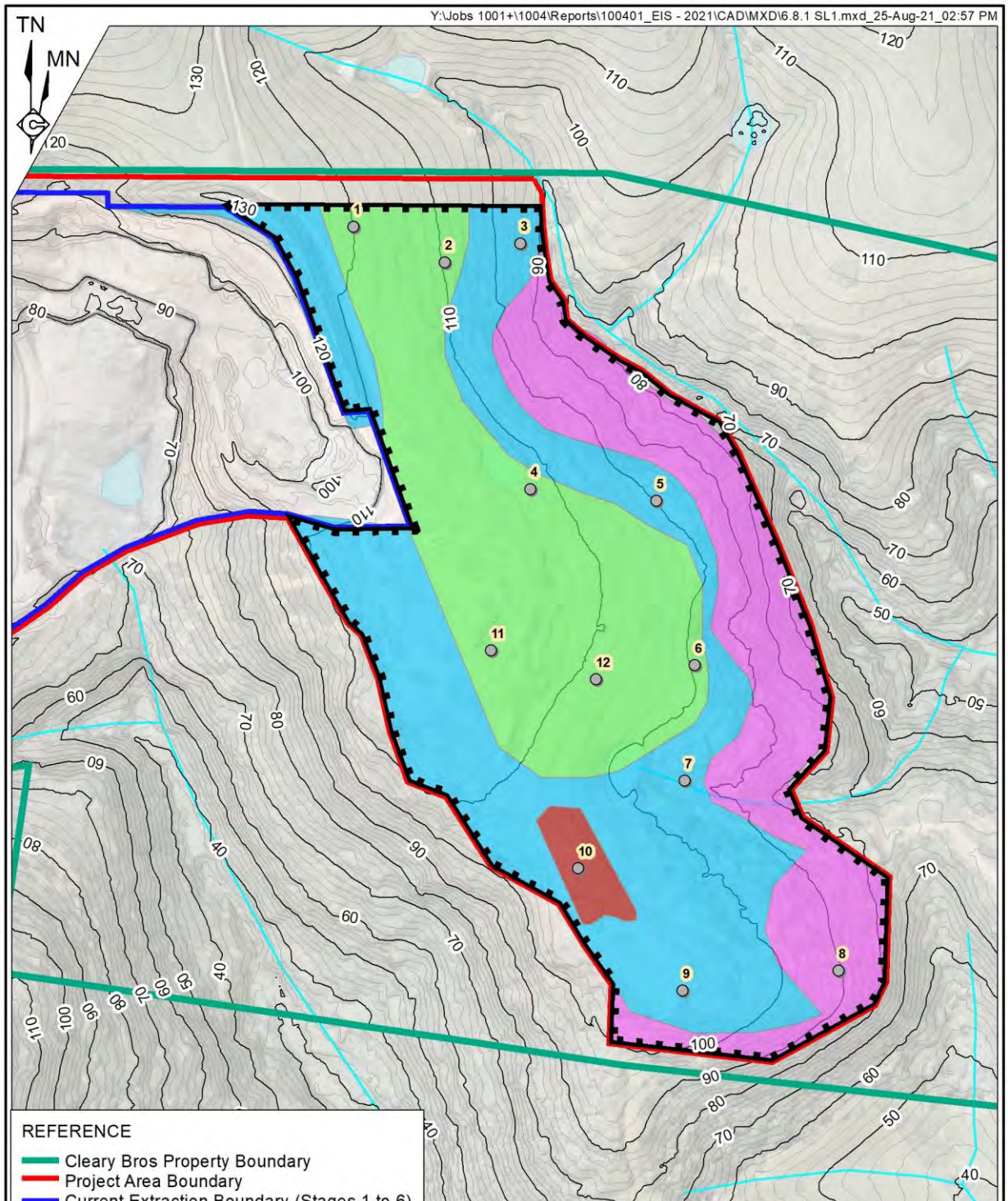
Stage 7 is located within land mapped as the Bombo Soil Landscape on the NSW eSpade[9] portal. SEEC (2021) excavated twelve soil test pits within Stage 7, the locations of which are shown in **Figure 6.8.1**. Samples of topsoil and subsoil were collected, where present, and basic chemical and physical testing of the samples defined four soil units in Stage 7, as shown in **Table 6.8.1**. Soil Units 1 to 3 are present throughout Stage 7 and Soil Unit 4 is stockpiled material (**Figure 6.8.1**).

[9] https://www.environment.nsw.gov.au/eSpade2Webapp

Table 6.8.1
Identified Soil Units in Stage 7

Soil Unit	Description and Soil Conditions	Key Features
1	Red and brown Ferrosols (Krasnozems) with medium to heavy clay subsoils and slow to impeded drainage.	Topsoil material (0 to 200 mm deep) generally suitable for use for rehabilitation purposes. Subsoils (below 200 mm) not suitable for rehabilitation purposes unless heavily ameliorated to break up clays.
2	Red and brown Ferrosols (Krasnozems) with light clay subsoils and moderate drainage.	Topsoil and subsoil materials (0 to 200 mm deep) generally suitable for use for rehabilitation purposes. Subsoils (below 200 mm) require minor amelioration with gypsum to break up clays.
3	Shallow brown organic loams with frequent rock outcrop.	Topsoil material is 0 to 400 mm deep and generally suitable for use for rehabilitation purposes.
4	Stockpiled material. Mixture of brown and red clay loams and light clays.	All stockpiled material assumed to be generally suitable for use for rehabilitation purposes.

Source: SEEC (2021) – Table 4



Basic chemical and physical tests were undertaken on all samples, and four representative samples were sent to a NATA-registered soil laboratory for further analytical testing. A summary of the analytical results is provided in **Table 6.8.2** and **Table 6.8.3**. Sections 2.3 and 2.4 of SEEC (2021) provide details of the laboratory test results. In summary, the Stage 7 soils:

- have plant water availability of 100mm/m to 140mm/m;
- have low to medium wind erodibility;
- are fine, non-dispersible to dispersible;
- are non-saline;
- have slight to strong acidity;
- are not sodic;
- are very weak to moderately leached;
- have very low to high available nutrients; and
- contain moderate to very high organic matter.

Table 6.8.2
Soil Test Results – Physical and Chemical Characteristics

Test Pit	Soil Layer	Plant Water Availability (mm/m)	Wind Erodibility Rating	Dispersion	Salinity	Acidity	Sodicity	Leaching
2	Subsoil	NT[1]	Low	Type D[2]	NT	NT	NT	NT
6	Topsoil	130	NT	NT	Non saline	Slight	Not sodic	Very weak
9	Topsoil	140	NT	Type F[3]	Non saline	Slight	Not sodic	Weak
9	Subsoil	110	Medium	NT	Non saline	Strong	Not sodic	Moderate
Note 1: NT = not tested Note 2: Type D = dispersible Note 3: Type F = fine, non-dispersible								
Source: SEEC (2021) – modified after Tables 7 to 11 and 14								

Table 6.8.3
Soil Test Results – Available Nutrients and Organic Matter

Test Pit	Soil Layer	Available Nutrients (mg/kg)						Organic Matter
		Nitrate	Phosphorous	Potassium	Sulfur	Calcium	Magnesium	
2	Subsoil	NT	NT	NT	NT	NT	NT	Moderate
6	Topsoil	Very low	Very low	High	Very low	Very low	High	Very high
9	Topsoil	Very low	Very low	High	Very low	Very low	High	Very high
9	Subsoil	Very low	Very low	Very low	Very low	Very low	High	Moderate
Source: SEEC (2021) – modified after Tables 15 and 16								

6.8.3 Soil Inventory

Table 6.8.4 presents an estimate of the volume of topsoil and subsoil in Stage 7, based on the average thickness of the soil layers in the Test Pits. The topsoil and subsoil would be used for rehabilitation of the Slopes and Plains Domains in the final landform, as described in Section 3.12.6.2.

Table 6.8.4
Soil Inventory for Stage 7

Soil Unit	Topsoil			Subsoil		
	Thickness (m)		Quantity (lcm[1])	Thickness (m)		Quantity (lcm[1])
	Range	Average		Range	Average	
1	0 - 0.25	0.15	14 970	0.55 – 0.8	0.6	57 244
2	0 – 0.40	0.25	23 602	0.45 – 1.0	0.7	68 817
3	0 – 0.30	0.10	16 662	-	-	-
4	0 – 0.20	0.10	1 074	0.4 – 2.2	1.6	4 832
Total			**56 308**			**130 893**
Note 1: lcm = loose cubic metres						
Source: SEEC (2021) - Table 19						

6.8.4 Land Capability

Based on the soil properties and the local environment for surface water, geology, rock outcrop and topography, SEEC (2021) assessed the existing land capability of Stage 7 as varying from Class III to Class VI, as shown in **Figure 6.8.2**. A summary of the land capability within Stage 7, as described in Section 2.6 of SEEC (2021), is provided as follows.

- Class III – approximately 8.5ha. Class III land has moderate to high land capability and can sustain high-impact land use such as cultivation or intensive grazing, provided the land is managed appropriately. Class III land is generally suitable for grazing, urban development, horticulture (orchards), and intensive forestry (SEEC, 2021).
- Class IV and Class V – approximately 6.4ha. Class IV land has moderate capability with moderate to high limitations for high-impact land use such as cropping, intensive grazing or horticulture. Class IV land is generally suitable for urban development or broad-acre grazing. Class V land is similar to Class IV but is steeper, necessitating more significant soil conservation techniques to mitigate the erosion hazard when grazed.
- Class VI – approximately 5ha. Class VI land has low capability with inherent constraints that need to be managed to prevent long-term degradation. Class VI land is generally suitable for grazing, forestry and nature conservation.

6.8.5 Land Uses

Surrounding land uses are described in Section 2.3.3. In summary, the Project Area is within a region that has been the focus of extractive industries since the 1960s. Land within this region that is not subject to extraction consists of grassland for grazing, or remnant vegetation on steeper slopes and within gullies.

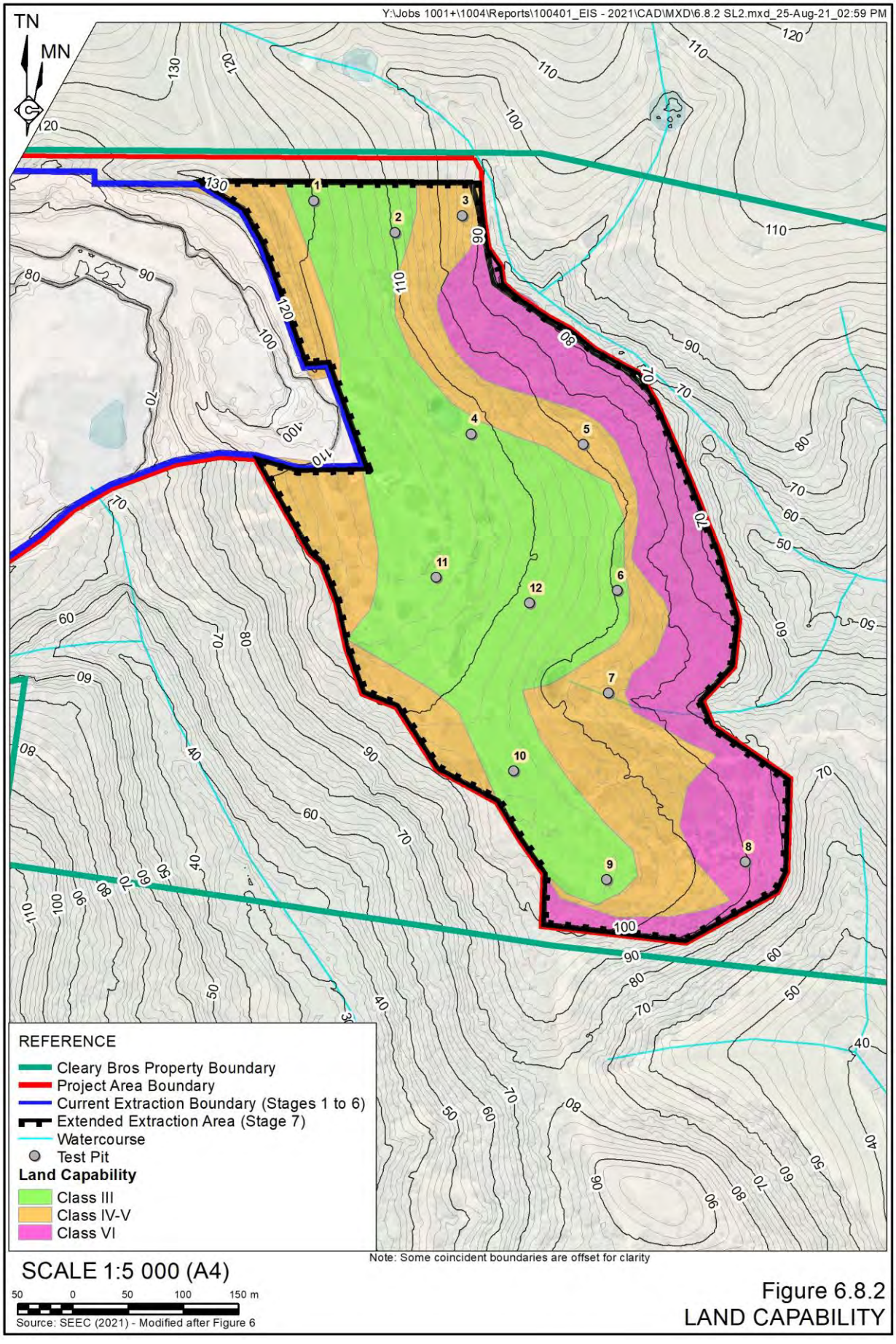


Figure 6.8.2
LAND CAPABILITY

6.8.6 Management and Mitigation Measures

Cleary Bros would implement the following management and mitigation measures throughout the Project life to minimise the potential for unacceptable soil and land capability-related impacts.

- Clearly mark areas for stripping and stockpiling.
- Strip topsoil from all areas of disturbance and store in stockpiles on relatively flat areas (<10% slope) orientated parallel to the contours no more than 2m high.
- Strip subsoil (where present) from areas of disturbance and store in stockpiles no more than 4m high.
- Refrain from stripping or placing soil during wet conditions.
- Ensure that the soil stockpile surfaces have a surface that is as 'rough' as possible, in a micro-scale, to assist in surface water runoff control and seed retention and germination.
- Spread seed of a suitable cover crop on all soil stockpiles to facilitate early vegetation and apply water, if required.
- Ensure that soil stockpiles are constructed with side slopes of 1:3 (V:H) or less and that the surface of all stockpiles achieves an effective 70% vegetation cover as soon as practicable. This would be achieved through the use of mulches, spray on polymer-based products or other practices that would allow a vegetative cover to become established.
- Signpost the soil stockpiles and limit operation of machinery on the stockpile to minimise compaction and further degradation of soil structure.
- Rip or scarify all areas to be respread with topsoil to allow the respread material to be keyed into the underlying material.
- Amelioration and fertilisation of topsoil and subsoil is recommended prior to use in rehabilitation to ensure appropriate growing conditions, in accordance with the nutrient and ameliorant application rate specified in Section 2.4.7 of SEEC (2021).

6.8.7 Assessment of Impacts

SEEC (2021) completed an assessment of the soils within Stage 7 and determined that those soils were suitable for revegetation purposes, subject to amelioration and fertilising as described, and posed no adverse impact for rehabilitation activities, SEEC (2021).

Adherence to the recommended topsoil and subsoil stripping, handling, stockpiling procedures and other management practices, together with appropriate rehabilitation practices would result in a minimal impact to soils within the Project Area. The Project would not significantly impact the post extraction agricultural potential of the land given the existing land uses both within and immediately surrounding the Project Area and the prevalence of low, moderate and high capability soils.

The Slope Domain and Plains Domain comprise approximately 75% of the proposed final landform. Provided that that topsoil and subsoil is placed and satisfactorily revegetated in accordance with the final landform (see Section 3.12.5), the land capability class for the Slope Domain and Plains Domain would be Class IV to Class VI, which is suitable for ongoing pasture and grazing activities.

6.8.8 Conclusion

The soils assessment for the Project identified no significant constraints for the use of the topsoils and subsoils for rehabilitation and revegetation purposes. Amelioration and fertilisation of topsoil and subsoil would need to be undertaken to ensure ideal growing conditions. As a result, the Project would not have a significant impact on soil resources.

The existing land capability of Stage 7 varies between Class III (high capability) in flatter areas to Class VI (low capability) generally in steeper areas. Post extraction, the slopes and plain domains within the final landform would be re-established as Class IV to Class VI land, suitable for grazing purposes. The other domains, comprising approximately 25% of the Project Area would comprise Class VII and VIII land suitable for nature conservation.

6.9 Surface Water

6.9.1 Introduction

The SEARs for the Project require the EIS to include an assessment of the following potential surface water-related issues.

- A detailed site water balance.
- Identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*.
- Demonstration that water for the operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP).
- A description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo.
- An assessment of the likely impacts on the quality and quantity of existing surface water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives.
- An assessment of the likely impacts of the development on watercourses, riparian land, water-related infrastructure, and other water users.
- A detailed description of the proposed water management system, water monitoring program and other measures to mitigate surface water impacts.
- An assessment of any likely flooding impacts of the development.

The assessment requirements of the DPE Water, Biodiversity & Conservation Division (BCD), Environment Protection Authority (EPA) and Shellharbour City Council were also considered during the preparation of the surface water assessment. A summary of the SEARs and the requirements of the DPE Water, BCD, EPA and Shellharbour City Council are listed in **Table A.1** and **Table A.2**, within **Appendix A** together with a record of where each requirement is addressed in the EIS.

A surface water assessment for the Project was undertaken by Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd and is presented as Part 7 of the *Specialist Consultant Studies Compendium* and is hereafter referred to as SEEC (2021). The following subsections provide a summary of the soil and surface water assessment and describe the operational safeguards and management measures that would be implemented by Cleary Bros. Reference is made, where appropriate, to the current *Water Management Plan* (WMP) for the current extraction area prepared by Cardno (2020) with all relevant mitigation measures included in the WMP incorporated within this subsection.

6.9.2 Existing Environment

6.9.2.1 Surface Water Catchments

The Project Area is located within the Rocklow Creek catchment with runoff from the Project Area generally flowing in a southeasterly direction before joining the Minnamurra River, which drains into the Tasman Sea at Minnamurra (**Figure 6.9.1**). For the purposes of this assessment, the watercourses within and draining from the Project Area are divided into three subcatchments, namely the Western, Southern and Eastern Subcatchments (see **Figure 6.9.1**). Runoff flowing within the Western and Southern Subcatchments flow into the Dunmore Lakes dredge pond and then into Rocklow Creek whilst runoff within the Eastern Subcatchment flows beneath the Princes Highway and ultimately flows into Rocklow Creek immediately east of the Illawarra Railway Line. It is noted that little use is made of the water downstream of the Project Area for agriculture, principally given the intermittent nature of the flows.

The areas for the three subcatchments are as follows.

- Western Subcatchment – 228ha
- Southern Subcatchment – 78ha
- Eastern Subcatchment – 245ha

Local catchments immediately surrounding the Project Area are presented in **Figure 6.9.2**, and are generally cleared of trees on the flatter sections and heavily vegetated on the steeper sections. The Western Subcatchment includes Watercourses 1 and 2, which merge to form Watercourse 3 which runs along the western flank of Stage 7. The Southern Subcatchment includes two small un-named watercourses draining the southern part of the Stage 7 area, which combine to form Watercourse 4. The Eastern Subcatchment includes a number of tributaries (including Watercourse 5) that merge to form Watercourse 6 on the eastern side of Stage 7.

Individual catchments within the Project Area have been assigned a letter to aid identification as shown in **Figure 6.9.2**. Catchments G and I drain westward into Watercourse 3. Catchment C drains westwards towards the existing sump within Stage 6. Catchments H and J drain to the southeast into Watercourse 4. Catchment F drains to the east into Watercourse 5, while Catchments A, B, D and E drain into Watercourse 6, with Catchments D, E and F covering most of Stage 7. The northeastern corner of the Stage 7 extraction area has been designed to ensure that it does not intersect Watercourse 6 and thereby avoids any surface water runoff in Watercourse 6 from entering Stage 7.

It is noted that each of the above subcatchments are sufficiently elevated and exhibit gradients not to be the subject of any flooding.

6.9.2.2 Downstream Flows

Estimated flows in the watercourses downstream from the Project Area are provided in Table 26 of SEEC (2021). Flows in the western subcatchment at the southern boundary of the Project Area vary from approximately 265ML/day during a 1 in 2 year (50% AEP[10]) flood event to approximately 730ML/day during a 1 in 100 year (1% AEP[8]) flood event. Flows in the eastern catchment at the eastern boundary of the Cleary Bros. property vary from 436ML/day during a 1 in 2 year (50% AEP[8]) flood event to approximately 1 200 ML/day during a 1 in 100 year (1% AEP[8]) flood event.

[10] AEP = Annual Exceedance Probability

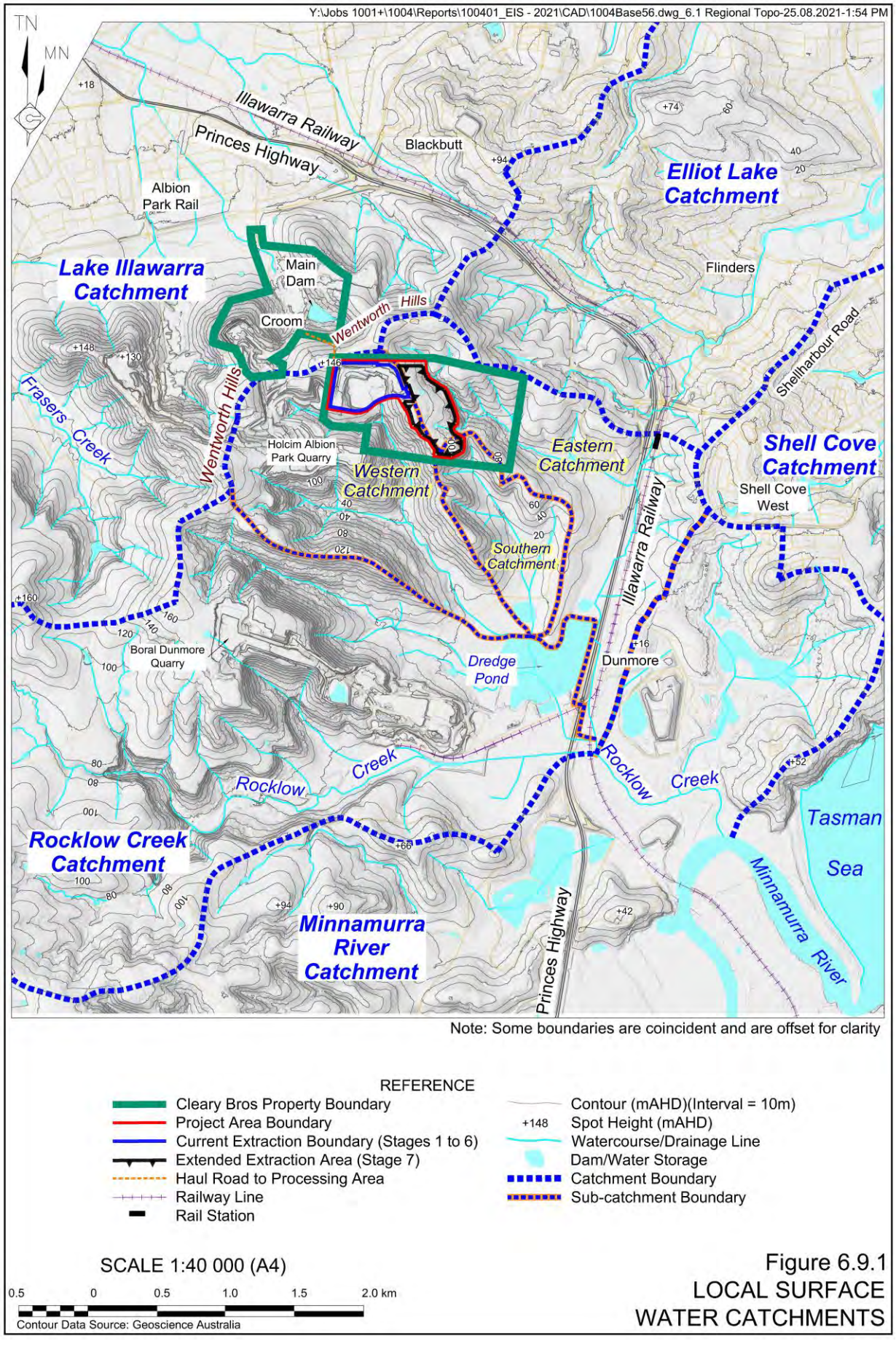
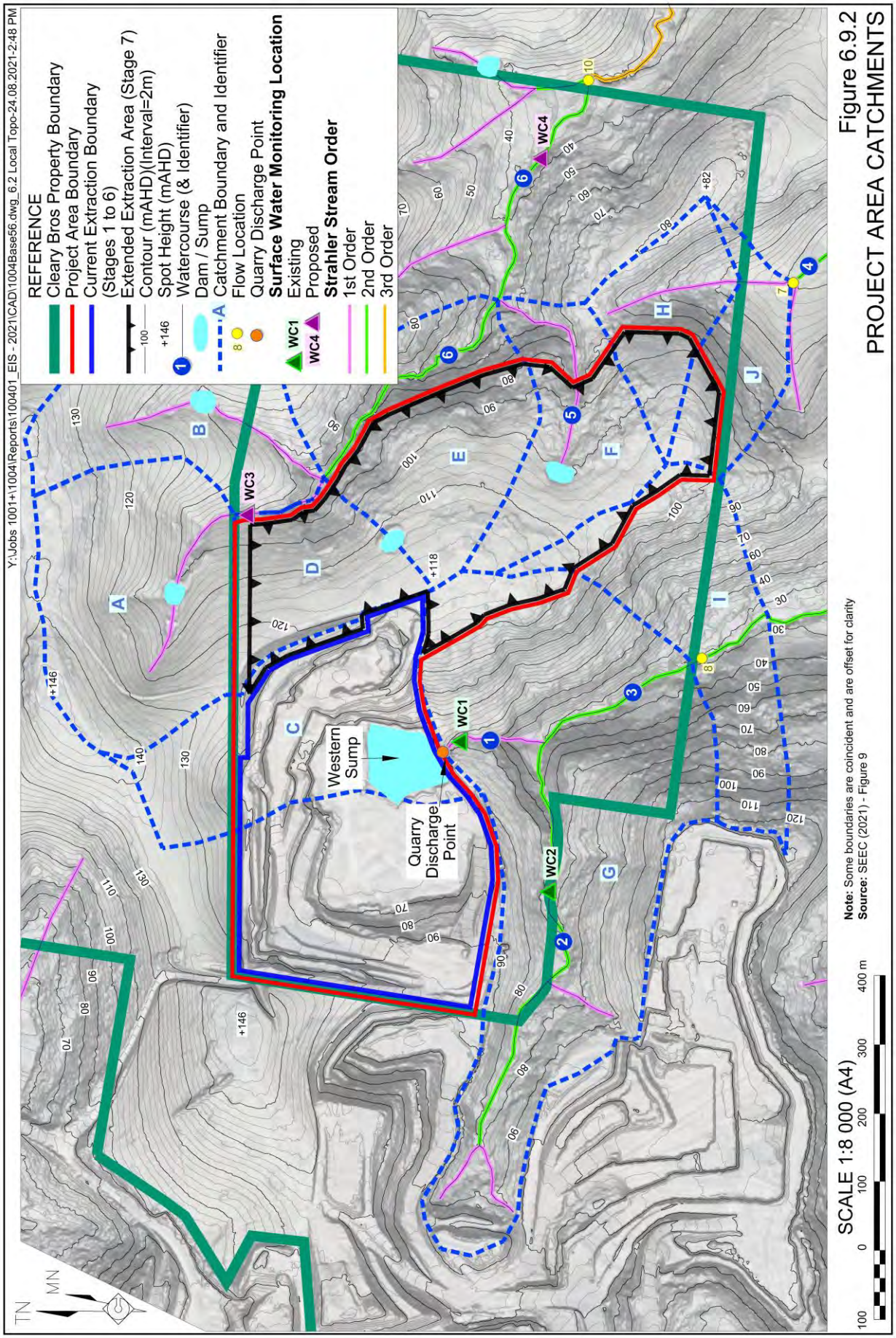


Figure 6.9.1
LOCAL SURFACE WATER CATCHMENTS


Y:\Jobs 1001+\1004\Reports\100401_EIS - 2021\CAD\1004Base56.dwg, 6.2 Local Topo-24.08.2021-2:48 PM
REFERENCE
Cleary Bros Property Boundary
Project Area Boundary
Current Extraction Boundary (Stages 1 to 6)
Extended Extraction Area (Stage 7)
Contour (mAHD)(Interval=2m)
Spot Height (mAHD)
Watercourse (& Identifier)
Dam / Sump
Catchment Boundary and Identifier
Flow Location
Quarry Discharge Point
Surface Water Monitoring Location
Existing
Proposed
Strahler Stream Order
1st Order
2nd Order
3rd Order
WC1
WC2
WC3
WC4
Western Sump
Quarry Discharge Point
TN
MN
SCALE 1:8 000 (A4)
100 0 100 200 300 400 m
Note: Some boundaries are coincident and are offset for clarity
Source: SEEC (2021) - Figure 9
Figure 6.9.2
PROJECT AREA CATCHMENTS

6.9.2.3 Water Quality

Cleary Bros has been monitoring surface water quality at monitoring sites WC1 on Watercourse 1 and WC2 on Watercourse 2, south of the current extraction area (Stages 1 to 6) (**Figure 6.9.2**) since 2009. The monitoring is undertaken in accordance with the *Quarry Environmental Management Plan*. The quality of water at Site WC1 reflects the quality of water discharged from the EPL discharge point on the southern boundary of the current extraction area. It is noted that the quality of water recorded at Site WC2 is comparable to that at Site WC1 although the salinity levels and total dissolved solids are higher at Site WC2 (SEEC 2021). WC2 is located immediately downstream of the adjacent Holcim quarry.

From a cumulative perspective, the combined surface water flows from the Holcim Quarry and the Project Area display water quality that satisfies EPA discharge criteria. Any runoff from the Boral Dunmore Quarry could enter Rocklow Creek close to its confluence with the Minnamurra River and there would be negligible opportunities for any cumulative impact from water flowing from the Project Area and the Boral Dunmore Quarry.

Recent water quality monitoring has included Watercourse 6 (WC3) near the northeastern corner of Stage 7. A further monitoring location (WC4) has been established; however, no samples have been collected from this location to date as this location has been dry during the sampling periods.

SEEC (2021) records that, due to the vegetation cover and no significant visible areas of erosion across the Stage 7 area, the quality of runoff from the Stage 7 area is good, with recent monitoring results for surface water at WC3 showing a pH of 7.4, electrical conductivity of 603µS/cm and total suspended solids of <5mg/L. The key water quality parameters for the water monitored at the monitoring locations are as follows.

- Flow rate
- Electrical conductivity
- pH
- Temperature
- Turbidity
- Oil and grease
- Total suspended solids
- Total dissolved solids
- Major anions and cations
- Alkalinity
- Dissolved metals

Details of the surface water quality recorded at the sampling locations are presented in Section 3.5 of SEEC (2021).

6.9.2.4 Current Water Management Practices

Cleary Bros manages surface water within the current extraction area in accordance with the *Quarry Environmental Management Plan*. Reliance is placed upon a single sump in Stages 1 to 6, referred to as the "Western Sump" in **Figure 6.9.2**, which collects all runoff from disturbed areas within the extraction area. Runoff collected in the sump following rainfall may contain elevated levels of suspended solids, which settle out over time. Following rainfall events, the excess water in the sump is tested and discharged in accordance with the water quality limits nominated within the Environment Protection Licence 299 into the adjoining Watercourse 1. Pumping records indicate that the quantity of water pumped into Watercourse 1 varies from approximately 10ML per year to approximately 250ML per year, dependent on rainfall.

6.9.2.5 Water Sharing Plan and Harvestable Rights

The Project Area is located within the Minnamurra River Management Zone of the Illawarra Rivers Water Source of the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011*.

Under the *Water Management Act 2000,* the Quarry has maximum harvestable rights of 18.56ML, based on Cleary Bros total land holding of 142.74ha. This quantity of water is mostly taken up by the long-established Main Dam located within the Lake Illawarra subcatchment adjacent to the fixed processing plant, to the north of the Project Area (**Figure 6.9.1**). The Main Dam has a capacity of 18ML and supplies water for a range of activities within the Quarry including dust suppression within the current extraction area.

The *Water Management (General) Regulation 2018* provides an exemption from the requirement for a Water Access Licence under Schedule 1 Clause 3 for dams used solely for the capture, containment and recirculation of drainage to prevent contamination of a water source located on a minor stream.

6.9.3 Stage 7 Operations

6.9.3.1 Water Flows

SEEC modelled the surface water flows in catchments impacted by the Project throughout the Project life. Reduced runoff would occur within Watercourses 1, 3, 4, 5 and 6 as the extraction area progressively captures parts of the catchments for these watercourses, diverting the runoff from these areas into the active extraction area sump. This would effectively decrease the peak flows in the downstream watercourses, with the dewatering of the sump following the settlement of fines generally leaving overall flow volumes unchanged or marginally higher depending on the stage of extraction and the area of exposed rock surface.

The estimated change in peak flows in watercourses adjacent to the Cleary Bros property boundary at the full extent of the Project is presented in **Table 6.9.1**. Flow locations 7, 8 and 10 refer to the Southern, Western, and Eastern subcatchments respectively, as shown in **Figure 6.9.2.** Peak surface water flows are estimated to decrease by approximately 18% to 26% across these subcatchments, while peak flows in Rocklow Creek are predicted to reduce by approximately 4%.

Table 6.9.1
Watercourse Flows During Stage 7d Operations (m^3/s)

Flow Location	Peak Flow Change (%)	1 EY[1]	50% AEP[2]	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
7	-23.4%	0.53	0.7	0.96	1.15	1.37	1.71	1.93
8	-25.7%	1.72	2.29	3.15	3.76	4.46	5.53	6.27
10	-18.0%	3.13	4.17	5.74	6.87	8.1	10.1	11.45
Note 1: EY = exceedances per year Note 2: AEP = annual exceedance probability								
Source: SEEC (2021) – Table 34								

Given the runoff coefficient within the extraction area would be greater than the existing grazing land, more runoff would be collected within the sumps, the bulk of which in turn would be released back into the downstream watercourses.

Cleary Bros current practice of containing all runoff from disturbed areas within the extraction area also reduces the quantity of water flowing downstream during flood periods. The controlled discharge of up to 9 ML/day of excess water following high rainfall periods in effect assists to maintain average flows for longer periods.

6.9.3.2 Water Demand

The annual water usage for the broader Albion Park Quarry and associated activities is currently estimated to range between 75ML/yr for a wet year and 93ML/yr for a dry year (SEEC, 2021). Extraction within Stage 7 would require increased water usage for dust suppression on the extended internal haul roads and for dust suppression on the crushing and screening plants. The estimated additional water usage for dust suppression of the haul roads and crushing and screening plants within Stage 7 is summarised in **Table 6.9.2**.

Stages 7a and 7b would have the highest water demand with an additional 15.1ML/yr required. With the increased water demand for haul road dust suppression in Stage 7, the maximum annual water requirement would range between approximately 92ML/yr to 110ML/yr during Stage 7a and Stage 7b operations. There would be no other changes to water demand as a result of extraction from the Project Area as the annual quantity of material processed within the Project Area would not change.

Overall, the maximum annual water demand for dust suppression would vary from: 110.1ML (93ML + 17.1ML) for Stages 7a and 7b; 102.6ML (93ML + 9.6ML) for Stage 7c; and 100.0ML (93ML + 7.0ML) for Stage 7d.

Table 6.9.2
Additional Water Requirements for Stage 7

Stage	Haul Road Dust Suppression			Water for Processing (ML/yr)	Total
	Approximate Additional Haul Road Length (m)	Water Application Rate L/m²/hr	Annual Additional Volume for Dust Suppression (ML)		
7a	300 - 600	2	7.60 - 15.10	2	9.60 – 17.10
7b	600	2	15.10	2	17.10
7c	300	2	7.60	2	9.60
7d	200	2	5.00	2	7.00
Source: SEEC (2021) – Table 35					

6.9.3.3 Water Balance

SEEC (2021) prepared a water balance for the Project with the predicted annual water surpluses presented in **Table 6.9.3**. The water balance focusses on the additional water requirements for Stage 7 activities as the base load for the water requirement for road watering would continue to be drawn from the main dam to the northwest of the Project Area. Water usage for the Project would primarily be for dust suppression on the internal haul roads and the two mobile crushing and screening plants, plus evaporative losses from sumps in the extraction area. As shown in **Table 6.9.3**, the volume of runoff from the Stage 7 area comfortably exceeds these water requirements. Following rainfall events, this excess runoff would be used for dust suppression purposes and/or discharged to local watercourses, after the settlement of sediment, in accordance with the conditions of EPL 299. Further details on the surface water balance are provided in Section 4.2.5 of SEEC (2021).

Table 6.9.3
Summarised Annual Water Surpluses for the Project

Stage	Average Annual Runoff (ML)	Average Annual Evaporation Loss (ML)	Available (ML)	Dust Suppression (ML)	Total Water Surplus (ML)*
7a	62.30	3.37	58.93	9.60 – 17.10	41.83 – 49.33
7b	77.33	4.67	72.66	17.10	55.56
7c	110.78	7.35	103.43	9.60	93.83
7d	147.69	8.20	139.49	7.00	132.49
* Collecting in sumps and available for discharge					
Source: SEEC (2021) – modified after Tables 38 and 39					

6.9.4 Management and Mitigation Measures

The strategy for the management of surface water throughout the Project life would be comparatively simple given:

i) negligible upslope runoff would enter the extraction area; and

ii) all rainfall falling within the active extraction area would be retained within the extraction area.

This latter management measure is of importance as Cleary Bros is able to ensure that the quality of water leaving its property is of an acceptable quality and the retention of the water on site in turn reduces flood flows downstream and enables more consistent flows at other times.

Figure 6.9.3 displays the key features of the surface water management within the Project Area.

The key measures adopted to minimise upslope runoff entering the extraction area are:

i) the northern amenity barrier; and

ii) a setback would be maintained between Watercourse 6 and the northeastern extent of Stage 7 to prevent inflows from the watercourse into the extraction area. As recommended by SEEC (2021), a minimum cross-sectional area of 10.2m^2 (including freeboard) would be retained for Watercourse 6 adjacent the Stage 7 boundary to prevent inflows in a 1% AEP storm event.

In the event that the northern amenity barrier is not constructed in accordance with any agreement with the owners of "Figtree Hill", a clean water diversion would be installed to prevent surface water inflows to the extraction area.

The only upslope runoff entering the Project Area is from a 3.5ha area of grazing land immediately north of Stages 1 to 6. This runoff would continue to report to the Western Sump within the extraction area.

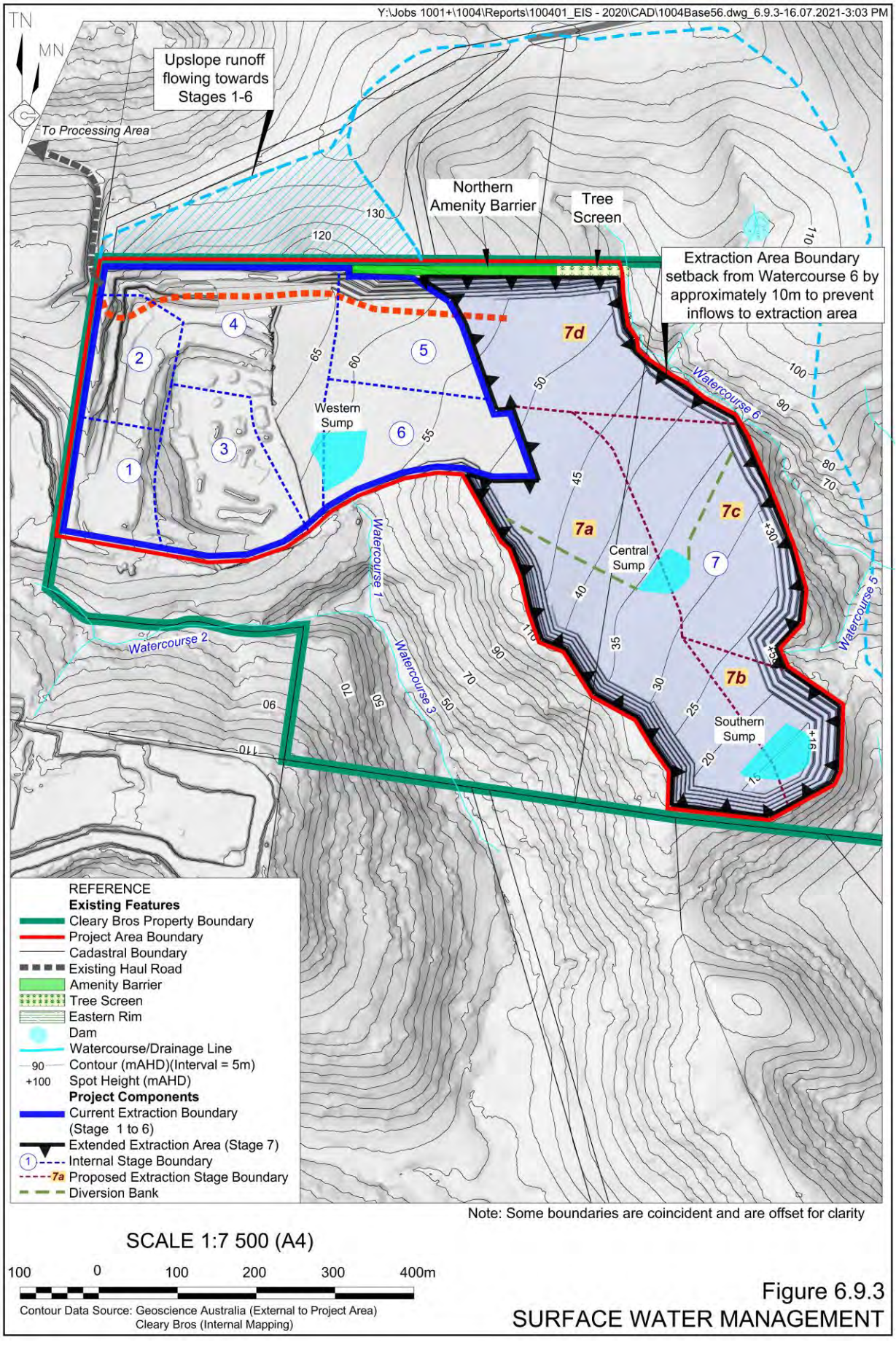


Figure 6.9.3
SURFACE WATER MANAGEMENT

The rain falling within the extraction area would continue to report to the lowest point of the active extraction area. Effectively, a sump would be created at these points which would progressively move as extraction extends and deepens in each stage. Ultimately, three sumps would be created within the Project Area, namely the Western, Southern and Central Sumps.

- The Western Sump already exists within Stages 1 to 6 and collects all runoff from within these stages and the 3.5ha of land immediately to the north of Stages 1 to 6. The current licenced discharge from the Western Sump (Point 6 on EPL 299) is located immediately south of the sump. This sump would be retained in the final landform (see **Figure 3.8**) and collect runoff from the rehabilitated Stages 1 to 6.
- The Southern Sump would be developed at the southern end of Stage 7 encompassing parts of Stages 7a and 7b. This sump would remain operational for the entire Project life.
- The Central Sump would be developed largely within Stage 7c and provide a sump for the collection of runoff from the northern areas within Stages 7a and 7c and the entire Stage 7d.

All sumps would be progressively rehabilitated (as discussed in Section 3.12.5) to create an open water domain with their margins profiled with backfilled overburden and VENM/ENM.

The runoff collected within the sumps would either be used untreated for use in dust suppression along the haul roads within the Project Area or treated (if required) and released into the adjacent downstream watercourse(s). The release of treated water would be undertaken in accordance with the conditional requirements of EPL 299. Cleary Bros typically releases up to 9ML/day on the days when excess water needs to be released and then only after testing confirms the quality of the water is suitable for its controlled release.

6.9.5 Assessment of Impacts

With the adoption of the management and mitigation measures described in Section 6.9.4, the surface water impacts of the Project are predicted to be minimal, both in terms of impacts upon downstream flows and water quality. The drainage controls proposed for the Project would convey sediment-laden water internally to sumps in the extraction area that would allow treatment (if required) prior to discharge and/or for re-use for dust suppression purposes.

The reduction in peak downstream flows would be a gradual process as the extraction footprint progressively increases. Peak surface water flows are estimated to decrease by approximately 18% to 26% across the subcatchments adjacent to the Project, while peak flows further downstream in Rocklow Creek are expected to reduce by approximately 4%. As runoff collected in the extraction area sumps would be discharged to the local watercourses following the settlement of any fines, changes to overall flow volumes would be negligible or potentially marginally greater than pre-development flows.

The impacts of these periods of reduced peak flows downstream from the Project Area are assessed to be minimal given the limited use of the water on downstream properties before it enters Rocklow Creek.

It is concluded that none of the watercourses in the vicinity of the Project Area would be the subject of any flooding spreading onto the adjoining land given their elevated locations and relatively steep gradients. Importantly, Cleary Bros' current practice involving the retention of all runoff, under all rainfall events, within the extraction area and its controlled release when water quality is acceptable reduces runoff during periods of high flow and subsequently maintains flow for longer periods between high flow events. The release of up to 9ML of water per day from the extraction area would typically represent between 1.5% and 4% of natural high flow events downstream of the Company's property. Hence, the Project would have negligible adverse impacts on downstream flooding and changes in water quality.

6.9.6 Monitoring

Monitoring would continue in accordance with the Quarry's *Water Management Plan*, and would include the additional surface water monitoring locations shown on **Figure 6.9.2**. The existing frequency of water quality monitoring (biannually) would be maintained. Monitoring of discharges from the extraction area would continue on a daily basis, as required by EPL 299.

6.9.7 Conclusion

The Project would generate sediment-laden runoff which would be directed to internal sumps within the Project Area. The accumulated water would either be used for dust suppression or tested, and if necessary treated, to ensure that it meets quality criteria nominated in the Quarry's Environment Protection Licence, prior to controlled discharge after rainfall events through the Quarry's licensed discharge point(s). As a result, the Project would not have a significant impact on surface water quality or overall downstream flows.

6.10 Groundwater

6.10.1 Introduction

The SEARs for the Project require the EIS to include an assessment of the following potential impacts of the Project on 'water,' with points 1 to 3 related to 'water' in general, and points 4 to 6 related to 'groundwater' specifically.

1. Identification of any licensing requirements or other approvals under the *Water Act 1912* and/or *Water Management Act 2000*.
2. Demonstration that water for the operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP).
3. A description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo.
4. An assessment of the likely impacts on the quality and quantity of existing groundwater resources.
5. An assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users.
6. A detailed description of the proposed water management system, water monitoring program and other measures to mitigate groundwater impacts.

The assessment requirements of the DPE Water, Biodiversity & Conservation Division (BCD), Environment Protection Authority (EPA) and Shellharbour City Council were also considered during the preparation of the groundwater assessment. A summary of the SEARs and the requirements of the DPE Water, BCD, EPA and Shellharbour City Council are listed in **Table A.1** and **Table A.2**, within **Appendix A** together with a record of where each requirement is addressed in the EIS.

A groundwater assessment for the Project was undertaken by Jacobs Australia Pty Limited (Jacobs) and is presented as Part 8 of the *Specialist Consultant Studies Compendium* and hereafter referred to as Jacobs (2021). The following subsections provide a summary of the groundwater assessment and describe the operational safeguards and management measures that would be implemented by Cleary Bros. Reference is made, where appropriate, to the current *Water Management Plan* (WMP) for the current extraction area with all relevant mitigation measures included in the WMP incorporated within this subsection.

6.10.2 Existing Groundwater Environment

6.10.2.1 Climate

The groundwater assessment relied upon climate data obtained using the Queensland Government's online SILO database, with data extracted from the Bureau of Meteorology (BoM) Albion Park Post Office weather station (Station No. 068000) located approximately 5km northwest of the Project Area. Data collected from the Quarry's on-site weather station was not used due to data gaps and the limited record period (2013 to 2020) compared to SILO data which was available for periods of up to 126 years. **Table 6.10.1** presents a summary of key rainfall and evaporation statistics for the Project Area based on the available SILO data.

Table 6.10.1
SILO Data - Rainfall and Evaporation Summary

Parameter	Period												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Mean Monthly Rainfall (mm)[1]	103	121	130	101	92	108	70	67	58	75	83	78	1 084
Mean Monthly Pan Evaporation (mm)[2]	195	155	139	101	75	60	69	96	124	156	171	202	1 541
Mean Daily Pan Evaporation (mm)[2]	6.30	5.54	4.47	3.36	2.41	2.00	2.22	3.09	4.12	5.02	5.69	6.50	1 541
Mean Monthly FAO56 Evaporation (mm)[3]	138	111	104	79	60	47	54	73	95	118	125	142	1 144
Mean Daily FAO56 Evaporation (mm)[3]	4.44	3.96	3.36	2.62	1.92	1.55	1.75	2.35	3.15	3.80	4.17	4.59	1 144
Rainfall Surplus (mm)[4]	-92	-34	-9	0	17	48	1	-29	-66	-81	-88	-124	-457
Note 1: Based on records from 1893 to end of 2019.													
Note 2: Based on records from 1970 to end of 2019.													
Note 3: Based on records from 1970 to 25/11/2020.													
Note 4: Calculated by subtracting pan evaporation from rainfall.													
Source: Jacobs (2021) – modified after Table 3.1													

6.10.2.2 Groundwater Systems and Hydraulic Conductivity

Based on historical groundwater level records from the Quarry's groundwater monitoring bores (**Figure 6.10.1**) and observations made during resource definition drilling for the Project, Jacobs (2021) have identified the following broad groundwater systems applicable to the Project Area.

- A shallow (<10mBGL[11]) water table system, which is generally consistent with, and likely associated with, an upper weathered zone in the latite and agglomerate.
- Intermediate depth groundwater unconfined to semi-confined systems in the latite and agglomerate underlying the shallow water table system. Flow in these systems is almost exclusively dependent upon fracture/defect extent and unit contact planes (i.e. contact of latite and agglomerate).

Additionally, deep semi-confined to confined groundwater systems within the underlying Kiama Sandstone are thought to underly the intermediate depth groundwater systems, although these are not relevant as the Project would not intersect these systems.

Due to inferred poorly connected fractured flow paths and negligible matrix hydraulic conductivity within the latite and agglomerate, poor hydraulic connection is conceptualised between:

- the water table and underlying intermediate and deep groundwater systems;
- the intermediate groundwater systems themselves; and
- the deep sandstone groundwater system and overlying intermediate system.

[11] mBGL = metres below ground level

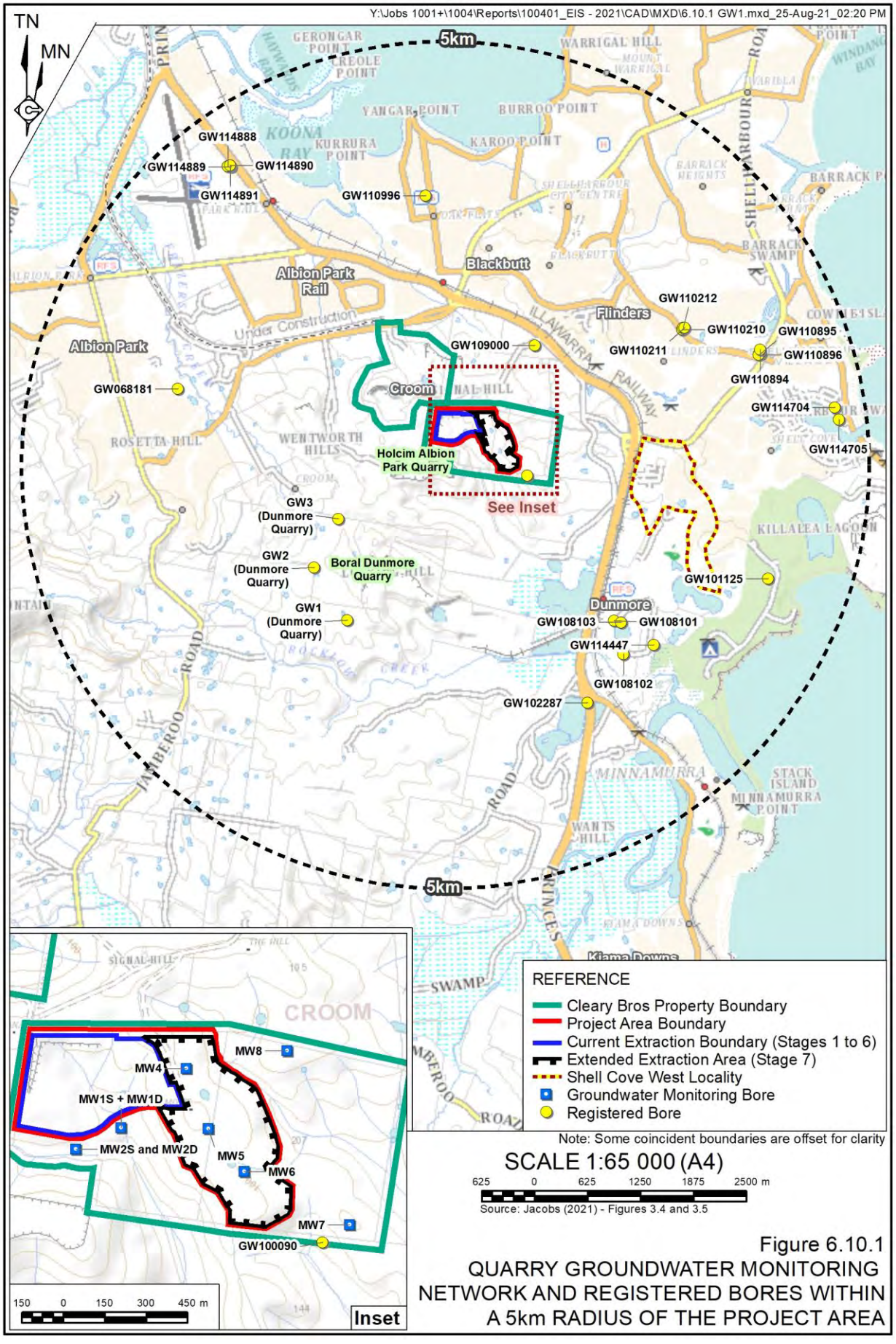


Figure 6.10.1
QUARRY GROUNDWATER MONITORING NETWORK AND REGISTERED BORES WITHIN A 5km RADIUS OF THE PROJECT AREA

Slug tests, a type of groundwater hydraulic test where the water level in a monitoring bore is raised or lowered and the rate of recovery is measured, were conducted for seven of the nine groundwater monitoring bores within the Project Area, with the remaining two bores being either dry or failing to recover following water quality sampling events. Hydraulic conductivity recorded within the groundwater monitoring bores ranged between 1.56 x 10^{-5} metres per day (m/d) and 7.64 x 10^{-3}m/d, with an average hydraulic conductivity of 1.71 x 10^{-3}m/d. Based on these results, Jacobs (2021) concluded that hydraulic conductivity of the latite and agglomerate within the Project Area is generally low and typically less than 0.002m/d.

Jacobs (2021) notes that although preferential flow could occur at the interface of the latite/agglomerate and lower latite/sandstone, the results of monitoring bore slug tests did not indicate distinctly different estimates of hydraulic conductivity at bores MW2D (1.56 x 10^{-5}m/d), MW5 (2.40 x 10^{-3}m/d) and MW6 (3.22 x 10^{-4}m/d) which have screens that span across latite/agglomerate contacts. Consequently, the latite and agglomerate matrix hydraulic conductivity, fracture and contact plane hydraulic conductivity and storage is considered to be sufficiently low that 'aquifers' (defined as groundwater systems from which useable volumes of groundwater can be pumped) in these systems are unlikely to exist. This conclusion is further supported by the lack of observed groundwater inflow to the current extraction area (see Section 3.11.4 of Jacobs, 2021).

6.10.2.3 Groundwater Levels

Table 6.10.2 provides a summary of groundwater levels recorded at the nine groundwater monitoring bores between December 2008 and September 2020.

Table 6.10.2
Quarry Groundwater Monitoring Bore Summary

	Groundwater Level (m AHD)		
Monitoring Bore ID	**Minimum**	**Average**	**Maximum**
MW15	63.03	66.36 (3.48mBGL)	69.09
MW1D	45.54	51.33 (18.51mBGL)	60.58
MW2S	63.12	65.35 (8.97mBGL)	68.97
MW2D	56.18	64.49 (9.91mBGL)	72.06
MW4	112.55	112.71 (4.21mBGL)	115.05
MW5	76.15	80.15 (36.74mBGL)	80.34
MW6	88.44	88.70 (6.07mBGL)	92.21
MW7	70.15	71.01 (10.74mBGL)	80.95
MW8	100.84	101.31 (7.87mBGL)	102.27
Source: Jacobs (2021) – modified after Table 3.3			

Regional groundwater levels and flow directions were conceptualised by Jacobs (2021) through the contouring of groundwater levels measured in the nine groundwater monitoring bores within and adjacent to the Project Area, 27 registered groundwater bores identified through the Water NSW online bore database, and three groundwater monitoring bores located at the Dunmore Quarry (see **Figure 6.10.1**). Contours were also informed by an additional 379 control points located along the Pacific Ocean, Macquarie Rivulet, Minnamurra River and Lake Illawarra. The resulting contours generally suggest that groundwater flows from areas of relatively high elevation to areas of relatively low elevation before discharging into Lake Illawarra, Macquarie Rivulet, the Minnamurra River and other low lying areas including the Pacific Ocean. Groundwater levels in the vicinity of the Project Area are relatively elevated (Jacobs, 2021).

6.10.2.4 Groundwater Quality

Groundwater quality monitoring has been undertaken on a six monthly basis since 2008 / 2009 for groundwater monitoring bores MW1S, MW1D, MW2S and MW2D and, more recently, on a quarterly basis for the recently installed groundwater monitoring bores MW4, MW5, MW6, MW7 and MW8. The water quality data collected from these bores up until 23 November 2020 were relied upon for this assessment. In summary, key groundwater quality characteristics include the following.

- EC typically less than 2 000µS/cm but ranges from around 100µS/cm to 2 500µS/cm.
- Average TDS of between 640mg/L and 843mg/L for bores subject to regular sampling (MW1S, MW1D, MW2S and MW2D).
- TDS for single sampling round bores (MW4, MW5, MW6, MW7 and MW8) ranging from 217mg/L to 760mg/L.
- Average TDS values generally representative of 'fresh water', with instances of 'brackish' water recorded during historic regular sampling.
- pH typically ranging from 6.0 to 7.5.
- Average nitrogen species values of 1.3mg/L nitrate, 0.017mg/L nitrite, 0.2mg/L ammonia, 1.5mg/L total Kjeldahl nitrogen and 2.8mg/L total nitrogen.
- Average total phosphorous value of 0.52mg/L.
- Water type according to a piper plot is typically mixed type, although some samples from bores MW1D and MW5 plot as sodium chloride type, some samples from bores MW1S, MW1D, MW2S, MW2D and MW8 plot as calcium carbonate or manganese bicarbonate, and some samples from bore MW1S plot as calcium chloride type.
- Oil/grease was recorded at some bores during sampling rounds in 2008, 2009, 2010 and 2015. Also, a sampling round undertaken by Jacobs on 16/12/2019 included detection of hydrocarbons. The source is unknown, however, with the exception of instances in 2015, the oil and grease detections occur in the early phase of the data set (i.e. relatively close to the drilling date). Hydrocarbon and oil/grease detections may therefore represent contamination by pipe grease during bore drilling.
- Measurements outside of default ANZG guideline values included:
  - freshwater 95% species protection toxicant default guideline values for slightly to moderately disturbed ecosystems (frequently for copper, zinc and nickel guideline values and rarely for cadmium, lead and mercury); and
  - physical and chemical stressors for lowland rivers (frequently for total nitrogen and total phosphorous, occasionally for pH and rarely for EC).

6.10.2.5 Storage, Recharge, Discharge and Drawdown

Groundwater system storage, defined by physical properties that characterise the capacity of a groundwater system to release water, is defined in terms of specific yield and specific storage. Specific yield, also known as the drainable porosity, is generally less than or equal to the effective porosity (i.e. total connected pore space). Specific storage is the amount of water that a proportion of a groundwater system releases from storage, per unit mass or volume of a groundwater system, per unit change of head, whilst remaining fully saturated.

Groundwater system storage within the Project Area is inferred to be low for the latite/agglomerate, with specific yield inferred to be approximately 0.01 based on poorly connected fracture flow paths and low primary porosity (Jacobs, 2021). Specific storage is conceptualised to be in the order of 1×10^{-6} based on the material type in the vicinity of the Project Area and literature values for moderately fissured rock.

Groundwater recharge within the Project Area is inferred to be low based on low formation hydraulic conductivity and connectivity, clay overburden and relatively steep slopes which encourage runoff. Relatively higher recharge may occur on ridge top areas.

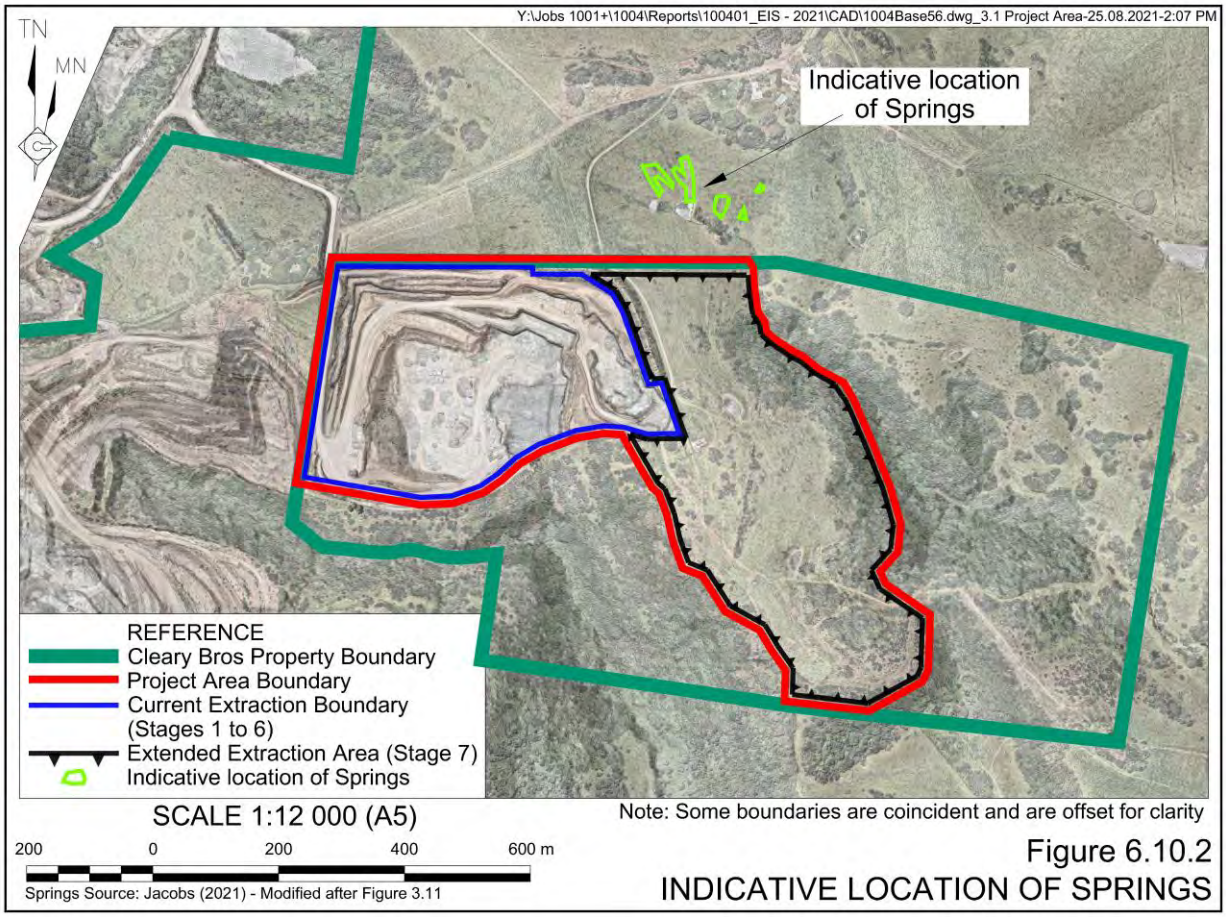
Groundwater discharge within the Project Area is conceptualised to occur through evapotranspiration, discharge to springs and discharge as base flow to watercourses. Ultimately, groundwater is conceptualised to discharge to Lake Illawarra and the Pacific Ocean within a regional context. Baseflow is inferred to occur to watercourses in the vicinity of the Project Area, however, is conceptualised to be low due to low hydraulic conductivity and is considered to represent a negligible component of the water balance with correspondingly insignificant influence on the existing environment.

Springs occur in the general area around the Project Area, including within 200m of the northern boundary of Stage 7 (**Figure 6.10.2**). Springs are thought to be controlled by shallow groundwater flow systems that are poorly connected to underlying deeper groundwater systems. This conclusion is consistent with characterisations of springs in the vicinity of the nearby Dunmore Quarry where water quality analysis indicated that springs relied on shallow, localised rainfall recharge rather than deeper groundwater systems. Vegetation in the vicinity of the springs to the north of the Project Area has previously been cleared and now consists of pasture grasses which are subject to ongoing grazing by cattle.

Groundwater extraction by existing groundwater bores in the vicinity of the Project Area is considered to be negligible. **Table 6.10.3** provides a summary of the three groundwater extraction bores closest to the Project Area.

Table 6.10.3
Registered Groundwater Extraction Bores close to the Project Area

Bore ID	Purpose	Distance from Stage 7	Bore Depth (m)	Yield (L/S)	Standing Water Level (mBGL)
GW100090	Water supply	160m – 200m southeast	66	0.1	0.3
GW109000	Water supply	900m northeast	78	0.8	27
GW44447	Stock and domestic	1 250m southeast	0	No data	No data
Source: Jacobs (2021) – Table 3.5					



Based on observations of dry side walls and pit floors made during a site inspection on 16 December 2019 and as the sump level (65m AHD) is below the average groundwater level recorded for the Quarry's groundwater monitoring bores, Jacobs (2021) consider groundwater to be discharging to the existing Quarry extraction area at very low rates (i.e. less than evaporation). At the time of the site inspection, the extraction area sump (approximate dimensions 40m x 50m x 1m deep) had a capacity of 2ML and extended through the lower latite and underlying sandstone contact. Cleary Bros notes that the sump always contains water and has a water level of approximately 65m AHD, with water also occasionally observed pooling in the southeastern section of the extraction area which is topographically lower than the sump. Groundwater inflow from the latite/sandstone contact or the sandstone is therefore believed to be contributing to the sump's volume of water.

Based on the above, Jacobs (2021) concludes that groundwater drawdown associated with the current extraction area is likely to be limited in extent to within a few hundred metres of the extraction area.

6.10.2.6 Groundwater Dependent Ecosystems

Jacobs (2021) assessed the potential occurrence of groundwater dependent ecosystems (GDEs) through a review of the Bureau of Meteorology's (BoM) GDE Atlas, mapping presented within the groundwater assessment report prepared for the Albion Park Rail Bypass (RMS, 2015) and high priority GDE mapping in the *Water Sharing Plan for the Greater Metropolitan Region*

Groundwater Sources (NSW Government, 2011). **Figure 6.10.3** shows potential terrestrial and aquatic GDE areas mapped in the vicinity of the Project Area under the BoM GDE Atlas. The following provides a summary of GDEs mapped in the vicinity of the Project Area.

- The BoM GDE Atlas identifies:
  - low and moderate potential terrestrial GDEs in the south and east of the Stage 7 area as well as to the east, west and south of the Stage 7 area;
  - small areas of high potential terrestrial GDEs close to the eastern boundary of the Stage 7 area and approximately 200m southwest of the Stage 7 area;
  - no mapped potential aquatic GDEs within 1km of the Stage 7 area; and
  - moderate and high potential aquatic GDEs associated with Lake Illawarra and water bodies associated with former sand dredging operations respectively in a regional context.
- RMS (2015) mapped GDEs comprising SEPP14 wetlands, including wetlands associated with the Croom Voluntary Conservation Area, Macquarie Rivulet and north of Macquarie Rivulet, freshwater wetlands and Illawarra Lowlands Grassy Woodland. GDE mapping did not extend to the south or east of the Stage 7 area as part of RMS (2015).
- The closest high priority GDEs included in the Water Sharing Plan are the Macquarie Rivulet and the Minnamurra River Estuary, which are located more than 3km from the Project Area.

Springs in the vicinity of the Project Area are discussed in Section 6.10.2.5.

Jacobs (2021) partially inspected the vegetated area mapped as high potential terrestrial GDE located to the east of the Stage 7 area, although the inspection was limited to vegetation in the western section of this area due to dense lantana coverage. Jacobs (2021) noted that the inspected areas did not appear to host potential GDEs and considers the likelihood of GDEs to be low.

6.10.3 Conceptual Hydrogeology

The conceptual hydrogeological model adopted for the Project is presented in Section 4.1 of Jacobs (2021), and is summarised as follows.

- There are two broad groundwater systems comprising a shallow (<10 mBGL) water table system in the upper weathered material, and intermediate depth unconfined to semi-confined systems underlying the shallow water table system, which are dependent on fracture/defect extent and unit contact planes.
- There is poor hydraulic connection between the various groundwater systems.
- The limited rainfall recharge infiltrates the weathered upper latite layer which occupies the top surface of the Stage 7 extraction area before discharging at springs, foothills, and drainage lines.

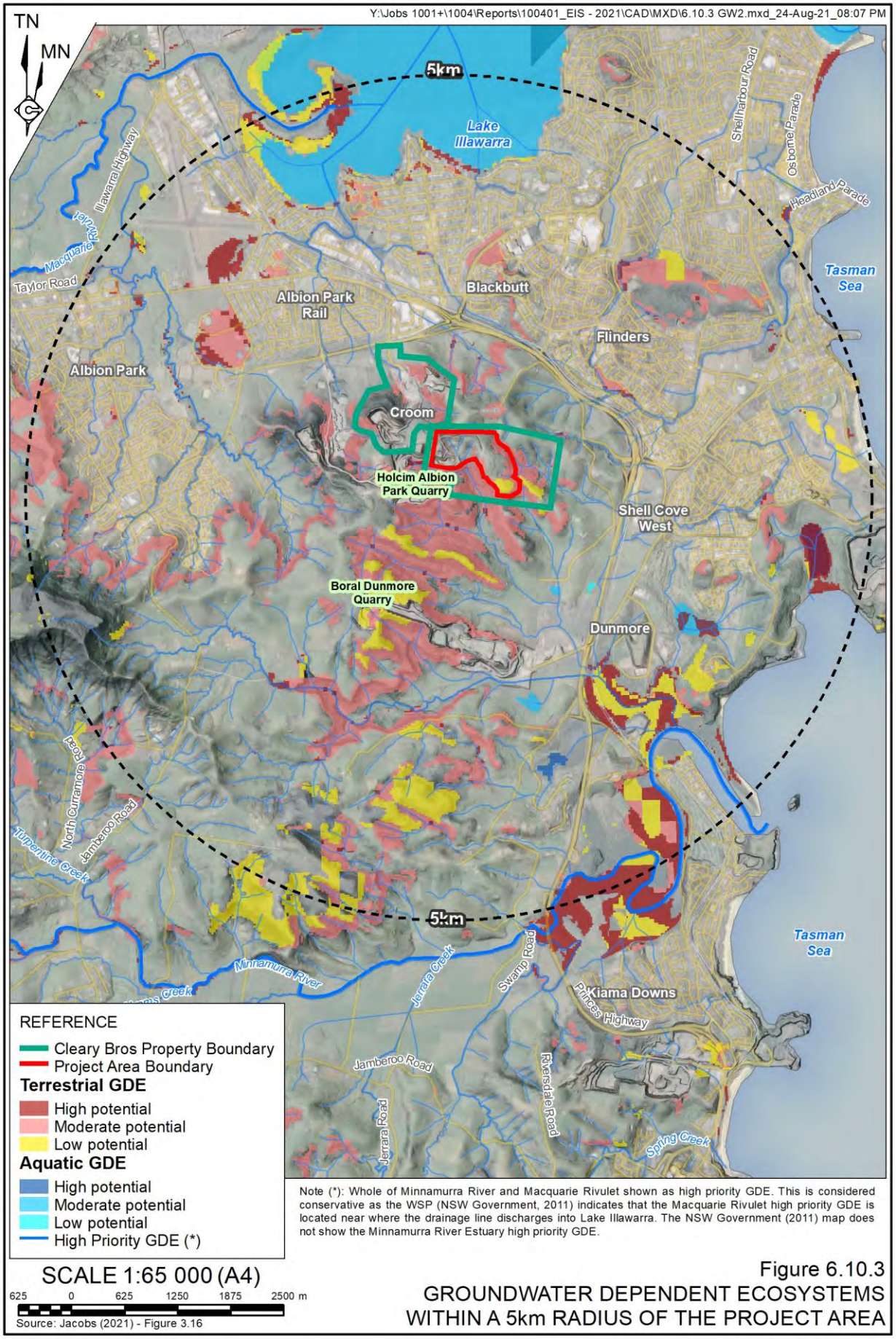


Figure 6.10.3
GROUNDWATER DEPENDENT ECOSYSTEMS WITHIN A 5km RADIUS OF THE PROJECT AREA

- Preferential flow could occur at the interface of the latite/agglomerate and lower latite/sandstone.
- The latite and agglomerate matrix hydraulic conductivity, fracture and contact plane hydraulic conductivity and storage is sufficiently low that 'aquifers' in these systems are unlikely to exist.

6.10.4 Management and Mitigation Measures

Cleary Bros would employ a number of management and mitigation measures on site to ensure that groundwater impacts are minimised. These measures would include the following.

- Implementing Cleary Bros' existing spill response procedures, including training and standard practices for hydrocarbon and chemical spill control, containment and clean up, in the event of accidental spills or leaks.
- Maintaining the Pollution Incident Response Management Plan for the Quarry, including associated protocols for communicating pollution incidents to potentially affected parties, throughout the Project life.
- Implementing the existing groundwater monitoring program (see Section 6.10.6) throughout the Project life.
- Implementing appropriate make good provisions (e.g. replacement of impacted bores) in the event that existing groundwater bores are impacted beyond the relevant *Aquifer Interference Policy* Minimal Impact Considerations.

6.10.5 Assessment of Impacts

6.10.5.1 Groundwater Inflow

A Class 1 numerical groundwater flow model was developed for the Project using the United States Geological Survey (USGS) modelling code, MODFLOW. A Class 1 model was selected because the Project is considered low risk and the 'aquifers' within the resource to be extracted are considered low value due to their very low yields. Indeed, 'aquifers' are not conceptualised to typically be present within the resource to be extracted. The yields of these groundwater systems are considered to be too low to constitute 'aquifers'.

The modelled inflow rate for the current extraction area (i.e. Stages 1 to 6) was 38kL/day (Jacobs, 2021). This inflow rate is consistent with the observed lack of seepage into the extraction area as inflow at this rate would readily evaporate under climate conditions characteristic of the Project Area. **Table 6.10.4** presents the modelled groundwater inflow rates for each of the Stage 7 extraction stages. In summary, modelled groundwater inflow increases as extraction increases, peaking at approximately 187kL/day during Stage 7d and decreasing sightly to approximately 185kL/day 100 years post-extraction.

It is noted that due to evaporative losses which occur as groundwater seeps from exposed extraction area faces, the quantity of dewatering of groundwater inflows that would be required from the sump(s) may be less than the modelled groundwater inflow rates.

Table 6.10.4
Modelled Groundwater Inflow Rates – Stage 7 Extraction Stages

Extraction Stage	Model Time		Groundwater Inflow Rate (kL/day)
	Days	Years	
Current Extraction Area	1	-	38
End of Stage 7a	4 381	12	125
End of Stage 7b	6 389	17.5	134
End of Stage 7c	10 040	27.5	149
End of Stage 7d	13 507	37	187
100 Years After Extraction is Completed	50 011	137	185
Source: Jacobs (2021) - Table 6.1			

The results of uncertainty analyses undertaken to assess the effect of varying model input parameters on model predictions do not vary considerably from the base case results. Under the uncertainty scenarios, the minimum and maximum groundwater inflow rates were 106kL/day (43% lower than the base case rate) and 259kL/day (39% higher than the base case rate) respectively (Jacobs, 2021).

6.10.5.2 Groundwater Drawdown

Figure 6.10.4 presents the modelled groundwater level drawdown in the vicinity of the Project Area at the end of Quarry life (i.e. end of Stage 7d). In summary, 2m groundwater drawdown levels would extend to an average of 150m from the Stage 7 extraction area (Jacobs, 2021). A maximum extension of the 2m drawdown level would occur approximately 250m to the west (associated with the existing quarry) whilst a minimum extension of the 2m drawdown level would occur approximately 50m to the east of the Stage 7 area. Following 100 years post-extraction, modelled drawdown would be similar to that shown for Stage 7d as the modelled groundwater inflow rate to the extraction area remains very similar.

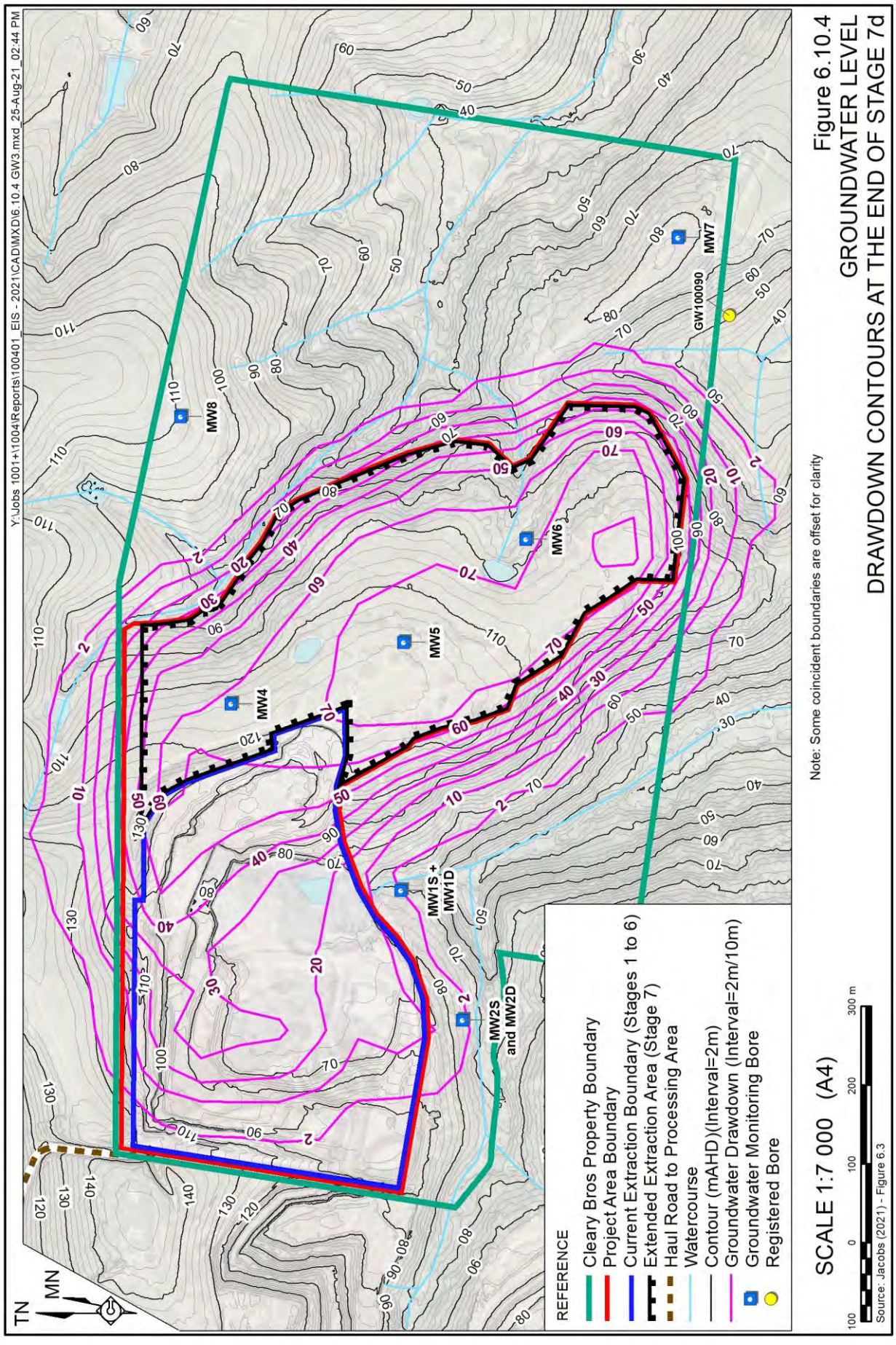
The results from uncertainty analyses of the modelled drawdown predictions did not vary considerably from the base case results, with 2m drawdown level contours remaining similar for all uncertainty model runs and a maximum difference in the predicted 2m drawdown contour of approximately 100m.

The modelled 2m drawdown contour does not encroach on any existing groundwater bores under the base case or any of the uncertainty analysis model runs.

The modelled drawdown does not encroach on any mapped potential high priority GDEs.

The modelled 2m drawdown contour does not encroach on the identified springs located to the north of the Stage 7 area. As these springs are thought to be controlled by shallow groundwater systems that are poorly connected to underlying deeper groundwater systems, Jacobs (2021) have assessed the springs as unlikely to be impacted by the modelled groundwater drawdown.

Predicted groundwater level reductions are less than the *Aquifer Interference Policy* (DPI, 2012) Minimal Impact Considerations (Jacobs, 2021).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MW8
MW7
GW100090
MW6
MW5
MW4
MW1S + MW1D
MW2S and MW2D
REFERENCE
Cleary Bros Property Boundary
Project Area Boundary
Current Extraction Boundary (Stages 1 to 6)
Extended Extraction Area (Stage 7)
Haul Road to Processing Area
Watercourse
Contour (mAHD)(Interval=2m)
Groundwater Drawdown (Interval=2m/10m)
Groundwater Monitoring Bore
Registered Bore
TN
MN
SCALE 1:7 000 (A4)
100 0 100 200 300 m
Source: Jacobs (2021) - Figure 6.3
Note: Some coincident boundaries are offset for clarity
Figure 6.10.4
GROUNDWATER LEVEL
DRAWDOWN CONTOURS AT THE END OF STAGE 7d

6.10.5.3 Baseflow Reduction

Groundwater level drawdown resulting from the interception of groundwater by the proposed Stage 7 extraction area has the potential to reduce baseflow to watercourses in the vicinity of the Project Area. Modelled baseflow reductions to watercourses in the vicinity of the Project range from <1k L/day at the commencement of the Project to a peak of <5kL /day at the cessation of extractive activities.

6.10.5.4 Water Licencing

Cleary Bros currently holds a Water Access Licence (reference WAL 41971) for 15 units (15ML) from the Sydney Basin South Groundwater Resource within the *Greater Metropolitan Region Groundwater Sources Water Sharing Plan 2011*.

Without partitioning groundwater and surface water take and based on the predicted maximum groundwater inflow rate of 187kL/day, the Project would require an additional entitlement of 53 units from the Sydney Basin South Groundwater Source of the *Water Sharing Plan for the Greater Sydney Metropolitan Region Groundwater Sources 2011*. Jacobs (2021) notes that there is ample unallocated groundwater from this source to fulfil the anticipated requirement for the Project.

If groundwater and surface water take is partitioned due to the reduction in baseflow contribution to local watercourses, the additional groundwater entitlement required would be 51 units. Cleary Bros would apply for entitlements of 51 units (equivalent to 51ML on a 100% allocation) to cover the shortfall between the groundwater entitlement of 66 units (66ML) required and the current entitlement hold of 15 Units (15ML) through an upcoming Controlled Allocation Order. A further annual surface water entitlement of 2 units (equivalent to 2 ML on a 100% allocation) from the Minnamurra River Management Zone of the Illawarra Rivers Water Source of the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011* would be required to account for anticipated watercourse baseflow reductions (maximum <5kL/day) associated with the Project. Cleary Bros intends to secure the necessary surface water entitlements through the purchase of existing entitlements on the open market, should the Project be approved.

6.10.5.5 Final Void

Groundwater impacts following the completion of extraction activities are likely to be practically the same as those anticipated during the final extraction stage (Stage 7d). As the estimated groundwater inflow rates into the extraction area void are low relative to the area's evaporative potential, it is considered unlikely that groundwater inflows would significantly contribute towards the formation of a lake within the final extraction area void (Jacobs, 2021).

6.10.5.6 Groundwater Quality

Jacobs (2021) indicate that the Project is unlikely to lower the groundwater beneficial use category beyond a distance of 40m from the Project Area. This is consistent with the *NSW Aquifer Interference Policy* (DPI, 2012) Minimal Impact Consideration criterion.

The Project does present a low risk of groundwater contamination in the event that spills or leaks of hazardous materials (e.g. fuels, lubricants or hydraulic oils) occur during extraction operations. Potential contamination impacts were assessed by Jacobs (2021) as low risk and would be mitigated as outlined in Section 6.10.4.

6.10.6 Monitoring

Groundwater quality monitoring and the collection of groundwater level data would occur on a quarterly basis throughout the Project life. Monitoring would be undertaken using the Quarry's existing groundwater monitoring bore network (bores MW1S, MW1D, MW2S, MW2D) with monitoring extended to a further five recently constructed monitoring bores (MW4, MW5, MW6, MW7 and MW8). The existing bores and bores MW7 and MW8 would be monitored up to the cessation of extraction activities, while bores MW4, MW5 and MW6 would be monitored only until they are decommissioned due to the encroachment of the extraction area. The need for groundwater monitoring post-extraction would be determined based on an assessment of groundwater conditions at the end of the extraction activities within the Project Area.

The groundwater level and quality monitoring program for the Project is outlined in Table 6.1 of Jacobs (2021). With the exception of the following, the Project's groundwater monitoring program would be the same as that outlined under the Quarry's existing approved groundwater monitoring program.

- Sampling would be undertaken quarterly rather than on a six-monthly basis.
- Dissolved oxygen and redox would be included as field parameters.
- Alkalinity would be speciated (i.e. bicarbonate, carbonate and hydroxide).
- Magnesium would be included in the analysis of major cations.
- Nitrate and total nitrogen would be included in the nitrogen analysis.
- Initially, all previous dissolved heavy metals would be tested regardless of EC levels and manganese would be included in the dissolved heavy metal analysis. During the course of the monitoring, if concentrations of particular dissolved heavy metals are frequently below the limit of reporting at relatively low EC levels, then EC triggers may be developed, whereby a reduced dissolved heavy metals suite is analysed at low EC levels and the extended dissolved heavy metals suite analysed at relatively higher EC levels.
- Total suspended solids would no longer be analysed.

6.10.7 Conclusion

The groundwater flow model developed by Jacobs (2021) predicted the following impacts associated with the Project.

- A maximum groundwater inflow rate of up to 187kL/day.
- The 2m drawdown contour extends approximately 50m to 250m from the extraction area.
- A reduction in baseflow to local watercourses ranging from <1kL/day during Stage 7a to a peak of <5kL/day during Stage 7d.

The results of the uncertainty analyses undertaken by Jacobs (2021) did not differ significantly from the base case modelling results. Additionally, the modelled impacts align with observations from the existing Quarry where groundwater drawdown is limited and groundwater inflow is very low.

Springs identified in the vicinity of the Project Area are unlikely to be impacted by the Project as they are likely to rely on localised rainfall recharge rather than the deeper groundwater systems beneath the Project Area.

Potential Project-related groundwater impacts have been assessed by Jacobs (2021) as being less than the *NSW Aquifer Interference Policy's* Minimal Impact Considerations and would include:

- a 2m groundwater level drawdown contour which does not encroach on any existing registered groundwater bores used for water supply;
- no drawdown impacts on high priority GDEs, with the closest mapped high priority GDEs located approximately 3km from the Project Area; and
- no likely reduction in groundwater quality or the beneficial use category of the groundwater source beyond 40m from the Project Area.

The Project would require an additional 51 units of groundwater entitlement from the Sydney Basin South Groundwater Source of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* and a further 2 units of surface water entitlements from the Minnamurra River Management Zone of the Illawarra Rivers Water Source of the *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011*. Cleary Bros would secure the necessary entitlements for the Sydney Basin South Groundwater Source and the Minnamurra River Management Zone through an upcoming Controlled Allocation Order and through the purchase of existing entitlements on the open market respectively.

With the implementation of the management and mitigation measures outlined in Section 6.10.4, the Project is considered a low risk to groundwater systems in the vicinity of the Project Area (Jacobs, 2021).

6.11 Public Safety Hazards

6.11.1 Introduction

The SEARs for the Project require the EIS to include an assessment of potential hazards, including an assessment of the likely risks to public safety, paying particular attention to potential bush fire risks, and the transport, storage, handling and use of any hazardous or dangerous goods.

The key hazards that Cleary Bros need to manage as they relate to public safety are related to bush fire and an accident involving the mobile manufacturing unit delivering explosives to the Project Area.

The risk assessment for both of these hazards which is presented in **Appendix E** identifies that whilst the likelihood of either event is rare, the consequences would be major or catastrophic. Hence, a medium risk is assigned to both hazards.

Cleary Bros manages these hazards in accordance with Section 4.16 of the *Quarry Environmental Management Plan*, extracts of which are incorporated within Sections 6.11.2 and 6.11.3. It is noted that throughout the operational life of the Quarry to date, incidents with either bush fire or truck accidents involving explosives have never occurred which supports the rare likelihood ranking for these hazards.

No hazardous or dangerous goods are stored within the Project Area and all hydrocarbons are managed on site in a manner that complies with the *Quarry Environmental Management Plan.*

6.11.2 Bush Fire

6.11.2.1 Introduction

Section 4.14 of the EP&A Act details the requirement for developments to conform to the specifications and requirements of the document entitled "*Planning for Bush Fire Protection*" (RFS, 2019), however, Sub-section (1B) states that Section 4.14 does not apply to State Significant Development. While the requirement for a bush fire assessment in accordance with RFS (2019) is not required, the procedure detailed in that document has been adopted to identify the potential hazard for the Project. The bush fire assessment has been prepared by R.W. Corkery & Co. Pty Limited.

6.11.2.2 Bush Fire Management Objectives

The objectives of RFS (2019) are to:

- afford occupants of any building adequate protection from exposure to a bush fire;
- provide for a defendable space to be located around buildings;
- provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent the likely fire spread to buildings;
- ensure that appropriate operational access and egress for emergency service personnel and residents is available;

- provide for ongoing management and maintenance of bush fire protection measures; and
- ensure that utility services are adequate to meet the needs of fire fighters.

It is noted that whilst no permanent buildings would be constructed within the Project Area, the above objectives have been considered in relation to the areas which would be most likely to be occupied during extraction and processing operations, namely the crib hut with two portable toilets.

6.11.2.3 Assessment of Bush Fire Hazard

Introduction

The Rural Fire Service (RFS) mapping tool, accessed on 4 August 2021, identifies the Quarry Site as being within a designated bush fire prone area. **Figure 2.6** displays the bush fire prone land within and surrounding the Project Area. The following sections use the RFS (2019) procedure to determine the Category of Bush Fire Attack (or bush fire hazard) for the Project Area. Given that the crib hut, two portable toilets and light vehicle parking and would be located within Stages 1 to 6 throughout the Project life, the assessment therefore has been identified as the only component at risk of Bush Fire Attack.

Fire Weather

The Shellharbour LGA occurs within the Illawarra / Shoalhaven Fire Area and is designated a Fire Danger Index of 100.

Vegetation Formations

A review of vegetation mapping within 140m of Stages 1 to 6 identified the following vegetation formations.

- Rainforest (principally to the south of Stages 1 to 6)
- Grassland (principally to the north of Stages 1 to 6)

Effective Slope

The maximum effective slopes within 100m of the Stages 1 to 6 are as follows.

- Rainforest (downslope) – 14 degrees
- Grassland (upslope) – 0 degrees[12]

Hazard Assessment

It is possible to calculate the bush fire hazard (referred to as the Bush Fire Attack Level in RFS, 2019) from a combination of the Fire Danger Index, vegetation formation, effective slope and the proximity of activities to the bush fire hazard. **Table 6.11.1** summarises the Bush Fire Attack characteristics calculated for the Stages 1 to 6 as well as the recommended minimum Asset Protection Zone (APZ) to be maintained between built structures and each vegetation zone.

[12] The actual slope is up to 14 degrees to the north of Stages 1 to 6, however, in accordance with RFS (2019), all upslope vegetation is considered 0 degrees.

Table 6.11.1
Bush Fire Attack Levels – Stages 1 to 6

Fire Danger Index	Vegetation Formation	Maximum Effective Slope	Separation Distance (m)	Bush Fire Attack Level	Minimum APZ (m)
100	Rainforest	14°	5m	BAL-FZ	23m
100	Grassland	0°	0m	BAL-FZ	10m
Based on RFS (2019)					

The following descriptions of the predicted bush fire attack and levels of exposure are provided for the Category of Bush Fire Attack (or bush fire hazard) in AS2959.2009.

- BAL-Low: There is insufficient risk to warrant specific construction requirements.
- BAL-12.5: Ember attack.
- BAL-19: Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux.
- BAL-29: Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux.
- BAL-40: Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with the increased likelihood of exposure to flames.
- BAL-FZ: Direct exposure to flames from fire front in addition to heat flux and ember attack.

Based on the information provided in **Table 6.11.1**, and in accordance with Table A1.12.2 of Appendix 2 of RFS (2019), minimum APZs of approximately 23m (Rainforest) and 10m (Grassland) should be maintained between any structures within Pits 1-6 and surrounding vegetation.

6.11.2.4 Management and Mitigation Measures

It is recognised that some areas of the Project Area would remain vegetated and, therefore, it would be possible for bush fire to spread both within the Project Area and adjacent to the active extraction and processing area if management measures are not adopted to mitigate this hazard.

In terms of potential impacts, the assets considered at risk include employees and Cleary Bros fenceline neighbours. In order to protect these assets, the *Quarry Environmental Management Plan* would be reviewed and updated and incorporate a section addressing bush fire management which would be prepared in consultation with the local RFS. The bush fire management section would include the following.

- A review of bush fire hazards and identification.
- A summary of controls and management measures including fire response equipment and locations.
- Emergency contact details.
- Training requirements.

Various activities that may increase the risk of fire on the Project Area and the controls proposed to limit the risk posed by these are presented in **Table 6.11.2**

Table 6.11.2
Bushfire Hazard – Activities and Controls

Activity	Possible Ignition Source	Safeguards and/or Controls
Refuelling	Spilt fuel or dry grass ignited by spark.	• Refuelling undertaken within a cleared area of the Project Area. • Engines in all vehicles to be turned off during refuelling. • No smoking policy to be enforced in designated areas of the Project Area. • Fire extinguishers maintained within all site vehicles and mobile equipment.
General Activities	Cigarettes, Rubbish, e.g. glass, metal.	• No smoking policy to be enforced in designated areas of the Project Area. • Focus on housekeeping to be maintained by the Applicant. • Water cart available. • Fire extinguishers maintained within all site vehicles and mobile equipment.

Additional general bush fire management measures to assist in the event of a local bush fire event documented within the Quarry Environmental Management Plan are as follows.

- Site emergency personnel would be trained in the proper use of the firefighting equipment on site.
- The water cart would be made available for firefighting purposes in the event of a bush fire.
- A protocol would be developed for restricting work in vegetated areas during high fire danger periods of the bush fire season (in accordance with the hazard category notifications).
- The local RFS would be consulted prior to each bush fire season to discuss the planned controls during the following season, status of access tracks, and equipment availability.
- Any firebreaks required would be developed and maintained in consultation with the local RFS.
- The local RFS would be consulted regarding any controlled burns planned for asset protection and / or ecological management.
- Emergency and Evacuation Management Procedures would be reviewed, and amended, if necessary in the event of a local bush fire.

6.11.2.5 Assessment of Impacts

With the implementation of the proposed safeguards and controls, it is considered that the bush fire hazard associated with the Project would be acceptable and the Project would not significantly contribute to raising the risk of bush fires impacting the fenceline neighbours, property or environmental assets.

6.11.3 Truck Delivery of Explosives

Cleary Bros contracts the delivery, loading and initiation of explosives to an accredited blasting contractor. The delivery of the components of the blasting materials used is undertaken using a licenced mobile manufacturing unit. All blasting materials would be transported to the Project Area on the day of each blast as none are stored within the Quarry.

The blasting contractor would continue to operate its equipment in accordance with an emergency response system which documents the required response to an incident involving the mobile manufacturing unit either on the public road network or within the property owned by Cleary Bros.

In the unlikely event of an accident involving the mobile manufacturing unit, the adoption of the emergency response system would avoid or minimise the adverse impacts of the incident upon public safety.

6.12 Traffic and Transportation

6.12.1 Introduction

The SEARs for the Project require the EIS to include an assessment of traffic and transportation. The assessment requirements of the then Road and Maritime Service (now Transport for NSW) and Shellharbour City Council were also considered during the preparation of the traffic and transportation assessment. A summary of the SEARs and the requirements of Transport for NSW and Shellharbour City Council are listed within **Table A.1** and **Table A.2** within **Appendix A**, together with a record of where each requirement is addressed in the EIS.

The Traffic and Transportation Assessment for the Project was undertaken by RW Corkery & Co Pty Limited, with extensive reliance placed upon the EIS prepared for the recently completed Albion Park Rail Bypass (Hyder and Cardno, 2015a) and supporting documentation, including the *Traffic and Transport Assessment* (Hyder and Cardno, 2015b).[13]

As identified in Section 1.3.3, transportation of quarry materials from the Albion Park Quarry is undertaken in accordance with a 1963 Deed between Shellharbour City Council and Cleary Bros, as modified in 1964. That Deed has no expiry date and imposes no limit on transportation operations. Notwithstanding this, off-site transportation operations were described in the context of the proposed extraction of 900 000tpa as currently permitted under MOD2 to LEC Consent No. 10639 of 2005. No increase in the existing approved production rate is proposed and, consequently no change in the existing transportation operations are proposed.

In light of the above and for consistency with prior applications to modify LEC Consent No. 10639 of 2005, the following subsections provide a summary of the upgraded road network in the vicinity of the Quarry, management and mitigation measures to be implemented and an assessment of traffic and transportation-related impacts.

6.12.2 Existing Environment

The road network in the vicinity of the Quarry has recently been upgraded as a result of the Albion Park Rail Bypass. **Figure 6.12.1** presents an overview of the local road network. In summary, the local road network may be described as follows.

- Site Access Road

  The Site Access Road is a sealed road approximately 50m long between the site security gate and the intersection with the East West Link (**Plate 6.12.1**). The road is in good condition and is a Local Road maintained by Council.

- East West Link

  The East West Link is a sealed, two-lane road with 2m wide sealed shoulders that provides a connection to the Princes Motorway / Princes Highway at the Oak Flats Interchange in the east and Croom Road in the west. The road has a sign posted speed limit of 80km/h and is in good condition having been opened to traffic in late 2020.

[13] Documentation related to the Albion Park Rail Bypass, including Hyder and Cardno (2015a and 2015b) is available at https://www.planningportal.nsw.gov.au/major-projects/projects/albion-park-rail-bypass.


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Princes Highway
Illawarra Railway
Princes Highway
Oak Flats Interchange
6.12.5
6.12.6
6.12.3
6.12.2
6.12.4
Site Access Road
6.12.1
Princes Motorway
East West Link
TN
MN
REFERENCE
Cleary Bros Property Boundary
SCALE 1:6 000 (A4)
100 0 100 200 300 m
Photo Source: Nearmap 9 February 2022
Figure 6.12.1
LOCAL ROAD NETWORK

The road becomes a divided road approximately 200m east of the intersection with the Site Access Road, with a grade-separated over pass over the Princes Motorway (**Plate 6.12.2**). The road is the primary access road for the Cleary Bros and Holcim Albion Park quarries and is described by Hyder and Cardno (2015b) as "a freight route to accommodate quarry movements to the Princes Highway."

- Princes Motorway west of the Oak Flats Interchange
- The Princes Motorway is a sealed, divided road, with two lanes in each direction and sealed shoulders. The Motorway has a sign posted speed limit of 100km/h and is in good condition having been opened to traffic in late 2021. The Motorway is a State Road that was extended from an interchange immediately north of Haywards Bay to the Oak Flats Interchange to bypass the urban area of Albion Park Rail. The Motorway provides the principal transport link to Sydney and Wollongong in the north (**Plate 6.12.3**).
- Princes Highway east of the Oak Flats Interchange

  The Princes Highway east of the Oak Flats Interchange is a sealed, divided road, with two lanes in each direction and sealed shoulders. The Highway has a sign posted speed limit of 100km/h and is in good condition. The Highway east of the Oak Flats Interchange is a State Road that provides the principal transport link for deliveries to the south of the Project.

Intersections in the vicinity of the Quarry may be described as follows (**Figure 6.12.1**).

- Intersection of the Site Access Road and East West Link.

  The intersection is a signalised T-intersection with the East West Link the through road (**Plate 6.12.1**). The intersection includes channelised right-hand and left-hand turn lanes on the East West Link for traffic entering the Site Access Road. Separate left and right turn lanes are provided for traffic exiting the Site Access Road onto the East West Link.

- Oak Flats Interchange

  The Oak Flats Interchange is a two-lane, grade separated roundabout over the Princes Motorway and Princes Highway (**Plates 6.12.4 and 6.12.5**). The interchange is signalised, with traffic lights to manage traffic flows and minimise congestion. The interchange provides access to and from the following roads.

  – East West Link.
  – Princes Motorway – westbound.
  – Princes Highway – east and westbound.
  – New Lake Entrance Road – northbound.

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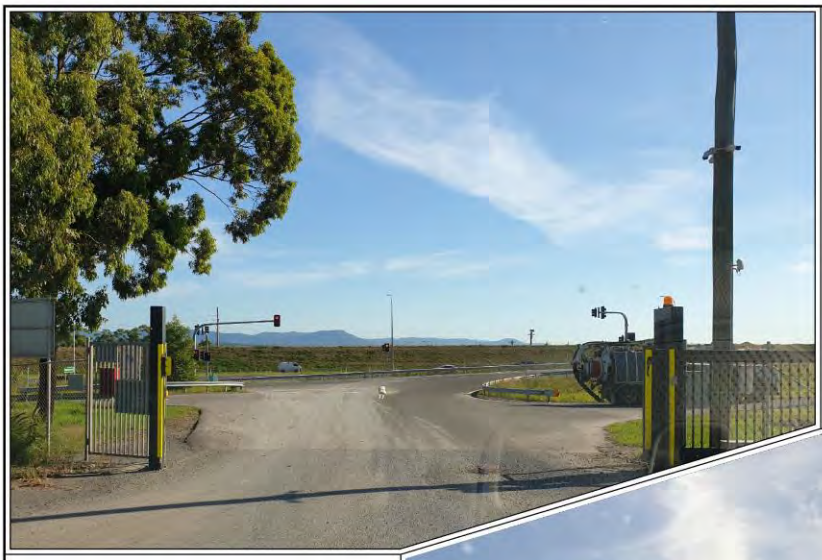

Plate 6.12.1: View of the Site Access Road Looking North forward the East West Link
(Source: Cleary Bros)

Plate 6.12.2: View of the East West Link looking east
(Source: Cleary Bros)

Plate 6.12.3: View of the Princes Motorway looking west
(Source: Cleary Bros)

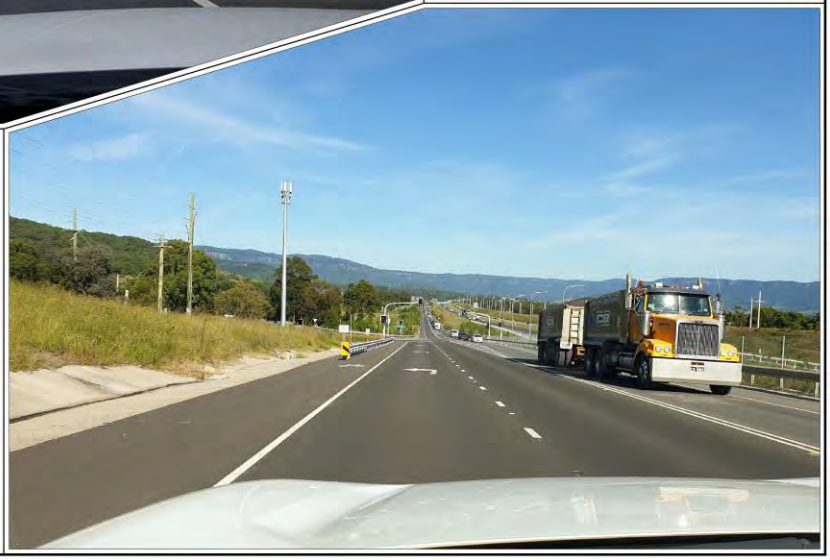

Plate 6.12.4: View of the east West Link showing the Left-hand turn Lane into the Site Access Road
(Source: Cleary Bros)

6.12.3 Management and Mitigation Measures

Cleary Bros would continue to implement the following management and mitigation measures related to traffic and transportation.

- Continue to implement a *Transport Management Plan*, including a Driver's Code of Conduct that outlines Cleary Bros expectations in relation to truck driver behaviour, including
  - accessing the site only via the East-West Link;
  - adherence to all relevant road rules; and
  - operate the vehicle in a safe manner.
- Implement procedures to monitor the effectiveness of the *Transport Management Plan*.

6.12.4 Assessment of Impacts

6.12.4.1 Justification of Assessment Methodology

In preparing this assessment of traffic and transport-related assessments, reliance has been placed on Hyder and Cardno (2015b). This approach is considered to be acceptable for the following reasons.

- The anticipated improvements associated with the Albion Park Rail Bypass works were then assessed Hyder and Cardno (2015b), with the year 2041 selected as the relevant future year for the assessment, with growth rates of between 0.8% and 2.8% per annum depending on location and direction of travel.
- The works assessed by Hyder and Cardno (2015c) have now been completed, with the realigned East West Link opened in late 2020 and Princes Motorway opened in late 2021.
- The Project would not result in an increase in the current approved extraction rate of 900 000tpa and, as a result would not result in additional off-site heavy vehicle movements.
- The vast majority of vehicles transporting quarry products would continue to travel east on the newly constructed East West Link and enter the Princes Highway / Princes Motorway (a State Road) at the Oaks Flat Interchange, a distance of approximately 750m only.
- Once on the State Road network, vehicles transporting quarry products travel either to the west and north towards Wollongong on the Princes Motorway or east and south towards Kiama and the Shoalhaven.
- A minority of vehicles transporting quarry products for local customers may travel to the west on the East West Link or on other Local and Regional roads.

6.12.4.2 Mid-block Road Performance – East West Link

Hyder and Cardno (2015c) identified at Figure 4-5 that the Average Daily Traffic on the East West Link in 2014 was 15 100 vehicles per day. In the absence of the now constructed Albion Park Rail Bypass, Hyder and Cardno (2015c) identified at Figure 6-1 that traffic growth would be expected to increase to an Average Daily Traffic level of 18,200 vehicles per day. However, following completion of the proposed bypass, the Average Daily Traffic on the East West Link in 2041 is expected to be only 11 500 vehicles per day, a substantial decrease on the 2014 traffic level.

As the Project would not increase the number of heavy vehicles transporting quarry products on the East West Link and the 2041 traffic levels are expected to be substantially lower than the 2014 traffic levels, the performance of the 750m section of the East West Link between the Site Access Road and the Oak Flats Interchange would continue to be acceptable.

Similarly, as only a small proportion of quarry products would be transported to local customers to the west towards Croom Road from the Site Access Road, the performance of that section of the East West Link would also be continue to be acceptable.

6.12.4.3 Heavy Vehicle Impacts

Hyder and Cardno (2015b) identify at Table 4-11, based on traffic counts taken on surrounding roads (not including the East West Link) that heavy vehicles comprise between 3% and 9% of all vehicles. Heavy vehicles on the Princes Highway were between 8% and 9% of all vehicles, with the proportion of heavy vehicles on other roads typically lower.

As the East West Link comprises "a freight route to accommodate quarry movements to the A1 Princes Highway" (Hyder and Cardno, 2015b at Section 3.3), heavy vehicle movements on that road are expected to be similar to those on the Princes Highway. Assuming 8.5% of all vehicles travelling on the East West Link are heavy vehicles, there would be approximately 978 heavy vehicle movements per day on the East West Link in 2041. Based on Cleary Bros 2021 weighbridge records, there were on average approximately 110 laden heavy vehicles dispatched via the Site Access Road each working day. Allowing for return on unladen vehicles, this represents approximately 22% of all heavy vehicles using the 750m section of the East West Link between the Site Access Road and the Oak Flats Interchange.

Finally, as the Project would not increase the number of heavy vehicle movements transporting quarry products and the East West Link was designed and assessed taking into account the current approved Albion Park Quarry heavy vehicle movements, the Project would not result in increased or unacceptable heavy vehicle impacts on that road.

6.12.4.4 Intersection Performance - Oak Flats Interchange

Hyder and Cardno (2015b) identify at Section 4.4.3 that the performance of the Oak Flats Interchange in 2014, prior to the recent upgrade works, provided an overall Level of Service of E, the second lowest classification, indicating that the intersection was operating at capacity. This performance was particularly influenced by north-bound traffic exiting the Princes Highway and turning east onto New Lake Entrance Road.

Hyder and Cardno (2015b) undertook an analysis of the anticipated ramp capacity for the Oak Flats Interchange in 2020, 2030 and 2041 taking into account the recent upgrade works, including signalisation of the interchange. That assessment determined that allowing for traffic growth over the assessed period, that the ramp capacity would be between a Level of Service A (good operation) and B (good operation with acceptable delays and spare capacity), the highest two classifications.

The Project would not result in additional Quarry-related traffic on the public road network and there would be no additional impact on the operation of the Oak Flats Interchange.

Cleary Bros acknowledge that with the signalisation of the interchange there has been a level of community concern in relation to the operation of the interchange, however, that remains a matter for Transport for NSW and the Project would not result in any changes to the performance of the interchange.

6.12.4.5 Intersection Performance – Site Access Road and East West Link

Hyder and Cardno (2015b) undertook an assessment of the operation of the intersection of the Site Access Road and the realigned East West Link. That assessment determined that in 2041, the Site Access Road would operate at a Level of Service of B and C (satisfactory operation) in the morning and evening peak hour periods.

As the Project would not result in additional Quarry-related traffic on the public road network, there would be no additional impact on the operation of the intersection of the Site Access Road and the East West Link.

6.12.4.6 Bus Services, Pedestrians and Cyclists

A review of the Premier Illawarra bus company route map identifies that no bus routes utilise the East West Link. As a result the Project would not adversely impact on bus routes or services.

Hyder and Cardno (2015b) identify at Section 6.7.3 that the proposed Albion Park Rail Bypass would result in construction of approximately 6.3km of off road shared paths. The Project would not impact these off-road paths.

In addition, 2m wide sealed shoulders have been constructed in each direction on the East West Link, providing additional connectivity for cyclists. As the Project would not result in additional Quarry-related traffic on the public road network, there would be no additional impacts on cyclists using those roads.

6.12.4.7 Road Safety

Hyder and Cardno (2015b) identified that the proposed Albion Park Rail Bypass would result in significant improvements to road safety in the vicinity of the Quarry. As the Project would not result in additional Quarry-related traffic on the public road network, there would be no additional road safety impacts and there is no requirement for a road safety audit.

6.12.4.8 Cumulative Impacts

A Cumulative Traffic Assessment was undertaken by The Transport Planning Partnership Pty Ltd (TTPP, 2016) to assess the combined operations of the following quarries in the area surrounding the Project.

- Cleary Bros Albion Park Quarry.
- Hanson Construction Materials Pty Ltd Bass Point Quarry.
- Boral Resources (NSW) Pty Ltd Dunmore Quarry.

The analysis determined the following.

- That the combined operation of each of the assessed quarry operations would represent an insignificant increase to total traffic volumes on the classified road network

- That peak hour cumulative truck movements would also represent an insignificant proportion of the total traffic and heavy vehicle flows along the principal quarry haulage routes.

6.12.5 Conclusion

In conclusion, the Project would not result in additional Quarry-related traffic on the public road network. Taking into consideration the substantial improvements in the local traffic environment associated with the Albion Park Rail Bypass and that the vast majority of the Quarry-related transportation utilises a 750m section of the East West Link before accessing the State Road network, the Project would have a negligible impact on traffic and transportation.

6.13 Economic Impacts

6.13.1 Introduction

The SEARs for the Project require the EIS to include a detailed assessment of the likely economic impacts of the development, paying particular attention to:

- the significance of the resource;
- the costs and benefits of the Project; identifying whether the development as a whole would result in a net benefit to NSW; and
- the demand on local infrastructure and services.

The assessment requirements of Shellharbour City Council were also considered during the preparation of the economic impact assessment. A summary of the SEARs and the requirements of Shellharbour City Council are listed in **Table A.1** and **Table A.2** within **Appendix A**, together with a record of where each requirement is addressed in the EIS.

The Economic Assessment (EA) for the Project was undertaken by Gillespie Economics and is presented as Part 9 of the *Specialist Consultant Studies Compendium* and hereafter referred to as Gillespie (2022). The following subsections provide a summary of the EIA.

6.13.2 Approach to the Economic Impact Assessment

In assessing the economic impacts of the Project, Gillespie (2022) considered:

- the economic efficiency of the Project, evaluated using a cost benefit analysis (CBA); and
- the Project's effects on the local economy, evaluated using a local effects analysis (LEA) and an input-output (IO) analysis.

Furthermore, Gillespie (2022) considered the economic implications of the Project on the broader Cleary Bros Group by accounting for the vertically integrated nature of the Group, with a particular focus on the implications for the downstream businesses dependent on the Project including:

- raw material extraction and processing;
- product transportation; and
- concrete batching.

Economies associated with the vertical integration of these services result in a reduction in the average cost of concrete production, securing Cleary Bros' ability to compete in the marketplace. Increased market competition offered by Cleary Bros results in benefits to consumers including lower market prices and increased output. As extraction and processing activities affect both product transportation and concrete production, the vertical integration of Cleary Bros has implications for the CBA and LEA of the Project.

6.13.3 Cost Benefit Analysis

6.13.3.1 Cost Benefit Analysis Methodology

The following key steps formed part of the CBA undertaken for the Project. Further details of the CBA methodology are provided in Section 4 of Gillespie (2022).

- Identification of the 'with' and 'without' Project scenarios.
- Identification and valuation of the incremental benefits and costs.
- Consolidation of value estimates using discounting to account for temporal differences.
- Application of decision criteria.
- Sensitivity testing.
- Consideration of non-quantified benefits and costs.
- Consideration of the distribution of costs and benefits.

The 'without' Project scenario forms the base case for the CBA against which the potential economic, environmental, social and cultural impacts of the Project are assessed. This scenario assumes that without the Project, extraction under existing approvals at an average rate of 750 000tpa would continue until the resource is exhausted around 2026 and the finalisation of the rehabilitation of approved disturbance areas would commence at this point. The 'with' Project scenario assumes that extraction at an average rate of 750 000tpa would continue for 30 years followed by rehabilitation of disturbed areas.

6.13.3.2 Cost Benefit Analysis Results

Table 6.13.1 presents the net costs and benefits associated with the Project, including which stakeholders would experience these costs and benefits (i.e. the incidence of costs and benefits). Details of how potential environmental, social and cultural impacts associated with the Project are quantified or assessed are provided in Section 4.5.4 of Gillespie (2022).

Table 6.13.1
Net Project Social Costs and Benefits and Incidence

Costs and Benefits	Incidence of Costs and Benefits[1]	Australia ($M)[2]	NSW ($M)[2]
Extraction and Processing Net Production Benefits			
Company Tax	Australian and NSW Government and households	10	3
Net Producer Surplus	Cleary Bros	22	22
Transport Net Production Benefits			
Company Tax	Australian and NSW Government and households	1	0
Net Producer Surplus	Cleary Bros	2	2
Concrete Net Production Benefits			
Company Tax	Australian and NSW Government and households	3	1
Net Producer Surplus	Cleary Bros	7	7
Additional Benefits			
Wage Benefits to Employment	People employed in extraction and processing, road transport and concrete production	Not Quantified	Not Quantified
Economic Benefits to Existing Landholders	Local landholders who sell land required for the Project (including buffer land)	0	0
Economic Benefits to Suppliers	Suppliers of inputs to production	Not Quantified	Not Quantified
Total Benefits		45	35
Environmental. Social and Cultural Costs			
Greenhouse Gas Emissions (Scope 1 and 2)	Australian and NSW households	0[3]	0[4]
Air Quality	Adjoining landholders	Meet relevant criteria – no material residual impact.[5]	
Noise and Blasting	Adjoining landholders	Blasting to comply with standards. Impact on residences on “Figtree Hill” to be managed in accordance with the NSW Government’s VLAMP.	
Road Transport	Australian and NSW Government and households	No local road impacts. Externality costs of heavy vehicle transport included in registration and other operating requirements and hence are reflected in operating costs – no material residual impact.[2]	
Surface Water and Groundwater	Other water users and Australian and NSW households	Cost of WALs included in capital costs. No drawdown impacts on registered groundwater bores or groundwater dependent ecosystems.	
Biodiversity	Australian and NSW households	Impacts on biodiversity would be offset – cost of offsets included in capital costs.	
Aboriginal Heritage	Aboriginal people and Australian and NSW households	No impact.	
Historic Heritage	Australian and NSW households	One item of local heritage significance impacted – not likely to be material.	
Visual	Nearby landholders	Cost of amenity barriers and tree screens included in costs. Some minor visual impacts in 10 to 15 years time – not likely to be material.	

Table 6.13.1 (Cont'd)
Net Project Social Costs and Benefits and Incidence

Costs and Benefits	Incidence of Costs and Benefits	Australia ($M)[1]	NSW ($M)[1]
Environmental. Social and Cultural Costs (Cont'd)			
Net Public Infrastructure Costs	Australian and NSW Government	No impact.	
Loss of Surplus to Other Industries	Other local businesses	No impact.	
Total Costs		0	0
Net Social Benefits		45	35

Note 1: NSW regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures perfectly mitigate, offset or compensate then no residual impacts occur and all impacts are borne by the proponent. This table identifies who bears residual impacts where mitigation, offset and compensation are imperfect.
Note 2: Present value at 7% discount rate.
Note 3: Rounded to $M. The estimated value is $7,900
Note 4: Rounded to $M. The estimated value is $2,500.
Note 5: Materially refers to whether valuation of these impacts would have any bearing on the estimated net social benefits of the Project. NSW Government (2012) identified that if a project has a net present value of say "$20 million, costs or benefits valued at less than $1 million are unlikely to be material.

Source: Gillespie (2022) – modified after Table 4.6

Overall, the Project is estimated to have net social benefits to Australia and NSW of approximately $45M and $35M respectively. Consequently, the Project is considered to be desirable and justified from an economic efficiency perspective (Gillespie, 2022).

As part of the sensitivity analysis for the EA, Gillespie (2022) tested the results of the CBA for changes to the following variables at 4% and 10% discount rates.

- Opportunity cost of land.
- Quarry capital cost, including biodiversity offsets, water access licences and the implementation of the NSW Government's VLAMP.
- Quarry operating costs.
- Quarry rehabilitation and decommissioning costs.
- Value of hard rock products.
- Quarry production levels.
- Residual value of Quarry land.
- Net transport revenue.
- Net concrete production revenue.

The results of the sensitivity analysis are presented in Table 4.7 of Gillespie (2022). In summary, the CBA results at the NSW level are most sensitive to reductions in the value of hard rock products and increases in operational costs. As the Quarry is an existing operation with known operational costs and the Project is underpinned by strong demand for hard rock products, sustained increases in operational costs and sustained reductions in hard rock product values are considered highly unlikely (Gillespie, 2022). Additionally, as mitigation, offset and compensation costs represent relatively small components of the capital and operating costs of the Project, it is unlikely that large changes in these costs would have a significant impact on the CBA results (Gillespie, 2022).

Under all scenarios examined by Gillespie (2022) as part of the CBA sensitivity analysis, the Project would generate net social benefits to NSW.

6.13.4 Local Effects Analysis

The local area considered by Gillespie (2022) as part of the LEA for the Project comprised the Illawarra Statistical Area Level 4 which includes the Wollongong, Kiama and Shellharbour LGAs. **Table 6.13.2** provides a summary of the anticipated local effects of the Project and details of the LEA are provided in Section 6 of Gillespie (2022). In summary, the results of the LEA indicate the following.

- The Project would provide 95 direct jobs, including 27 Quarry jobs, 32 transport jobs and 36 concrete production jobs.
- Assuming no job chain effects (i.e. job vacancies created by people filling Project jobs would remain unfilled), incremental disposable wages accruing to the Region from the Project would represent $1.7M per annum, equivalent to 23 direct full time equivalent jobs.

Table 6.13.2
Summary of Project Effects on the Local Community

Local Effects			
	Direct - Total	**Direct - Already Resident in the Local Area[1]**	**Net**
Employment FTE (No.)	95	90	23
Net Income ($M)	6.5	6.2	1.7
Non-labour Expenditure in the Local Area ($M)	21.5	-	-
Regional Impacts			
	Direct	**Flow-on**	**Total**
Output ($M)	45	45	90
Value Added ($M)	13	23	36
Income ($M)	7	11	18
Employment (No.)	81	139	219
Other Local Economic Impacts			
Displaced Activities		No impact	
Wage Rise Impacts		No material impact[2]	
Housing Impacts		No material impact[2]	
Demand on local infrastructure and services		No additional demand beyond current levels	
Local Environmental Impacts			
Greenhouse Gas Emissions (Scope 1 and 3)		$0.0001M[3]	
Operational Noise		Impact on residences within "Figtree Hill" addressed via a negotiated agreement.	
Biodiversity		Impacts on local biodiversity are offset.	
Historic Heritage		One item of local heritage significance impacted – not likely to be material.[2]	
Visual		Cost of amenity barriers and tree screens included in costs. Some minor visual impacts in 10 to 15 years time – not likely to be material.	

Note 1: Local Area = Illawarra Statistical Area Level 4.
Note 2: Materiality refers to whether valuation of these impacts would have any bearing on the estimated net social benefits of the Project. NSW Government (2012) identified that if a Project has a Net Present Value of say *"$20 million, costs or benefits valued at less than $1 million are unlikely to be material."*
Note 3: This figure is the estimated impact on NSW households apportioned to households in the Local Area. The Illawarra population is 4% of the NSW population.

Source: Gillespie (2022) – Table 6.6

- Based on a standard regional economic impact assessment using IO analysis which does not assume an absence of job chain effects and is not restricted to a focus on the existing labour force in the local area, the Project would provide a total of 219 jobs and $90M in output, $36M in value-added, $18M in gross wages annually.
- The main local environmental impacts are internalised into the production costs of Cleary Bros through mitigation, offset and compensation costs. Residual financial costs associated with local environmental impacts are likely to be immaterial.

6.13.5 Other Impacts

Gillespie (2022) provides the following other economic impacts relating to the ongoing operation of the Project.

1. The temporary loss of grazing on the Cleary Bros' property would have some limited impact on the regional economic impacts.

2. The ongoing employment for the Project is likely to have insignificant wage impacts given the scale of the Project and the availability of labour inside and outside the Region.
3. The Project is not expected to result in any substantial in-migration of workers and their families and consequently the impact on housing prices is expected to be negligible.
4. The Project would not generate any additional demands upon local infrastructure and services given the planned continuation of existing levels of production and employment.

6.13.6 Conclusion

The CBA undertaken by Gillespie (2022) indicates that the Project would generate net production benefits to NSW of $35M (present value at 7% discount rate), comprising $26M in extraction and processing benefits, $2M in transport benefits and $8M in concrete production benefits.[14] As the value of residual economic costs are likely to be considerably less than the estimated net production benefits, the Project is estimated to have net social benefits to NSW and is therefore desirable and justified from an economic efficiency perspective.

As well as providing net social benefits to NSW, the Project would provide direct economic activity, including the equivalent of 23 full time equivalent net jobs to the local area economy and indirect economic activity to the local area via both wage and non-wage expenditure. Based on the results of input-output analysis, the Project is estimated to provide direct and indirect effects to the local economy including 219 jobs and $90M in output, $36M in value-added, $18M in gross wages annually.

The main local environmental impacts are internalised into the production costs of Cleary Bros through mitigation and offset costs. Residual financial costs associated with local environmental impacts are likely to be immaterial.

[14] Difference in total is due to rounding.

6.14 Social Impacts

6.14.1 Introduction

The SEARs for the Project require the EIS to include "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 *Social impact assessment guideline for State significant mining, petroleum production and extractive industry development*, paying particular consideration to:

- how the development might affect people's way of life, community, access to and use of infrastructure, services and facilities, culture, health and wellbeing, surroundings, personal and property rights, decision-making systems, and fears and aspirations;
- the principles in Section 1.3 of the guideline; and
- the review questions in Appendix D of the guideline."

A Social Impact Assessment (SIA) for the Project has been prepared by Element Environment (Element) and is presented as Part 10 of the *Specialist Consultant Studies Compendium* and is hereafter referred to as Element (2022). The following subsections provide a summary of the SIA.

The SIA has been prepared with consideration of the NSW, regional and local community context and the understanding that Cleary Bros has been operating the Albion Park Quarry since 1963 with an established presence in the community. The SIA addresses all social impact categories defined in the Guideline. It is noted that the engagement undertaken by Cleary Bros, Element and RWC as part of the SIA is described in Section 5 and **Appendix C** of the EIS.

6.14.2 Social Locality

For the purposes of assessing the Project's social impacts and defining the social locality, Element (2022) considered the following 'areas of social influence'.

- **Nearby neighbours –** landholders and residents residing on properties that share a fence line with the property incorporating the Project Area. A further distinction is made through specific reference to the northern neighbours on the "Figtree Hill" property given the close proximity of the residences on that property to the Project Area.
- **Community** – the residents within surrounding suburbs in the Statistical Area 2 census geographies of Shellharbour-Flinders and Albion Park Rail. **Figure 6.13.1** displays the two statistical areas relied upon for the assessment.
- **Region** – refers to the Local Government Areas of Wollongong, Shellharbour, Kiama, Shoalhaven and Wingecarribee and the Greater Sydney Region. The region effectively covers the area where the majority of products from the Albion Park Quarry are used.

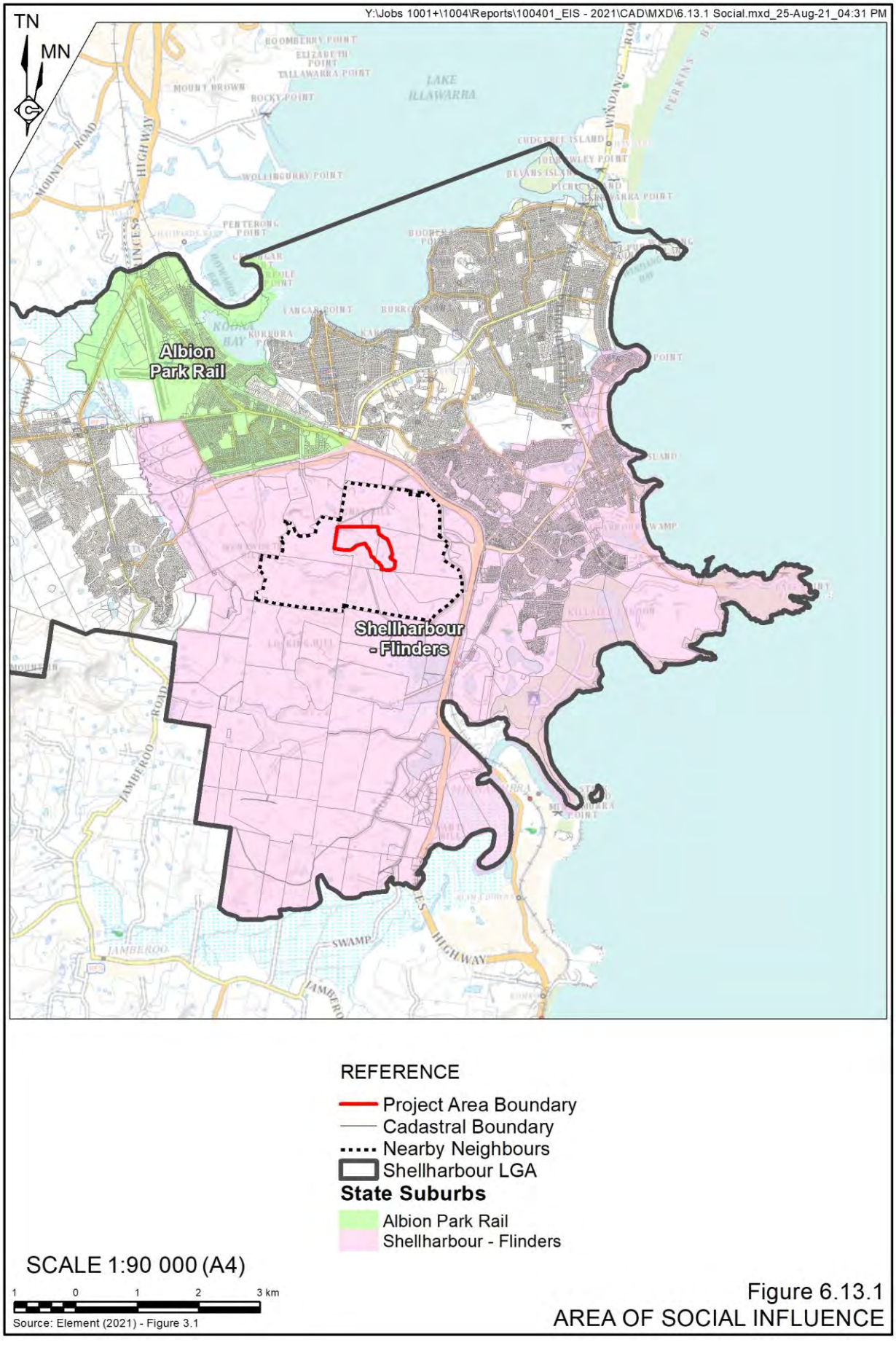

Figure 6.13.1
AREA OF SOCIAL INFLUENCE

The social baseline for the Project has been assembled through an interpretation/analysis of demographic data and research together with a review of surrounding land uses, existing social infrastructure and the relationship between Cleary Bros and the surrounding community.

Section 5 of the SIA presents the social baseline for the Project addressing each of the above localities. A distinction is made between a range of social indicators for Shellharbour-Flinders and Albion Park Rail SA2 (Statistical Area 2) census geographies. A comparison to Shellharbour City LGA data and NSW data is also provided where possible. The main social indicators addressed include place of birth, multi-culturalism, employment, status of industry, income, education, community networks and the socio-economic indices. A further component of the social setting includes the social infrastructure that underpins the social wellbeing of the population surrounding the Project Area.

The social baseline presented in Section 5 of the SIA also incorporates reference to the employees, supply and demand for the Quarry products, an analysis of community complaints and the community investment provided by Cleary Bros.

The key outcomes from the assembled information on the social setting of the community in comparison with the broader NSW includes the following.

- The populations in the suburbs surrounding the Project Area do not differ markedly in terms of gender or median age.
- Family composition is similar.
- A greater proportion of people residing in the Community were born in Australia.
- The levels of socio-economic disadvantage are average, i.e. falling within the third quintile of the SEIFA[15] index.

Comparisons between the two statistical areas around the Project Area identified the following.

- The median weekly household income for Flinders-Shellharbour is almost 30% higher than Albion Park Rail.
- Participation in the workforce was higher in Flinders-Shellharbour than in Albion Park Rail.
- Aged care residential services and hospitals provide the greatest employment opportunities in the Community. Table 5.7 in Element (2022) provides further details of employment status.
- A lower level of education has been attained by residents of Albion Park Rail compared with Flinders-Shellharbour.
- Albion Park Rail has a considerably lower SEIFA index score than Flinders-Shellharbour.

[15] The Socio-Economic Indexes for Areas (SEIFA) scores the relative socio-economic advantage and disadvantage across Australia.

The SIA also records that:

- 97% of Quarry employees reside in the LGAs of Wollongong, Shellharbour, Kiama, Shoalhaven and Wingecarribee;
- 74% of suppliers to the Albion Park Quarry are based in the LGAs of Wollongong, Shellharbour, Kiama, Shoalhaven and Wingecarribee, 18% based in Sydney and 8% elsewhere;
- 78% of Quarry sales have been to either local companies or local project sites in the Wollongong, Shellharbour, Kiama, Shoalhaven and Wingecarribee LGAs;
- Remaining sales values relate to Greater Sydney based companies or delivery locations in the Greater Sydney Region; and
- Cleary Bros is a locally family-owned business that has been a member of the Illawarra and Shoalhaven community for over 100 years and provides considerable sponsorship and support to numerous community groups and events.

6.14.3 Mitigation Measures

The SIA incorporates a range of Project specific mitigation measures, many of which have been identified within the supporting specialist consultant assessments relating to noise, blasting, air quality, visibility and historic heritage. The key focus of Project specific mitigation measures is upon management of amenity for surrounding landowners and residents. Cleary Bros would adopt the following additional social mitigation measures identified in the SIA.

- Continue open dialogue with the owners of "Figtree Hill" in accordance with the negotiated agreement to further mitigate the residual impacts on social amenity.
- Ongoing open and transparent discussions of social community impacts at biannual Community Consultative Committee meetings.
- Regular review and where appropriate, enhancement of Cleary Bros' social investment strategy to strengthen social value.
- Enhancement of Cleary Bros' existing engagement strategy in the Quarry Environmental Management Plan.
- Inform and educate nearby residents of outcomes of the SIA.
- Establish a framework to monitor and report on social impacts.

6.14.4 Assessment of Impacts

Element (2022) assesses the social impacts of the Project firstly without the mitigation measures referred to in Section 6.14.3 and then with the adoption of the mitigation measures to record the expected residual social impacts.

Table 6.14.1 lists the social impact categories nominated in the SIA Guidelines that have been assessed for the Project.

Table 6.14.1
Social Impact Categories

Categories	Definition
Way of life	How people live, how they get around, how they work, how they play, and how they interact each day.
Community	Community composition, cohesion, character, how the community functions, and people's sense of place.
Accessibility	How people access and use infrastructure, services and facilities, whether provided by a public, private or not-for-profit organisation.
Culture	Aboriginal and non-Aboriginal, including shared beliefs, customs, values and stories, and connections to Country, land, waterways, places and buildings.
Health and wellbeing	Physical and mental health especially for people vulnerable to social exclusion or substantial change, psychological stress resulting from financial or other pressures, access to open space and effects on public health.
Surroundings	Ecosystem services such as shade, pollution control, and erosion control, public safety and security, access to and use of the natural and built environment, and aesthetic value and amenity.
Livelihoods	People's capacity to sustain themselves through employment or business, whether they experience personal breach or disadvantage, and the distributive equity of impacts and benefits.
Decision-making systems	Including the extent to which people can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms.
Source: Element (2022) – Table 4.1	

As a result of its review of the Project and assembly of the social baseline or setting, Element (2022) has assembled the following perceived impacts (positive and negative) that relate to the Project.

1. Increase in operational dust, noise and vibration causing a decline in social amenity, health or way of life for nearby neighbours.
2. Expansion of existing land use and cumulative impacts of blasting resulting in a disadvantage to personal property (negative) for nearby neighbours.
3. Changes to the aesthetic value and amenity affecting surroundings and way of life.
4. Enhanced community wellbeing from continuation of job opportunities and community investment.
5. Distributive equity of economic benefits, between the region and nearby neighbours.
6. Cumulative impacts from surrounding quarries resulting in reduced social amenity, wellbeing and impact on surroundings for nearby neighbours.
7. Lack of trust in systems used to influence operational management systems and project design.
8. Further changes to land use affecting community character inducing a sense of loss of European heritage.
9. Further changes to land use affecting community character inducing a sense of loss of Aboriginal Heritage.
10. Further changes to land use affecting the availability of naturally occurring groundwater used for livestock, impacting livelihoods.

A summary of the social impacts and their significance to stakeholders is provided in **Table 6.14.2**.

Table 6.14.2
Summary of Social Impacts

Impact to People	Social Impact Category	Impact Significance (unmitigated / mitigated)		
		"Figtree Hill"[1]	Nearby Rural Neighbours	Community
Increase in operational noise causing a decline in social amenity, health or way of life for nearby neighbours and personnel[1]	Way of life Surroundings Health and wellbeing	High/Medium	Medium/Low	Low/Low
Increase in operational dust causing a decline in social amenity, health or way of life for nearby neighbours and personnel[2]	Way of life Surroundings Health and wellbeing	Medium/Low	Medium/Low	Low/Low
Increase in vibration causing a decline in social amenity, health or way of life for nearby neighbours and personnel[1]	Way of life Surroundings Health and wellbeing	Medium/Low	Low/Low	Low/Low
Amenity impacts and the Project leading to a decline physical health and wellbeing	Health and wellbeing	Medium/Low	Medium/Low	Low/Low
Amenity impacts and the Project leading to a decline mental health and wellbeing	Health and wellbeing	Medium/Low	Medium/Low	Low/Low
Expansion of existing land use resulting in a disadvantage to personal property for nearby neighbours	Livelihoods	Medium/Low	Medium/Low	Medium/ Medium (positive)
Changes to the aesthetic value and amenity affecting surroundings and way of life	Surroundings Way of life	High/Medium	Medium/Medium	Medium/Low
Enhanced community wellbeing from continuation of job opportunities and community investment	Way of life Community	N/A	N/A	High/High (positive)
Distributive equity of economic benefits, between the region and nearby neighbours	Way of life Community	Medium/Low	Medium/Low	N/A
Cumulative Impacts from surrounding quarries resulting in reduced social amenity and wellbeing for nearby neighbours	Community	Low/Low	Low/Low	Low/Low
Lack of trust in systems used to influence operational management systems and project design	Decision Making Systems	Medium/Low	Low/Low	N/A
Further changes to land use affecting community character inducing a sense of loss of European heritage	Culture	High/Medium	High/Medium	High/Medium
Further changes to land use affecting community character inducing a sense of loss of Aboriginal Heritage	Culture	N/A	N/A	Low/Low
Further changes to land use affecting the availability of naturally occurring groundwater used for livestock, impacting livelihoods	Livelihoods	Medium/Low	Low/Low	Low/Low

Note1: Cleary Bros and the owners of "Figtree Hill" have negotiated an agreement and the owners of "Figtree Hill that addresses a range of matters relevant to amenity of the property.

Note 2: Impacts are both operational and cumulative.

Source: Element (2022) - modified after Table 7.2

6.14.5 Conclusion

The SIA has assessed both the unmitigated and mitigated negative and positive social impacts of the Project. The predicted negative impacts are primarily expected to be direct and localised relating to:

- way of life (how people work, rest and play);
- surroundings including aesthetic values and/or amenity (social amenity); and
- impacts to personal and property rights.

The SIA has also assessed that the Project would result in positive impacts in the wider community in terms of continuation of employment, workforce and supplier expenditure, and community investment.