Montrose Quarry

Staging Plan and Rehabilitation Concept

Boral Resources (Vic) Pty Limited

23 May 2023

→ **The Power of Commitment**

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1. Introduction

GHD Pty Ltd (GHD) understands that Boral Resources (Vic) Pty Ltd (Boral) seeks to extend the existing extraction boundary of the Montrose Quarry, Work Authority 100 (WA 100) to extend its operational life by approximately 40 years. This requires the creation of a series of staged extraction and rehabilitation plans for the life of the quarry that demonstrate the development of the site from the current approved pit design to a proposed expanded pit footprint along with the associated progressive and final rehabilitation. As part of this intent, GHD has been requested to develop the staging plans for the expansion and rehabilitation of the quarry at 5 yearly intervals and an accompanying final rehabilitation concept plan.

In addition to this scope GHD has been requested to conduct a geotechnical assessment, including geotechnical risk assessment (GRA) and development of a risk register, ground control management plan (GCMP) and trigger action response plans (TARPs). These are being developed concurrently and summarised in two separate deliverables (Site Specific Geotechnical Assessment and the GCMP).

The proposed expansion to WA100 will extend the southern and eastern boundaries of the current approved extraction area.

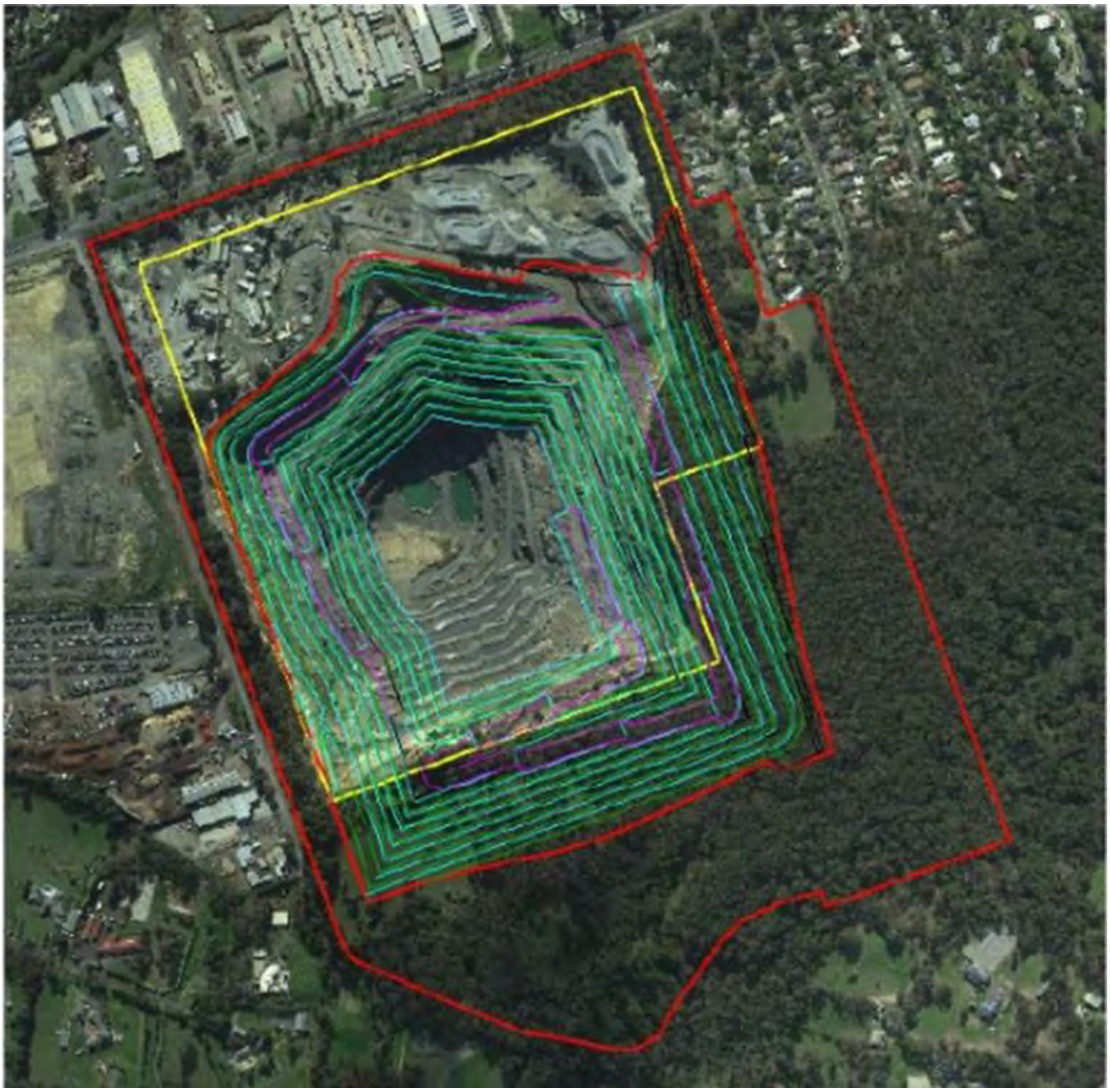


Figure 1 The proposed footprint of the expanded Montrose Quarry (Source – Boral).

1.1 Client Objectives

The primary objective is to expand the existing extraction boundary to extend the operational life of the quarry. Boral wish to also understand and assess the progression of mining throughout the life cycle of the quarry extension from current operations to rehabilitation. The aim is to highlight potential impacts of the proposed quarry expansion on current and future operations, the environment and local sensitive receptors. Staging plans are to take into consideration:

- Maximum resource extraction
- Internal storage of overburden and mine waste
- Site specific geotechnical assessment and allowable batter/slope profiles
- Access to expansion area internal overburden storage
- Staging progression plans on 5 yearly intervals
- Rehabilitation concept landform

The findings of the staging plans and rehabilitation concept will inform the proposed Site Rehabilitation Plan and subsequent Work Plan Variation (WPV).

1.2 Scope of Work

As outlined in the GHD proposal document titled '*Montrose Quarry Extraction and Rehabilitation Modelling – Proposal*', dated 8 October 2021, (GHD Report Ref: 12559266/88273/16), GHD's scope of work is as follows:

- Project inception and development of Basis of Design (BoD) documentation to ensure all inputs to the design, and their status, are understood by Boral, GHD and other stakeholders.
- Site visit with site team and review available information with the aim of establishing appropriate site geological and/or material property distribution profiles, extraction and rehabilitation design criteria including batter profiles and cut/fill slopes, configuration, civil and geotechnical engineering considerations.
- Development of pit models including identification of key inter-dependencies and criteria that are to be used to test and refine the staging and sequencing of the current work plan and extended pit scenarios for the respective life cycle of the quarry. Noting this will require input from Boral operational staff and development team members.
- Preparation of extraction staging plans for the current work plan and extended pit scenarios that include illustration of calendar 5-year timelines over the life of the quarry.
- Preparation of rehabilitation staging plans for the current work plan and extended pit scenarios that include timeline illustration every five years over the life of the quarry.
- Report preparation including documentation and diagrams, that can be presented to the various stakeholders.

To assist in assessing the number of rehabilitation outcomes, Boral proposed three potential scenarios. These scenarios are intended to provide Boral with a range of hypothetical solutions for varying final landform usage.

- Fill to RL 28: It is assumed that an RL 28 fill level will seal the pit from the water table, this has not been verified by detailed assessment. Potential land use includes water storage options.
- Fill to RL 112: Filling to this level may be suitable for recreational and nature services, including a small lake. Ferntree Gully Quarry Reserve is an analogous local example of a public space in steep terrain that incorporates a pit lake.
- Fill to RL 154: Filling to this level is expected to average inclines of no more than 1:15 (estimated). With reprofiling, this could be suitable for a wide range of next uses such as recreational or urban development.

1.3 Limitations

This report has been prepared by GHD for Boral Resources (Vic) Pty Limited and may only be used and relied on by Boral Resources (Vic) Pty Limited for the purpose agreed between GHD and Boral Resources (Vic) Pty Limited as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Boral Resources (Vic) Pty Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the bases of information provided by Boral Resources (Vic) Pty Ltd and others who provided information to GHD (including government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report (by the clients' other consultants) are likely to be constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

2. Existing Quarry and Remaining Extraction

2.1 General

The WA100 site is situated in Montrose, Victoria, an area located at the foothills of the Dandenong Ranges approximately 32 km east of Melbourne (Figure 2). The site and the proposed expansion area is bound by Canterbury Road to the north, residential housing to the northeast, Dr Ken Leversha Reserve to the east and south, and Fussell Road to the west.

The current quarry operation occupies 57.5 ha out of Boral's 77.4 ha landholding and supplies concrete aggregates for projects across the greater metropolitan Melbourne area.

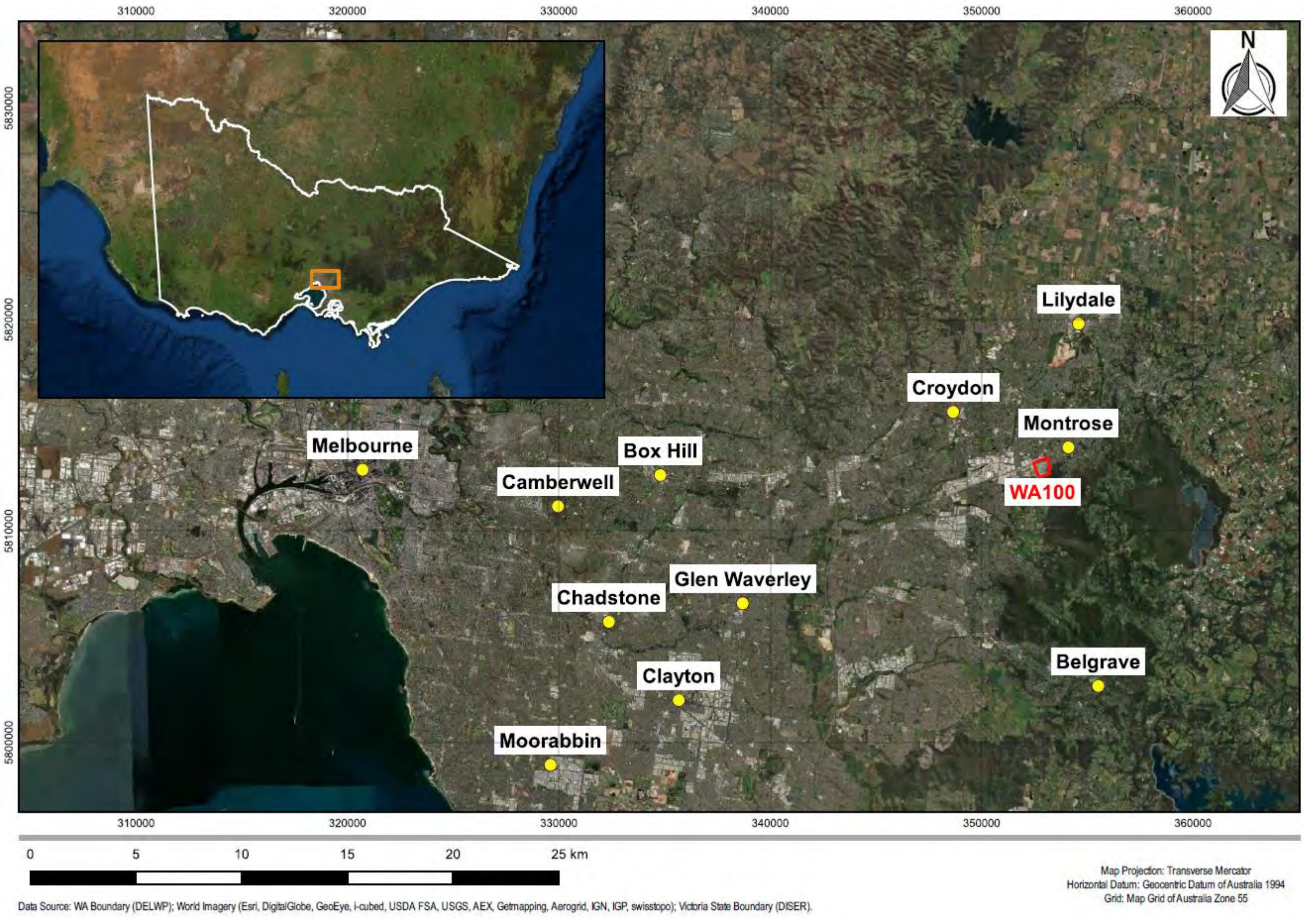


Figure 2 The location of Boral Montrose Quarry WA100

2.2 Site Observations

Matt Armstrong (Engineering Geologist), Nirav Patel (Senior Geotechnical Engineer) and Stefan Verhellen (Senior Mine Planner) of GHD carried out an inspection of the Montrose Quarry on 10 November 2021. The objective of the site visit was to inspect the stability performance of the existing quarry batters, undertake structural mapping, gain a visual appreciation of the efficacy of operational procedures and discuss operational constraints on extraction.

Visual inspections encompassed the entire extraction area, with structural field measurements taken from batters that were safely accessible by foot and where access was permitted. Summarised below are the relevant key observations pertaining to observed site conditions pertinent to the extractive operations and staging plan development. A more detailed description of the site conditions, specifically geotechnical and geological conditions is summarised in the corresponding Geotechnical Assessment titled '*Montrose Quarry (WA100) Geotechnical Assessment*', dated 25 November 2021, (GHD Report Ref: 12559266/59238/47).

2.2.1 Lithological Units

Four lithological units are currently exposed at Montrose Quarry, including a rhyolite, rhyodacite, welded tuff and soil fill unit. The site mostly comprises of the rhyolite and rhyodacite unit, with the contact between these two units exposed in the east and south wall of the current pit. The geology of Montrose quarry, as refined by PSM (2016), is presented in Figure 3.

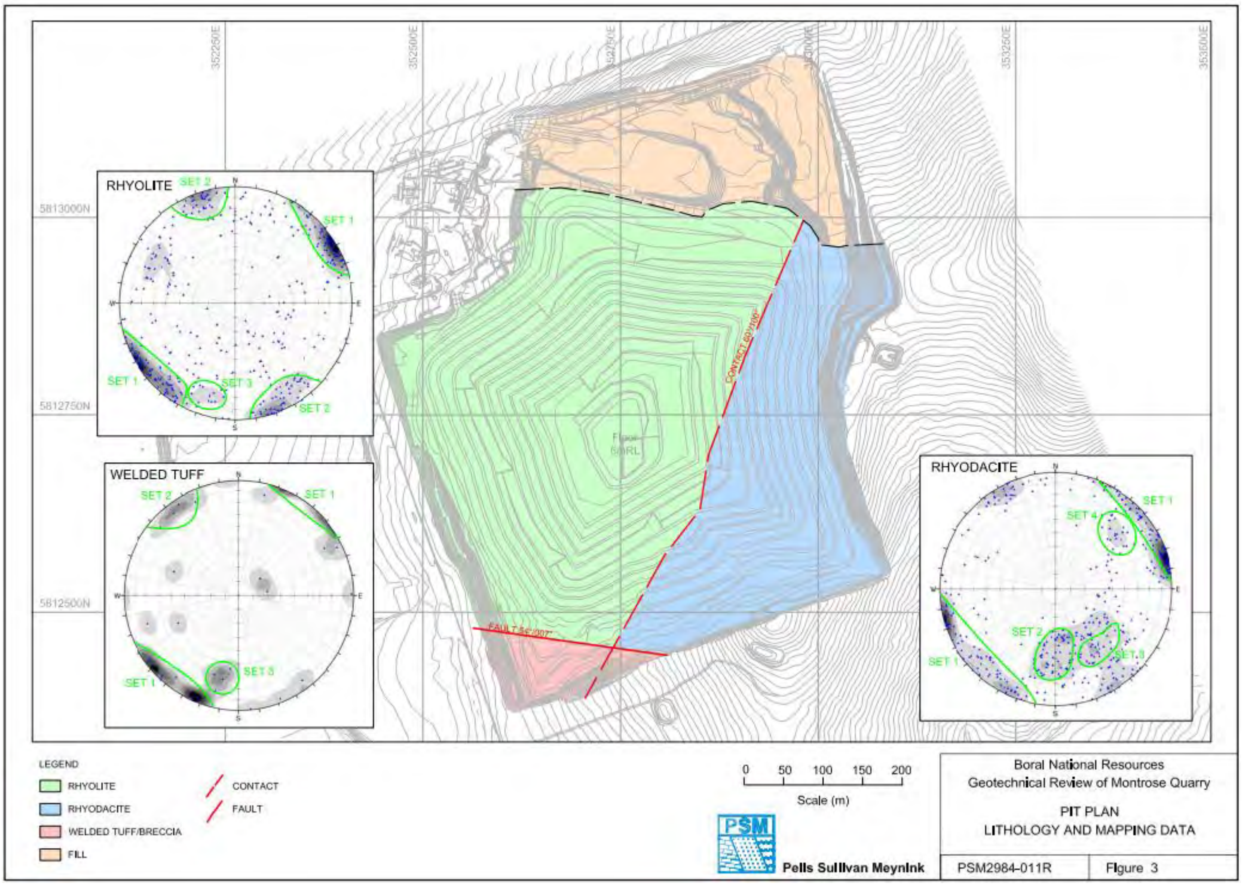


Figure 3 Lithological Units exposed at Montrose Quarry (PSM, 2016)

The depth of weathering was considered as part of the stability analyses and has been conservatively interpreted based on site observations. It should be noted that areas of intense weathering or reduced rock strength are likely to be encountered at contact and / or minor shear zones.

2.2.2 Stratigraphic Sequence

Four stratigraphic units have been observed on exposed quarry batters within the rhyolite and rhyodacite units. This includes a residual soil unit, a highly weathered unit, a moderately weathered to slightly weathered unit and a fresh unit. It should be noted that zones of intense weathering were also identified in the moderately weathered to slightly weathered and fresh units, this was typically observed along localised shear zones.

The stratigraphic sequencing, according to the observed weathering pattern, forms the basis for categorising materials with ‘similar’ geotechnical characteristics. It is noted that site observations and field estimates indicate that the rhyolite and rhyodacite unit exhibit similar rock strength properties and as such have been considered as a single unit. Montrose quarry materials were categorised using weathering grades, in accordance with the ISRM (1981) criterion, as outlined in Table 1.

Table 1 Summary of Material Type by Degree of Weathering

Unit	Degree of Weathering	ISRM (1981) Weathering Grade
1	Residual Soil	RS
2	Highly Weathered	HW
3	Moderately Weathered to Slightly Weathered	MW
4	Fresh	FR

2.2.3 Hydrogeology

The groundwater table at the Montrose Quarry was interpreted using the data from the site groundwater bores and numerical groundwater model. The measured groundwater level ranges from around 148m AHD to 180m AHD on the eastern side of the quarry. The area along Bungalook Creek to the south, has a depth to groundwater typically shallower than 5 m.

2.2.4 Current Pit Design

The provided design files pertaining to the current surface topography as of November 2020 were imported into the Maptek Vulcan 11 software and digitised to produce 3D surface models. Figure 4 depicts a 3D surface model of the current quarry profile and area of disturbance.

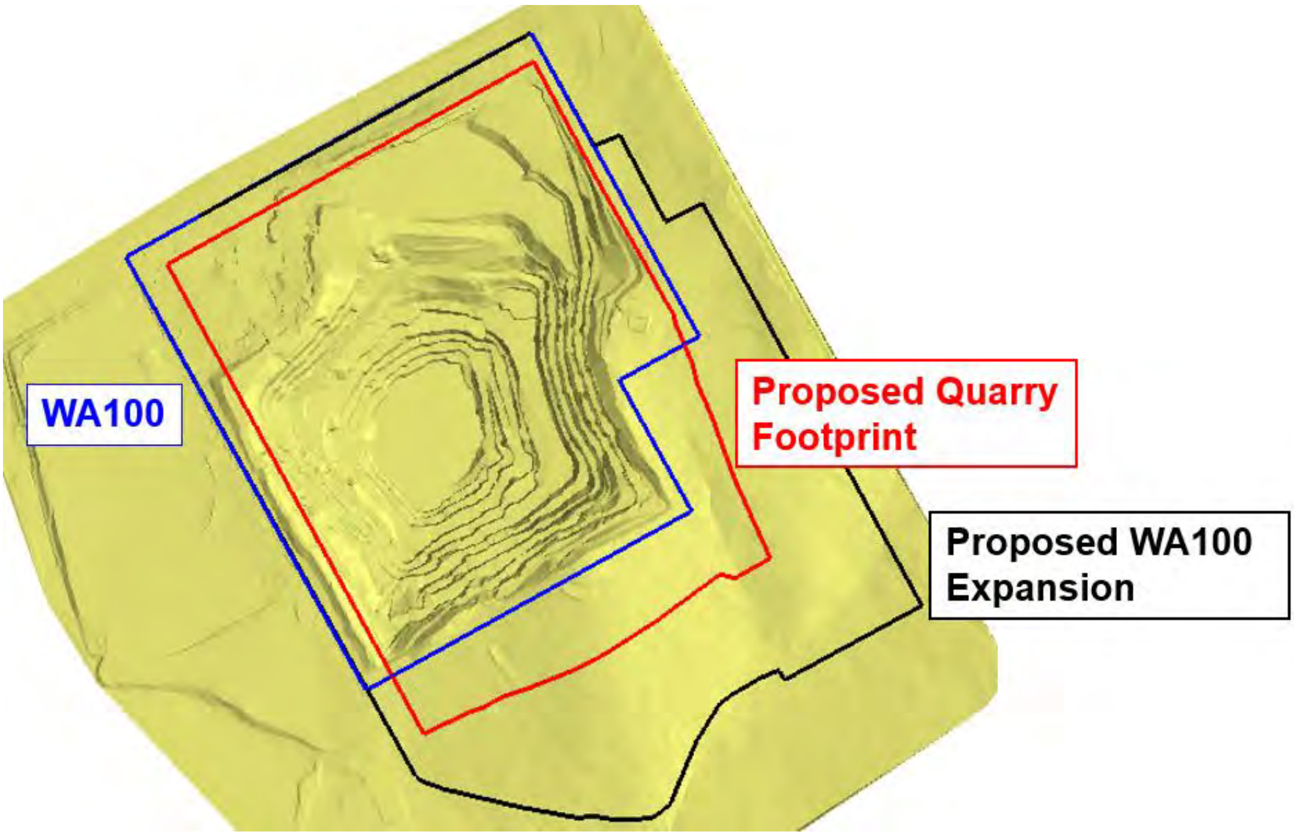


Figure 4 3D Surface Model of Current Extraction Area

Review of the November 2020 topography indicates that the current maximum depth of the quarry pit is in the order of 180 m below crest level, at approximately RL 21 m. Typical slope geometry consists of an overall slope angle in the order of 35° to 40°, batter heights occurring variably between 10 and 18 m and slope faces in the order of 75°. Bench widths along the North and South Wall were in the order of 10 to 15 m, and 5 to 10 m along the East and West walls. In some areas along the East Wall, bench widths were observed to be less than 5 m, with loss in berm width evident on some benches due to local batter scale instabilities.

2.2.5 Geotechnical Performance

Signs of previous single bench and multi-bench scale instabilities were evident during the site visit. However, this was not observed to affect the overall stability of the pit walls. Evidence of slumping in the soil fill material, sloughing / unravelling of the upper weathered units and batter-scale structurally controlled instabilities were readily observed on the exposed quarry batters. In general, no significant change in stability performance was observed compared to that described by PSM in previous site inspections.

However, instabilities extending over multiple benches were observed on the exposed pit walls (East and South), with undercutting of the batter face also evident in various areas. Significant berm loss has been observed at these locations. In areas where good blast and scaling practices have been observed (i.e., evidence of pre-split barrels or batter faces appear to have been scaled back), debris from structurally controlled instabilities are typically contained to a single bench.

2.2.6 Current Extraction

Quarrying operations are currently deepening the existing pit and where geometry allows additional trimming of the batters is conducted to maximise the extractable resource. Operations are conducted by pre-strip, drill & blast followed by truck & shovel. As required an excavator will follow the truck and shovel operations to scale walls and remove loose debris. All material is transported to the surface level primary crusher for processing.

All extracted material is processed on site with additional feed from Boral's Coldstream operations as required. Current projections (ie 2^{nd} half of 2022) indicate that the current pit has resource for an additional 18 months of extraction supplemented by feed from Coldstream.

3. Basis of Design

3.1 Guiding Design Principles

To formulate the staging plans and rehabilitation concept GHD has:

– Developed a pit model identifying key inter-dependencies used to test and refine the staging and sequencing extended pit design for the respective life cycle of the quarry with input from Boral operational staff and development team members.
– Prepared extraction staging plans for the current work plan and extended pit scenarios that illustrate calendar 5-year timelines over the life of the quarry.
– Prepared rehabilitation concept plans for extended pit in accordance with the work authority requirements.
– Considered the practical / operational requirements for the site including:
  - Continued quarrying of material
  - Dewatering of the quarry sump
  - Backfilling of the quarry floor
  - Staging backfilling to accommodate pre-strip of overburden
  - Providing achievable rehabilitation / dump infill rates, and any required individual material quality targets
  - Understanding available resources on site and imported resources available as an input into the development of the rehabilitation strategy
  - Understanding existing and intended rehabilitation equipment and build this into the proposed rehabilitation plan
  - Stand-offs from sensitive receptors and WA boundary

Three rehabilitation scenarios were provided by Boral with a range of hypothetical solutions for varying final landform usage.

– Fill to RL 28: It is assumed that an RL 28 fill level will seal the pit from the water table, this has not been verified by detailed assessment. Potential land use includes water storage options.
– Fill to RL 112: Filling to this level may be suitable for recreational and nature services, including a small lake. Ferntree Gully Quarry Reserve is an analogous local example of a public space in steep terrain that incorporates a pit lake.
– Fill to RL 154: Filling to this level is expected to average inclines of no more than 1:15 (estimated). With reprofiling, this could be suitable for a wide range of next uses such as recreational or urban development.

3.2 Updated Geotechnical Design Parameters

3.2.1 Design Acceptance Criteria

The nomination of suitable acceptance criteria is a key part of any design, this is particularly so for slopes that have experienced past instability and are now expected to remain stable for the foreseeable future.

Design acceptance criteria for the Montrose Quarry site have been nominated in line with accepted industry practice as outlined in DJPR's (2020) '*Geotechnical Guideline for Terminal and Rehabilitated Slopes*, and published precedents, as outlined in CSIRO's '*Guidelines for Open Pit Slope Design'*, (Stacey and Read, 2009). In nominating suitable design acceptance criteria, GHD has utilised the Factor of Safety (FoS) criteria outlined in Table 2 of DJPR (2020) and Table 9-3 of Stacey and Read (2009).

Table 2 FoS Guidelines (Table 2 after DJPR, 2020)

Consequence of Failure	Examples	Minimum FoS
Not Serious	Individual benches; small slopes (< 50 m), temporary slopes, not adjacent to haulage roads	1.3
Moderately Serious	Any slope of a permanent or semi-permanent nature	1.6
Very Serious	Medium sized (50-100 m) and high slopes (< 150 m) carrying major haulage roads or underlying permanent mine installations	2.0

Owing to the nature of the quarry deposit, two target FoS criteria have been nominated for this assessment, which are as follows:

- Working bench to Inter-ramp scale instabilities – FoS greater than 1.3
- Global scale instabilities – FoS greater than 1.6
- Rehabilitated batters – FoS greater than 2.0
- Seismic – FoS greater than 1.1

3.2.2 Initial Proposed Geometry

The results of the minimum catch bench width analysis determined a minimum bench width of 8 m is required for a 12 m high batter face. However, it should be noted that the following excavation methodology should be adopted to significantly minimise any potential material being generated from batter instabilities.

- Drilling and blasting to be undertaken over a continuous 12 m face height, subsequent to which the walls will then be excavated in 3 x 4 m flitches and scaled to remove any loose/disturbed blocks. This assumption has been considered when assessing maximum berm scale instability that can occur at any time.

Based on the outcomes of the stability analysis, Table 3 presents the initial recommended slope geometry for the final pit wall. In general, although a steeper Inter Ramp Angle (IRA) has been proposed by GHD compared to those previously recommended by PSM, the overall slope angle is noted to be within a similar magnitude.

Table 3 Summary of the Montrose Quarry Batter and Inter-ramp Slope Geometries

<table>
<tr><th rowspan="2">Pit Wall</th><th rowspan="2">Unit 1
(Residual Soil / Overburden Unit)
Slope Angle (°)</th><th colspan="4">Unit 2 – 4
(HW to FR Rock Unit)</th></tr>
<tr><th>IRA (°)</th><th>Overall Slope Angle (°)</th><th>Bench Height (m)</th><th>Bench Width (m)</th></tr>
<tr><td>North</td><td rowspan="5">1V:1.5H</td><td rowspan="2">33</td><td rowspan="2">51</td><td rowspan="5">12</td><td rowspan="5">8</td></tr>
<tr><td>North East</td></tr>
<tr><td>East</td><td>40</td><td>49</td></tr>
<tr><td>South</td><td>43</td><td>51</td></tr>
<tr><td>West</td><td>43</td><td>51</td></tr>
</table>

In addition to the proposed pit design above, a minimum stand-off distance (i.e., buffer) distance is required between the crest of the pit and the WA boundary. The minimum buffer distance for each considered rehabilitation option is presented in Table 4 below. It is recommended that for conservatism at this stage, that the maximum buffer distance from the WA boundary is adopted (i.e., corresponding to the minimum fill level).

Table 4 Stability Analysis Results – Rehabilitated Batters

Pit Wall	Minimum stand-off distance for FoS = 2.0		
	RL 28 m	RL 112 m	RL 154 m
North	11.8	11.6	1.3
East	36.1	36.0	35.8
South	6.8	6.8	6.7
West	35.2	35.2	26.8

It should be noted that in addition to the pit design parameters recommended above, a robust extraction methodology is also crucial to the stability of the pit walls and to maintain the integrity of the benches. The use of controlled blasting, presplit, trim blasts, followed by slope scaling or chaining and clean-up is considered favourable from a stability perspective. The recommended drill and blast techniques are further outlined in Geotechnical Assessment titled '*Montrose Quarry (WA100) Geotechnical Assessment*', dated 25 November 2021, (GHD Report Ref: 12559266/59238/47).

3.2.3 Revised Pit Geometry (Batter-berm configuration)

Revision of the pit geometry was undertaken after discussion between GHD and Boral technical staff. Boral site representatives requested the assessment of a batter bench configuration that complemented existing drill/blast and truck/shovel processes. Specifically, that the batter bench configuration would be designed at 8 m or 16 m face heights to allow for two 4 m flitches to be quarried from each production blast. The revised geometry is presented as Option B.

Based on the kinematic analysis, a batter-berm configuration of 16 m and 12 m is considered sufficient for catching and containing spillage to a single bench under managed conditions.

– NB: That this is an increase compared to the PSM report (in the order of 10 m)
– NB: Catching and containing spillage refers to single bench kinematic instabilities, not blasted material

Furthermore, a reduced batter height and associated berm width can be adopted for the final pit design, provided that an inter-berm angle equal to or less than 44° is maintained across the entire pit.

Based on the Option B design, the minimum stand-off distance is within the buffer from the crest of pit to the proposed WA boundary to maintain a FoS of greater than 2.0.

A summary of the accessed DAC for Option B compared to the initial design is shown in Table 5 below.

Table 5 ***DAC comparison of the initial design to Option B***

Stability Section	Initial GHD Design (GHD,2022) 75 Batter Face 12 m Batter Height 10 Bench Width		GHD Option B Design 75 Batter Face 16 m Batter Height 12 m Bench Width	
	Inter-ramp DAC – FoS >1.3	Global DAC – FoS >1.6	Inter-ramp DAC – FoS >1.3	Global DAC – FoS >1.6
E1	2.58	4.00	2.17	>4.00
S1	2.99	4.00		
W1	3.68	4.77	3.56	>4.00
NE1	3.08	4.73		

3.3 Development of the Pit Model

The design of an initial pit model was developed by GHD in consultation with Boral site and technical representatives. This initial pit model illustrates the final extraction of the resource within the current pit limits (Figure 5). GHD proposed a realignment of the ramp to include a switchback on the eastern side to allow for the integration of internal dumping required as part of the expansion This initial model then served as the basis for the development of the extension pit model and staging plans. The following inputs, supplied by Boral, were used to design the initial pit model:

– Survey data as at November 2020 provided by Boral at project inception.
– Quarry face data, supplied by Boral via Propeller (web-based portal), from November 2020 to May 2022
– Updated extraction design of the remaining resource at the base of the pit incorporating an altered ramp design, supplied by Boral via Propeller (web-based portal), May 2022
– Aerial photography of the site
– Ecological off-set boundary
– Sensitive receptor locations and off-sets

– WA boundary

A 3D model of the pit was compiled to use as the basis for volumetric calculations of the proposed expansion design. The pit model, representing the maximum extraction limit, then served as the basis from which subsequent staging plans, the internal overburden dump and rehabilitation concept were developed. The plan view of the final pit model is attached as Appendix A.

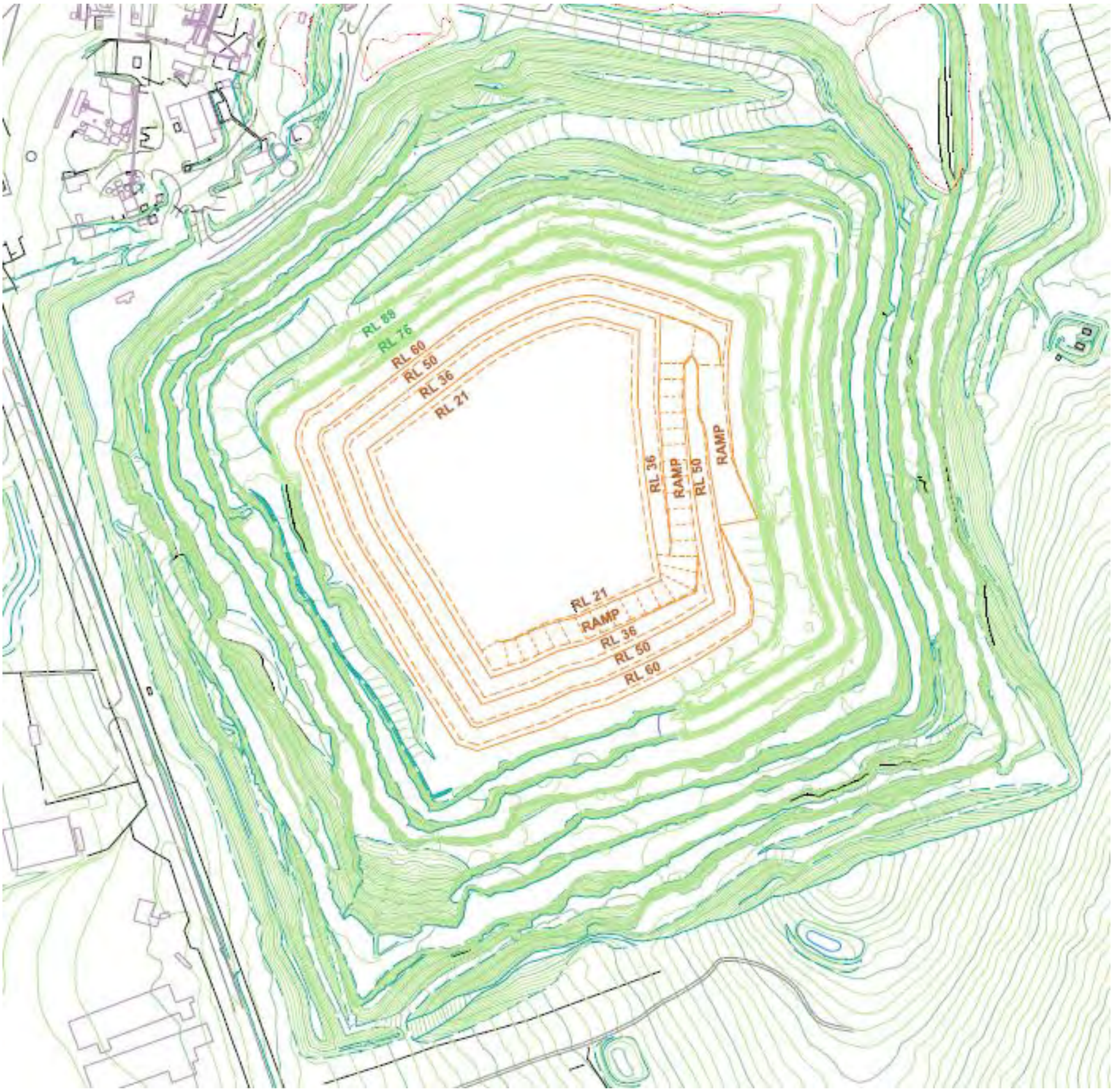


Figure 5 ***GHD Proposed ramp realignment at base of existing pit to include a switchback on the eastern side to allow integration of internal dumping during expansion***

The pit design for the quarry expansion is constrained by a series of buffer limits and associated buffer zones in relation to the WA boundary and sensitive receptors such as private dwellings. GHD has used the agreed limits / buffers, with the specific limiting geometry files detailed in Table 6.

Table 6 Boundary off-sets and buffers constraining pit limits

Boundary	Offset requirement
North	No off-set, Boral processing plant provides buffer from Canterbury Rd
East	Off-set 100 m from residential property, 33 Ash Grove and Dr Ken Leversha Reserve.
South	Dr Ken Leversha Reserve and Bungalook Creek
South-west	100 m from residential property 13 Jeanette Maree Court boundary
West	Fussell Rd / 20 m buffer from WA boundary
10 ha ecological off-set	Ecological offset provided by Boral Ecological offset includes buffer of 10m to define extraction limit Ecological offset affects eastern and southern extraction limit

When consideration of the principles given above in Guiding Design Principles (see Section 3.1) is introduced the associated impacts related to the sensitive receptors can be seen in the design of the pit model. These are shown pictorially below in Figure 6 and Figure 7 illustrating the adoption of batter geometries to navigate buffer zones and incorporate noise attenuation bunding as required.

3.3.1 Final Batter Profile

The final batter profile parameters were incorporated from the revised pit geometry (batter/berm configuration) of Option B, as assessed in Geotechnical Assessment titled '*Montrose Quarry (WA100) Geotechnical Assessment*', dated 25 November 2021, (GHD Report Ref: 12559266/59238/47). A summary of the adopted configuration is detailed below in Table 7.

Table 7 Adopted batter / berm configuration

Design parameter	Design parameter
Batter angle - resource	75º
Batter angle - rehab	33º
Inter-ramp angle (IRA)	49-51º
Batter height	16 m
Bench width	12 m
Ramp width	20 m
Ramp grade – permanent access ramp RL144 to base of pit	1:10

Figure 6 ***Extraction boundary off-set from residential property boundary above eastern batter***

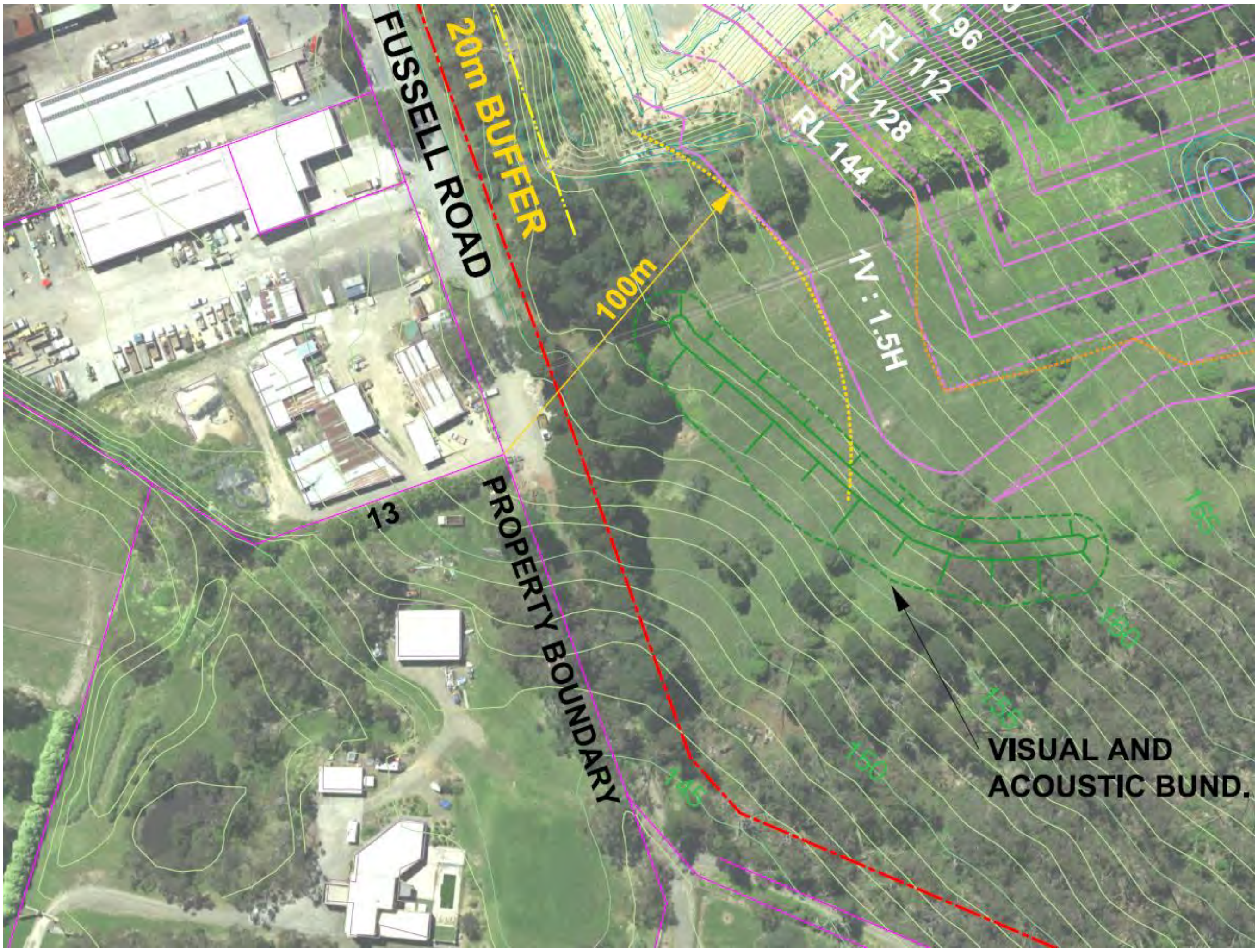


Figure 7 *Extraction boundary off-set from residential property boundary above south-western batter and concept noise attenuation bund*

4. Staging and Sequencing

The development of the staging plans was based on extraction and backfill rates supplied by Boral and discussions with Boral site representatives. This has allowed GHD to develop staging plans with due consideration of access and dumping options and alignment with site practices. A summary of the extraction rates used to develop the staging plans is detailed in Table 8.

GHD has not used these rates to develop staging plans for the development of the rehabilitation concept plan, as the availability of clean fill material, to be supplied externally to the quarry, is unknown at this time.

Table 8 Extraction and expected backfill rates

Extraction / Backfill Rate	Rate
Extraction	800 kt/yr
Stripping / Overburden Backfill	30,000 t/month

The development of the proposed pit expansion has been split into 8 stages. A methodology for sequencing the expansion has been developed and is illustrated in the accompanying staging plans 1 -8 in Appendix C. A summary of total extraction at each stage is detailed below in Table 9. A breakdown of extraction by bench at each stage is summarised in Appendix D.

Table 9 Summary of extraction volumes per stage

Stage	Volume (m^3)	Overburden (m^3)	Resource (m^3)	Resource (t) (2.7 t/m3)
1	55,400	55,400	-	-
2	682,400	408,000	274,400	740,880
3	1,609,000	638,800	970,200	2,619,540
4	938,100	349,500	588,600	1,589,220
5	1,354,300	124,500	1,235,500	3,335,850
6	1,336,700	-	1,337,000	3,609,900
7	2,132,900	-	2,132,900	5,758,830
8	2,246,900	-	2,246,900	6,066,630
Final	878,500	-	878,500	2,371,950
Total	11,234,200	1,576,000	9,658,000	26,076,600

Timeframes for extraction of each stage have been based on the above material movement rates provided by Boral and are summarised in Table 10. It is calculated that all overburden will be stripped within 8 years of commencing stage 1 and all available resource will be extracted within 32 years from commencement.

Table 10 Time to complete each stage based on provided extraction rates

Stage	Time from commencement (years)	Milestones
1	0.5	Initial eastern ramp access, OB excavation at RL 192. Upgrade of western haul road. Initial southern access ramp; at RL 192 and RL 160
2	2.3	Advance eastern batter face at Rl 192. Advance southern OB and resource faces from Rl 192 to RL 144. Complete first tier of dump at RL 36 and begin second tier at RL 50
3	5.5	Eastern batter, complete RL 192. Advance southern OB and resource faces, introduce bench level RL 128. Complete second tier of dump at RL 50 and commence third tier at R L70

Stage	Time from commencement (years)	Milestones
4	7.2	Eastern batter, excavate RL 176. Southern batter, Advance benches RL 126 to RL 160 eastwards. Complete third tier of OB dump at RL 70 and begin fourth tier at RL 88
5	10.2	OB excavation completed (to RL 128). Eastern batter, complete RL 176 and 160, establish RL 144.. Finish dumping to RL 88 (fourth / final tier).
6	14.7	Eastern batter, complete RL 144 and RL 128, establish RL 112. Southern batter, complete RL 128 and establish RL 112.
7	21.8	Eastern batter, continue RL 112 and establish RL 96. Southern batter, continue RL 96 and establish RL 80. No access from western haul road, access now from eastern haul road.
8	29.3	Completion of levels RL 96 & RL 80. Commencement of levels RL 64, RL 48 and RL 32 via extension of access ramp on southern and eastern sides. Potential to commence placement of imported fill material
Final	32.2	Completion of levels RL 48, RL 32 and RL 20. (Final Extraction Batters)

4.1 Overburden / Internal Dump

Contours for base of overburden were supplied by Boral. GHD has developed as isopach plan of overburden thickness and is attached in Appendix C. The overburden thickness varies from 4 m to 28 m in the south and from 4 m to 38 m on the eastern side. There would appear to be a possible anomaly as seen by the bullseye on the eastern side where the overburden shallows sharply to a 4 m thickness. This could potentially result in higher overburden volumes than those reported.

Weathered rhyolite/rhyodacite has been classified as a resource by Boral.

The overburden required to be removed in the quarry expansion is to be placed in an internal dump at the base of the pit and progressively filled in layers up to a final level, nominally RL 88. Figure 8 below illustrates a nominal overburden / waste dump design with a capacity of approximately 2.2 $Mm^{3.}$

The development of the internal waste dump has been assumed to following process:

- The first bottom two layers would be filled to match the existing bench levels at RL 36 (15 m thick) and RL 50 (14 m thick).
- A third 20 m thick layer is then placed starting from the western face to RL 70 with the toe limited at RL 50 to allow the future expansion batters to reach full depth.
- A fourth layer also starting from the western face to RL 88 would then be placed with leaving a 15 m berm at RL 70. A nominal 2H:1V fill slopes have been adopted.
- While the dump is designed to toe out against the final batters at completion, consideration has been given to maintain a sump at the base of the pit for water storage and storm water retention.
- The sump location changes as the dump advances as shown in the staging plans attached in Appendix C.

4.2 Access Options

Development of the proposed expansion was originally predicated on access along the eastern batter, eventually tying into the existing ramps and haulage network as quarrying progresses. This assumed that there was inadequate space on the western batters to accommodate a haul road due to the current extraction boundary, which in places, approaches the WA buffer zone.

Boral requested that GHD develop a concept haul road along the western batter and associated ramp to access the overburden from the south-west of the quarry. The south-western corner of the proposed extraction has reduced overburden thickness, allowing resource to be accessed earlier. The development of this additional ramp and haul route also provides Boral with an additional operational face providing operational flexibility.

4.2.1 Eastern Access Ramp

The eastern access ramp is designed as a 12 m wide cut / fill ramp at 1 in 8 grade, from the RL 160 stockyard area up to RL 192 to allow excavation of the uppermost overburden benches. This ramp is progressively shortened as overburden levels are excavated as shown on Stage 1 – 5 drawings (see Appendix C). The eastern expansion will more likely need to be developed level by level until completion of the 160 Bench after which the permanent access ramp can commence, allowing multiple benches to be developed concurrently. It is at about this point that southern development would begin to retreat to the south western corner and ultimately reach their terminal faces.

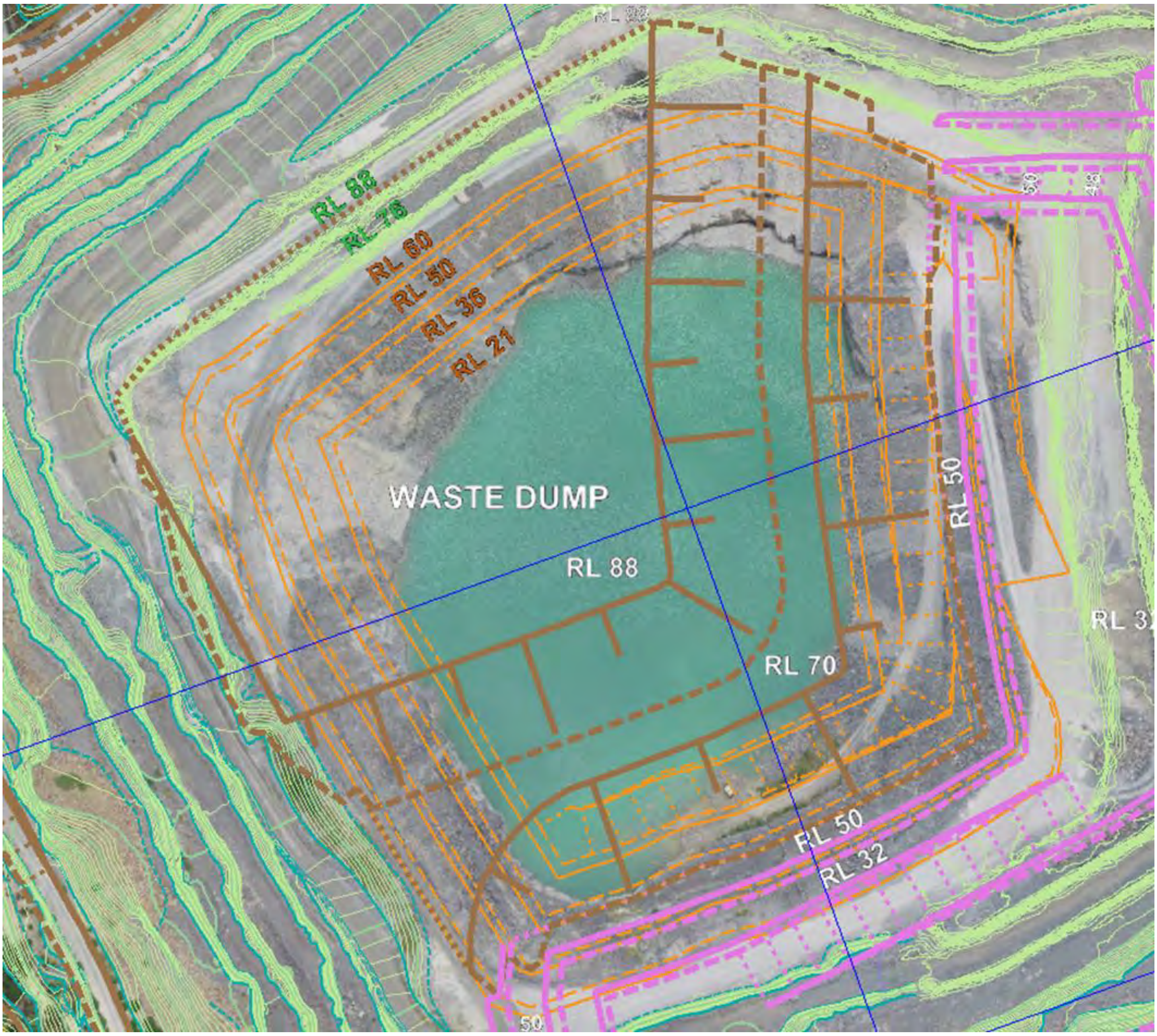


Figure 8 ***Nominal overburden / waste dump design***

4.2.2 Southern Development / Western Haul Route

The existing western perimeter track would be upgraded to create a haul route that will allow access to the southern region of the expansion much sooner than if the development was limited to only commencing from the northeast. The development of the western haul route and initial ramp are detailed in Appendix B in both plan and section view.

At the south west end of the upgraded western haul route an initial access ramp from RL144 to RL176 (20m wide, 1 in 10 grade) and RL176 to RL192 (12m wide, at 1 in 8 grade) is created. This will allow overburden initially, then rock to be transported from the southern expansion via the upgraded western haul route. Overburden excavation in the south commences from RL 192 & 160 progressively and rock extraction commences from the RL 144 Bench as shown on the Stage 1 & 2 drawings.

These ramps will eventually be removed in latter stages of development (stage 6 onwards).

5. Rehabilitation Concepts

To develop an understanding of the volumes required to backfill the Montrose quarry, a number of rehabilitation options were reviewed. These options were the culmination of multiple discussions between Boral and GHD. The intent of this step was to review initially three rehabilitation options and then a fourth so as to help inform Boral's understanding of the fill required to achieve a closure landforms and consideration of market conditions for fill and void space.

Backfill quantities have been modelled by volume and are described in this section accordingly. The nominated fill rate advised by Boral of 500,000 t/year has been converted to a volumetric rate of 250,000 m^3/year based on Boral's advised average density for the backfill of 2 t/m^3.

5.1 Options Analysis

Initially three rehabilitation options were proposed by Boral to be considered:

- Fill to RL 28: It is assumed that an RL 28 fill level will seal the pit from the water table, this has not been verified by detailed assessment. Potential land use includes water storage options.
- Fill to RL 112: Filling to this level may be suitable for recreational and nature services, including a small lake. Ferntree Gully Quarry Reserve is an analogous local example of a public space in steep terrain that incorporates a pit lake.
- Fill to RL 154: Filling to this level is expected to average inclines of no more than 1:15 (estimated). With reprofiling, this could be suitable for a wide range of next uses such as recreational or urban development.

GHD in consultation with Boral has agreed that the preferred option for the concept rehabilitation design is a fourth option of fill to RL 98 with batter to crest fill at 3H:1V.

The factors considered in assessing the backfill options are summarised below:

Table 11 Rehabilitation Concept Options

Rehabilitation Concept	Backfill Volume (m^3) assumes internal O/B dump complete	Time to Backfill (years)	Considerations
Fill to RL 28	150,000	0.6	Slopes would be largely unbuttressed with exposed batters in perpetuity. Potential to create pit lake based on water level studies. Lost commercial potential as clean fill storage. No alternative final land use possible. Unlikely to meet minimum expectations of ERR or community. Ongoing liability for Boral.
Fill to RL 112	8,700,000	35	Unlikely to meet minimum expectations of ERR or community. Slopes would be buttressed and upper exposed batters in perpetuity. Limited future land-use potential. Access to useable surface area required through exposed batters. Backfill required over 35 years. Ongoing liability for Boral.

Rehabilitation Concept	Backfill Volume (m^3) assumes internal O/B dump complete	Time to Backfill (years)	Considerations
Fill to RL 154	19,700,000	79	Slopes fully buttressed although significant section of eastern batters left exposed in perpetuity. Multiple land-uses available. Backfill required over 79 years. Long life of rehabilitation phase. Uncertainty to availability of clean fill over lifetime of rehabilitation. Continued liability for Boral through to completion.
Fill to RL 98 and batter to crest at 3H:1V	14,000,000	56	1 in 3 Slopes fully cover remnant excavated batter thus more likely to meet minimum expectations of ERR and community Slopes fully buttressed. No batters exposed in perpetuity. Increased land use potential. Access maintained though rehabilitated area. Backfill completed in approximately 56 years. Potential to facilitate fastest release of liability for Boral.

5.2 Recommended Concept

With completion of the options analysis a preferred final rehabilitation landform was adopted which would see the pit void filled with material from external sources in addition to the development of an internal overburden dump to manage mining waste from operations.

This landform as illustrated in the rehabilitation concept drawing in Appendix E proposes to fill the final void to RL98. Above RL98 fill would be placed at a 3H:1V slope up to the pit crest. Intermediate berms at nominal 30 m vertical intervals would confine the slope lengths to no more than 100 m each. A 15 m wide ramp on the eastern side (retained from extraction operations) would provide access to the RL98 level. This is an additional 10 m higher than the nominal internal dump design height of RL88 as shown in staging plans 7-8 (Appendix C).

There is 14,000,000 m^3 of void space at the completion of extraction, assuming that the internal dump (2,200,000 m^3 capacity) is completed, between the base of the quarry and the fill level of RL98, and 3H:1V slopes. The total surface area of the completed rehabilitation concept is 38 Ha.

Filling of the void would commence as soon as practicable however this would likely be towards the completion of the extraction process. It is currently proposed that Boral will source the additional material required to complete the rehabilitation concept from external sources on the open market or from other Boral sites as required/available. Boral currently assumes to backfill the quarry void at a rate of 250,000 BCM per annum. At this rate, backfill of the remaining 14,000,000 m^3 of void space would take approximately 56 years to complete.

A series of sequencing plans has been developed outlining the steps involved in backfilling the pit void to achieve the rehabilitation concept (see Appendix E).(see Appendix C). Backfilling would begin towards the completion of the extraction process(as shown in Stage 8 extraction plan) and would commence with filling the remainder of the internal dump as well as dumping at the base of the pit in areas not impacted by the final extraction. A summary of the backfilling staging is shown in Table 12 below.

Table 12 Rehabilitation Concept Backfill Volumes by Stage

Stage	Fill Level	Remaining Internal Dump (m^3)	Imported Fill (m^3)	Volume – Cumulative (m^3)
1. 10 yrs	RL 70	300,000	2,300,000	2,600,000
2. 20 yrs	RL 88 (partial fill)	-	2,000,000	5,100,000
	RL 112 (partial fill)	-	500,000	
3. 30 yrs	RL 98 (complete)	-	8,000,000	7,300,000
	RL 112 (top of 1 in 3 batter)	-	1,400,000	
4. 40 yrs	RL 120 (top of 1 in 3 batter)	-	2,300,000	9,900,000
5. 54 yrs	RL 150 (top of 1 in 3 batter)	-	3,500,000	13,400,000
Backfill Complete	Final 1 in 3	-	900,000	14,300,000

The rehabilitation concept is further illustrated in Appendix F as a series of 3D rendered images of the site from eight (8) vantage points. These images are intended to show the rehabilitation concept in-situ with respect to the surrounding landscape. Examples of the 3D rendered images are shown below in Figure 9 and Figure 10

Figure 9 Oblique view, orientated eastwards, towards Mount Evelyn.

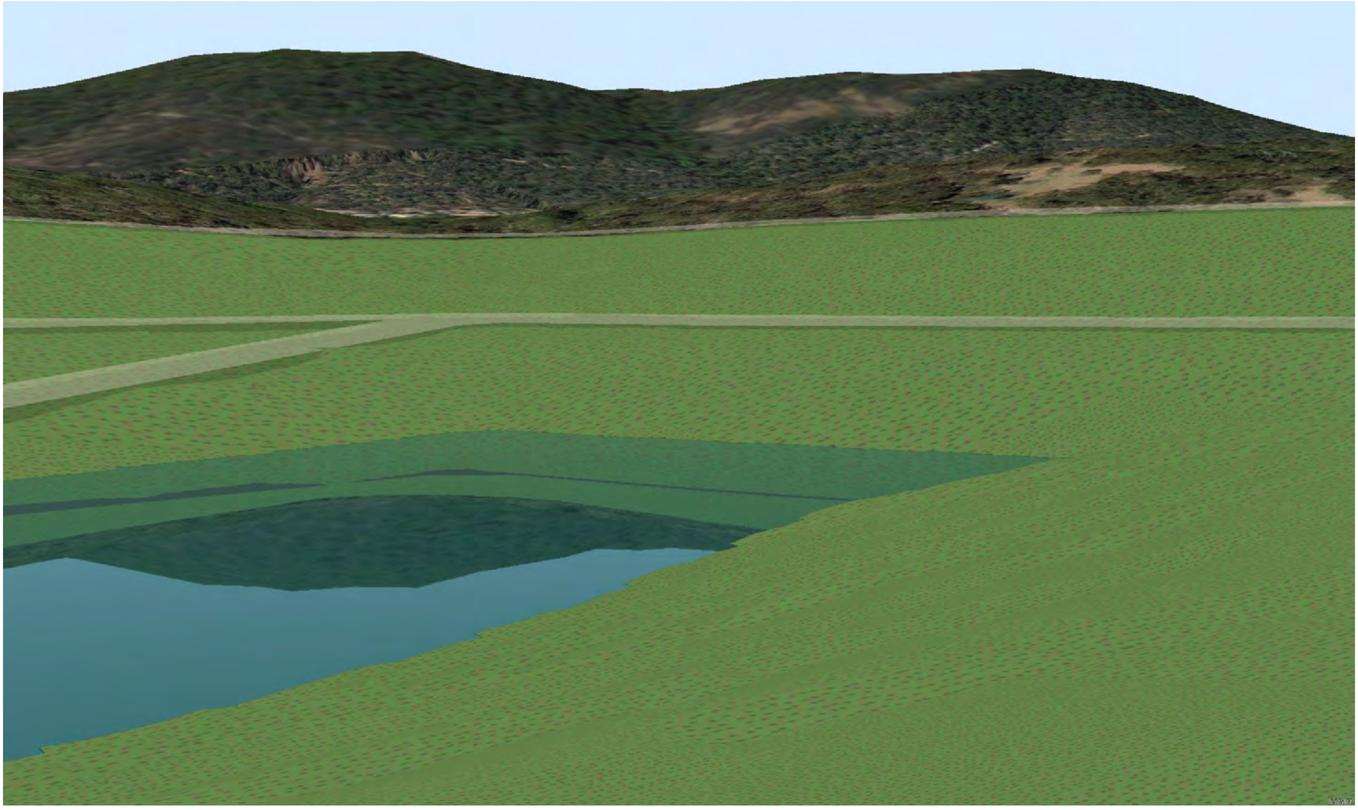


Figure 10 Internal view, orientated southeast, towards the Dandenong Ranges.

As part of the geotechnical assessment, completed in advance of this rehabilitation concept design, an erosion assessment was conducted using the Revised Universal Soil Loss Equation (RUSLE). RUSLE is a tool used to estimate the potential soil loss due to direct rainfall on an exposed slope and can provide an indication of the general erosion risk of the surface. It is useful for quantifying the impact of various factors that contribute to erosion when designing batters under long term (rehabilitated) conditions.

One of the factors considered in the RUSLE assessment the topographic factor (LS) which accounts for a slopes height (L) and gradient (S) and is used to represent the effect of topography on erosion rates. The topographic factors used in the assessment are detailed in Table 13.

Table 13 Summary of Topographic Factors

Geometry	Gradient (V:H)	Slope Length (m)	Topographic Factor, LS
North Wall	1V:1.5H (≈ 34°)	72	10.3
East, South and West Wall		54	10.8

Of note is the increased slope length of the batters from the assumed values in the earlier geotechnical assessment (72 m for the northern batter and 54 m for all other batters) compared to the current rehabilitation concept (approx. 100 m). As stated in the geotechnical assessment, GHD recommends that work is undertaken to verify the suitability of the erosion input parameters presented within the assessment, or in this case re-assess the model considering the increased slope length.

The Geotechnical Assessment titled '*Montrose Quarry (WA100) Geotechnical Assessment*', dated 25 November 2021, (GHD Report Ref: 12559266/59238/47) can be referenced to understand the erosion assessment in greater detail.

5.3 Legislative Considerations

While the outcome of this scope of works is not to develop a rehabilitation plan, it is intended to inform the development of a suitable final landform for rehabilitation. The rehabilitation concept is intended to directly feed into a subsequent rehabilitation plan and inform Boral's decision as to what the preferred final landform design and final land use will be. GHD has considered the requirements of a rehabilitation plan, within GHD's understanding of what is required by current legislation.

To this end, the following legislation is to be considered in the development of the concept design.

The relevant pieces of legislation that have been considered in the design of the rehabilitation concept are:

– *Mineral Resources (Sustainable Development) Act 1990*
– *Mineral Resources (Sustainable Development) (Extractive Industries) Regulations 2019*
– *Preparation of Work Plans and Work Plan Variations – Guideline for Extractive Industries Projects Revised October 2020 (Version 1.2)*
– *Preparation of Rehabilitation Plans - Guideline for Extractive Industry Projects March 2021 (Version 1.0*)
– *Geotechnical Guideline for terminal and rehabilitated slopes - Guideline for Extractive Industry Projects September 2020 (ERR)*

Both the MRSD Act and the Regulations include requirements for a rehabilitation plan. Section 79 of the *MRSD Act 1990* sets out what a rehabilitation plan must consider:

– Any special characteristics of the land.
– The surrounding environment.
– The need to stabilise the land.
– The desirability or otherwise of returning agricultural land to a state that is as close as is reasonably possible to its state before the mining licence, prospecting licence or extractive industry work authority was granted; and
– Any potential long-term degradation of the environment.

The Regulations further specify what information must be included in a rehabilitation plan lodged on or after 1 July 2021 at regulation 11(2) includes a description of proposed land uses for the affected land after it has been rehabilitated, that considers community views expressed during consultation; and a landform that will be achieved to complete rehabilitation, which must:

– Be safe, stable and sustainable; and
– Be capable of supporting a final land use.
– Objectives that set out distinct rehabilitation domains that collectively amount to the landform described.
– Criteria for measuring whether the objectives described have been met; and
– A description of, and schedule for, each measurable, significant event or step in the process of rehabilitation.
– An identification and assessment of relevant risks that the rehabilitated land may pose to the environment, to any member of the public or to land, property or infrastructure in the vicinity of the rehabilitated land, including:
  - The type, likelihood and consequence of the risks; and
  - The activities required to manage the risks; and
  - The projected costs to manage the risks; and
  - Any other matter that may be relevant to risks arising from the rehabilitated land.

6. References

DJPR (2021). *Preparation of Rehabilitation Plans - Guideline for Extractive Industry Projects March 2021 (Version 1.0)*

DJPR (2020). *Geotechnical Guideline for terminal and rehabilitated slopes - Guideline for Extractive Industry Projects September 2020 (ERR)*

DJPR (2020) *Preparation of Work Plans and Work Plan Variations – Guideline for Extractive Industries Projects Revised December 2020 (Version 1.3)*

GHD (2021). *Geotechnical Assessment 'Montrose Quarry (WA100) Geotechnical Assessment', dated 25 November 2021, (GHD Report Ref: 12559266/59238/47)*

Mineral Resources (Sustainable Development) Act 1990 (Vic)(Austrl.), Act Number 92/1990, Version 126, effective 01/07/2021

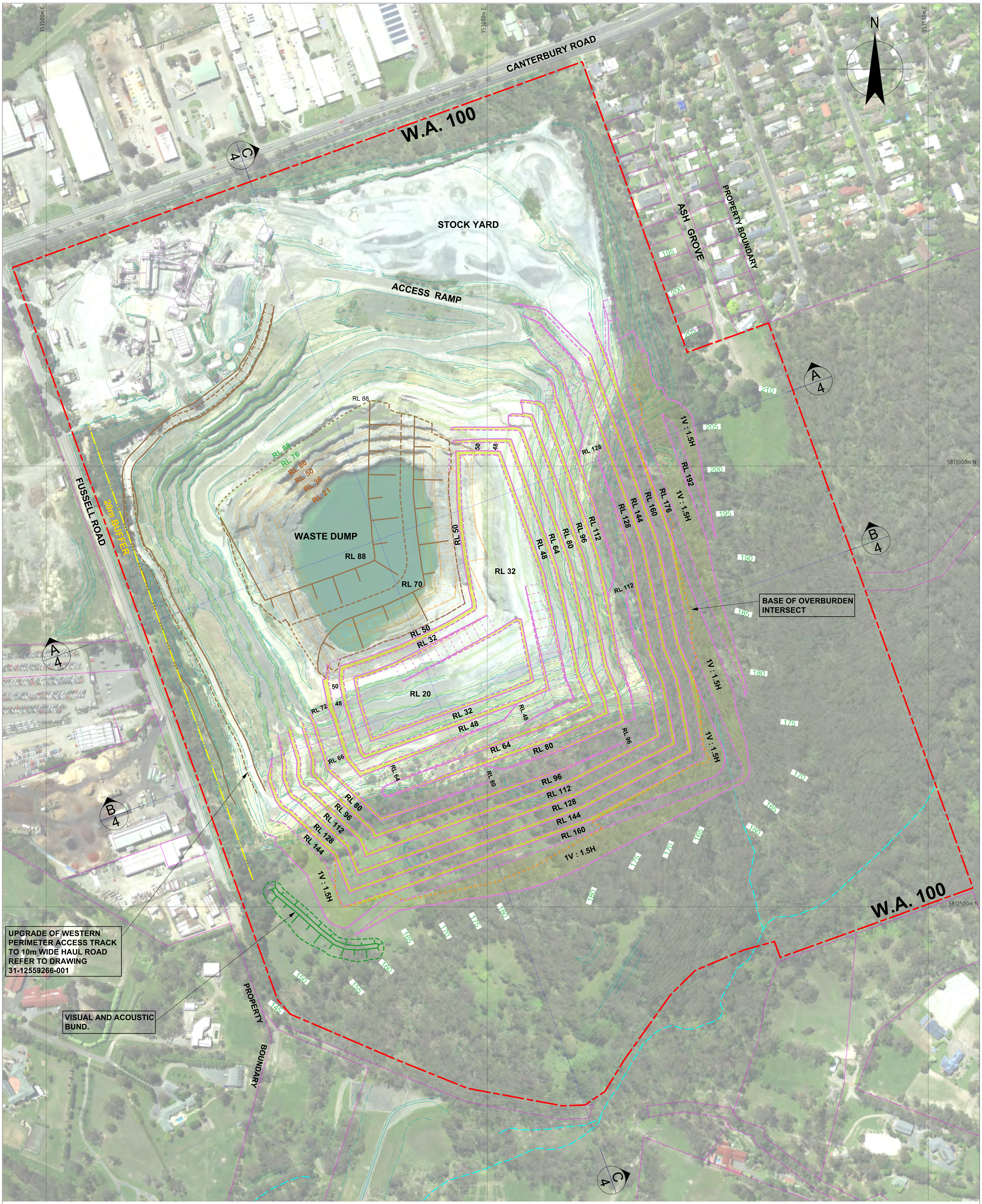
Mineral Resources (Sustainable Development) (Extractive Industries) Regulations 2019 (Vic)(Austrl.), Statutory Rule 137/2019, Version 002, effective 23/06/2020.

Read, J., & Stacey, P. (2009). *Guidelines for Open Pit Slope Design.* CSIRO Publishing.

Appendices

Appendix A

Final Pit Model



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LEGEND:

- Existing Quarry Faces
- RL 35 — Current Design of Final Batters
- RL 96 — Proposed Expansion Final Batter

Rev	Description	Checked	Approved	Date
0	Issued to Client	M Armstrong	M Laird	4/11/2022

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Project No.

Client **BORAL**

Project **MONTROSE QUARRY EXTENSION**

Status

Status Code

Drawing Title **Final Batters**

Size A1

Drawing No. 31-12559266-C003

Rev 0

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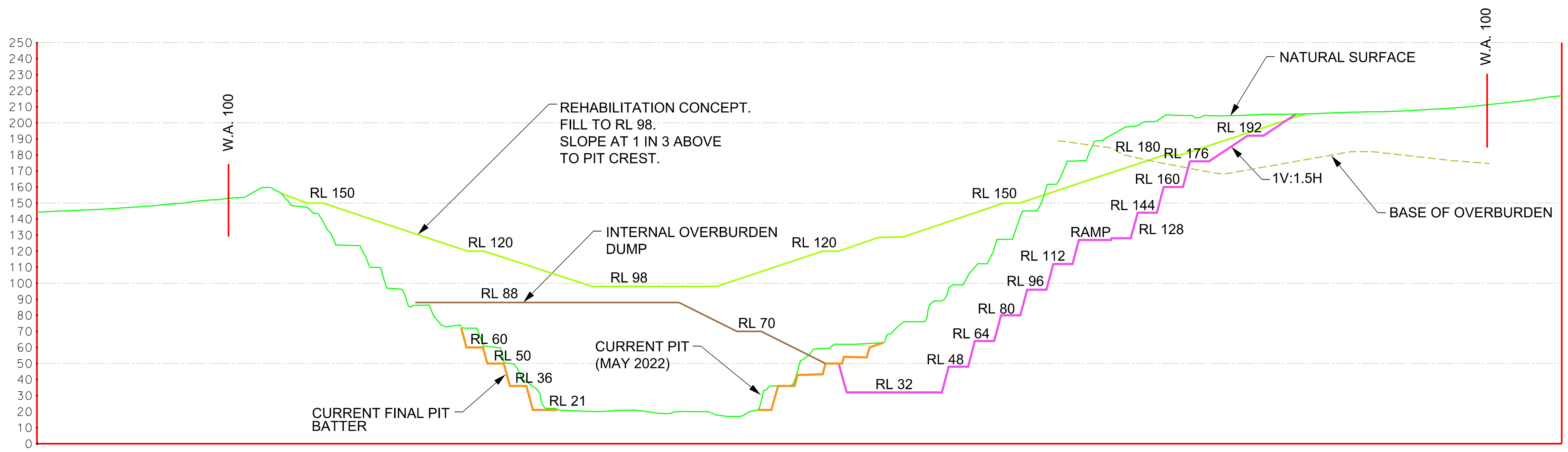

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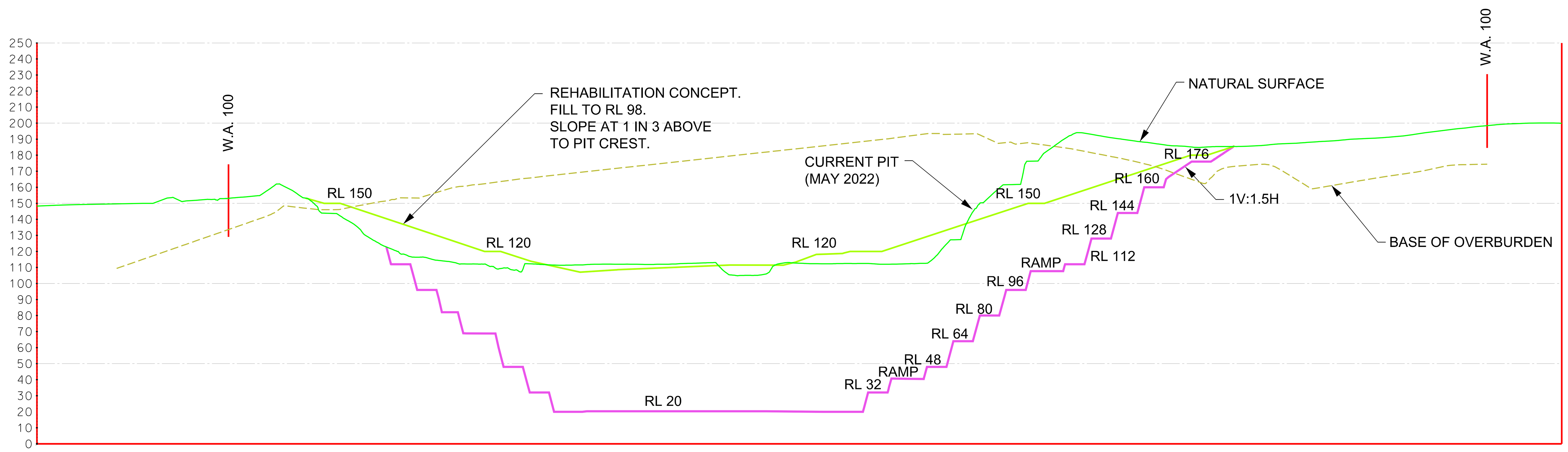

SECTION B - B

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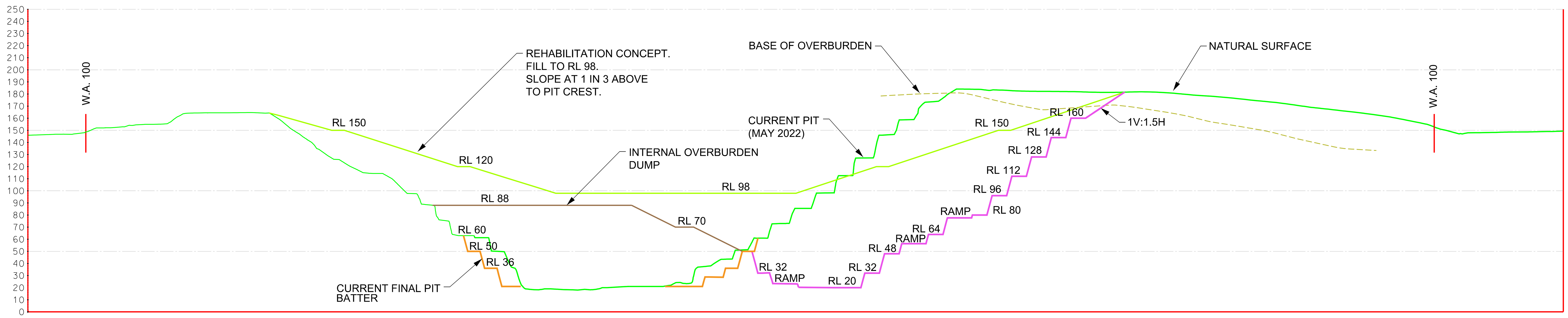

SECTION C - C

NORTH SOUTH SECTION THRU CENTER OF CURRENT PIT

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Rev	Description	Checked	Approved	Date
0	Issued to Client	M Armstrong	M Laird	4/11/2022

Author S. Verhellen | Drafting Check J Bohan

Designer S. Verhellen | Design Check M Armstrong

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Drawing Title **TYPICAL SECTIONS**

Size A1

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Appendix B

Western Haul Road Concept

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Author S. Verhellen — Drafting Check J Bohan

Designer S. Verhellen — Design Check M Armstrong

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Scale 1:1,000 AT A1

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Drawing Title **WESTERN ROAD UPGRADE PLAN**

Size A1

Drawing No. 31-12559266-C001

Rev 0

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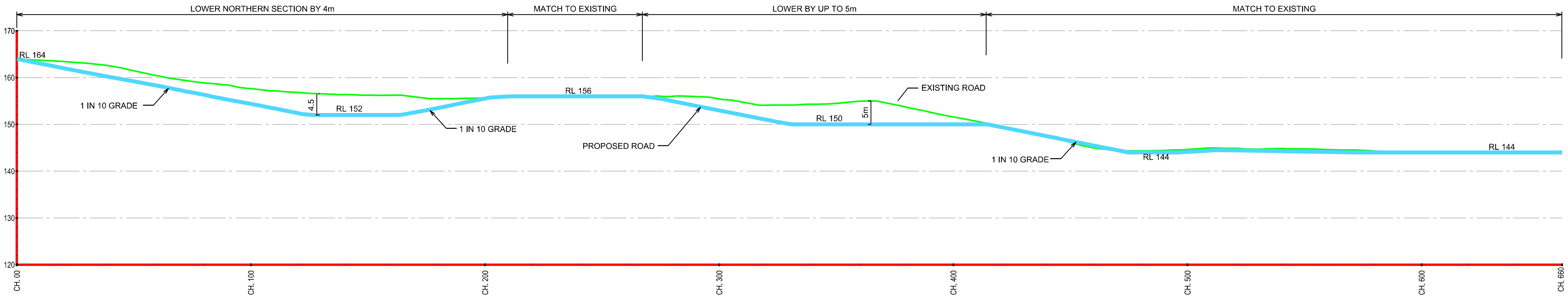

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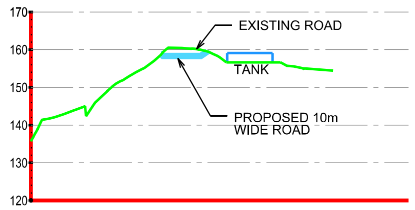

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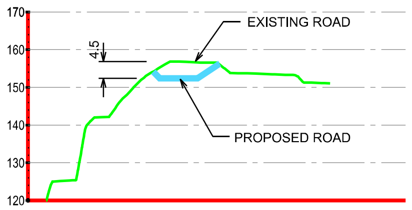

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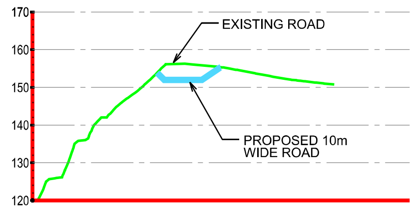

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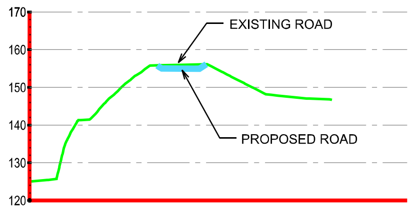

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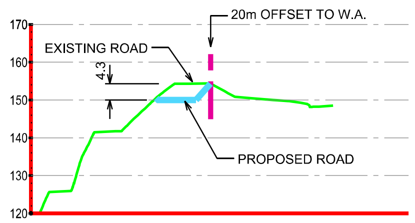

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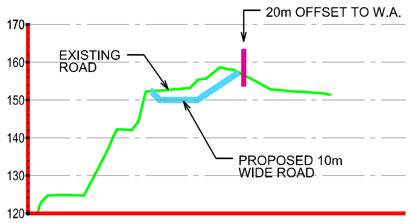

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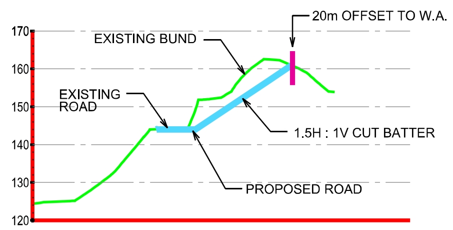

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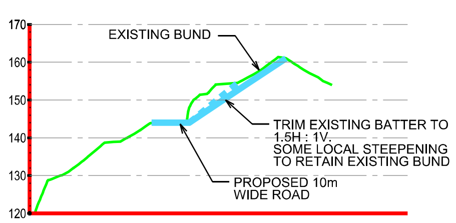

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Rev A

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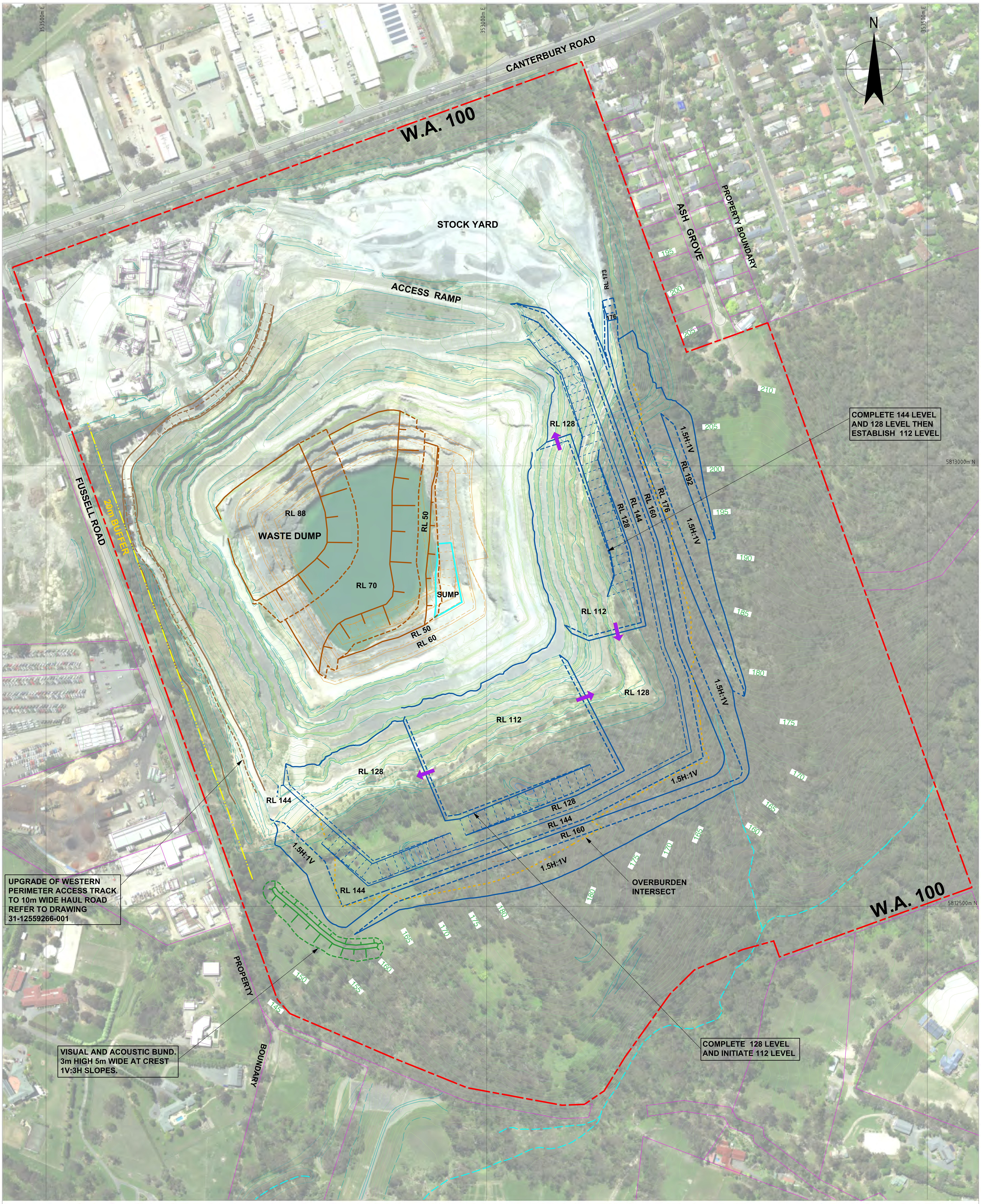

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Rev	Description	Checked	Approved	Date
0	Issued to Client	M Armstrong	M Laird	4/11/2022

Author: S. Verhellen — Drafting Check: J Bohan

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Project: **MONTROSE QUARRY EXTENSION**

Status — Status Code

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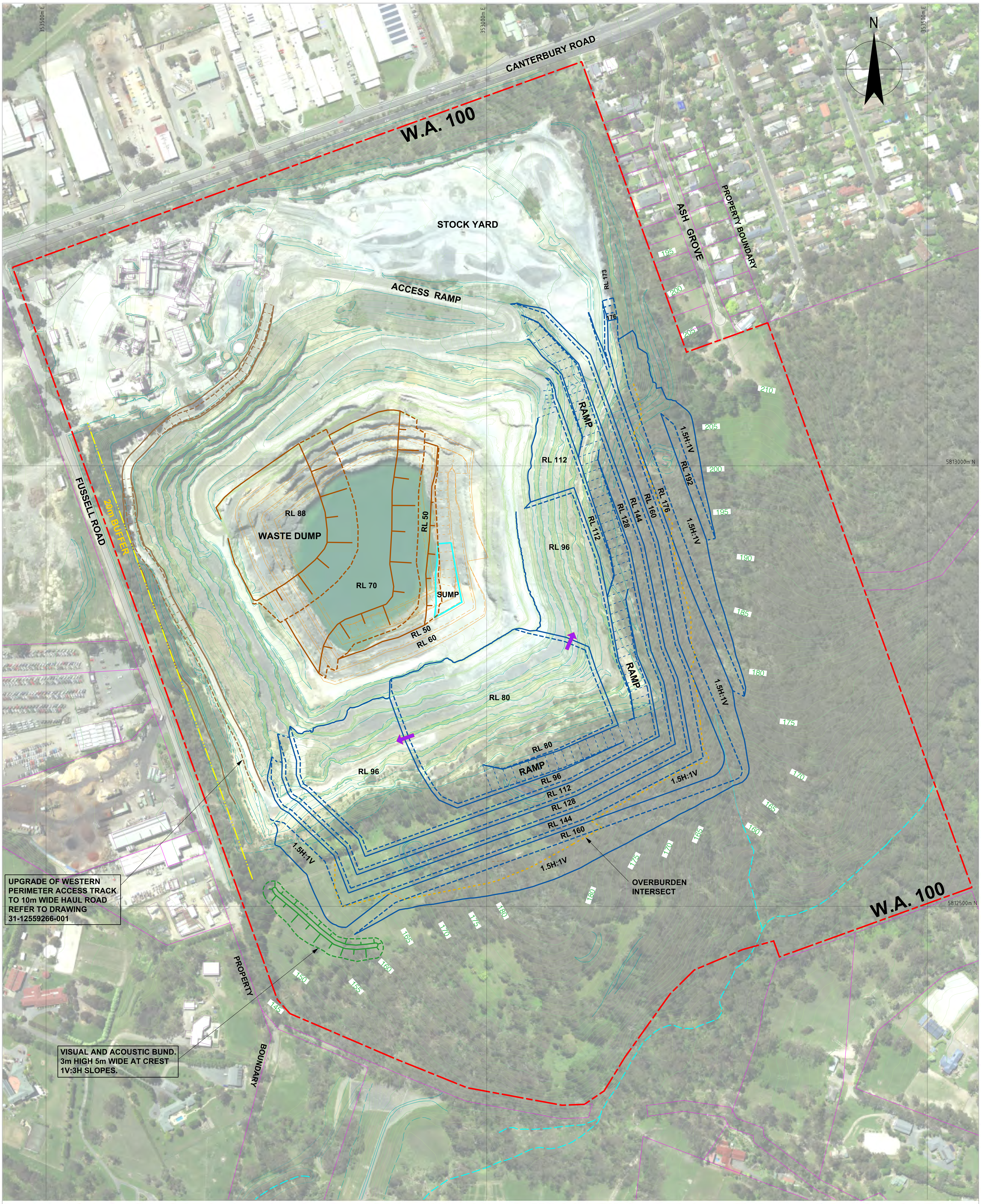

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SCALE 1:2000 AT ORIGINAL SIZE

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0	Issued to Client	M Armstrong	M Laird	4/11/2022

Author S. Verhellen — Drafting Check J Bohan

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Drawing Title **Extraction and Dumping Sequence Stage 7**

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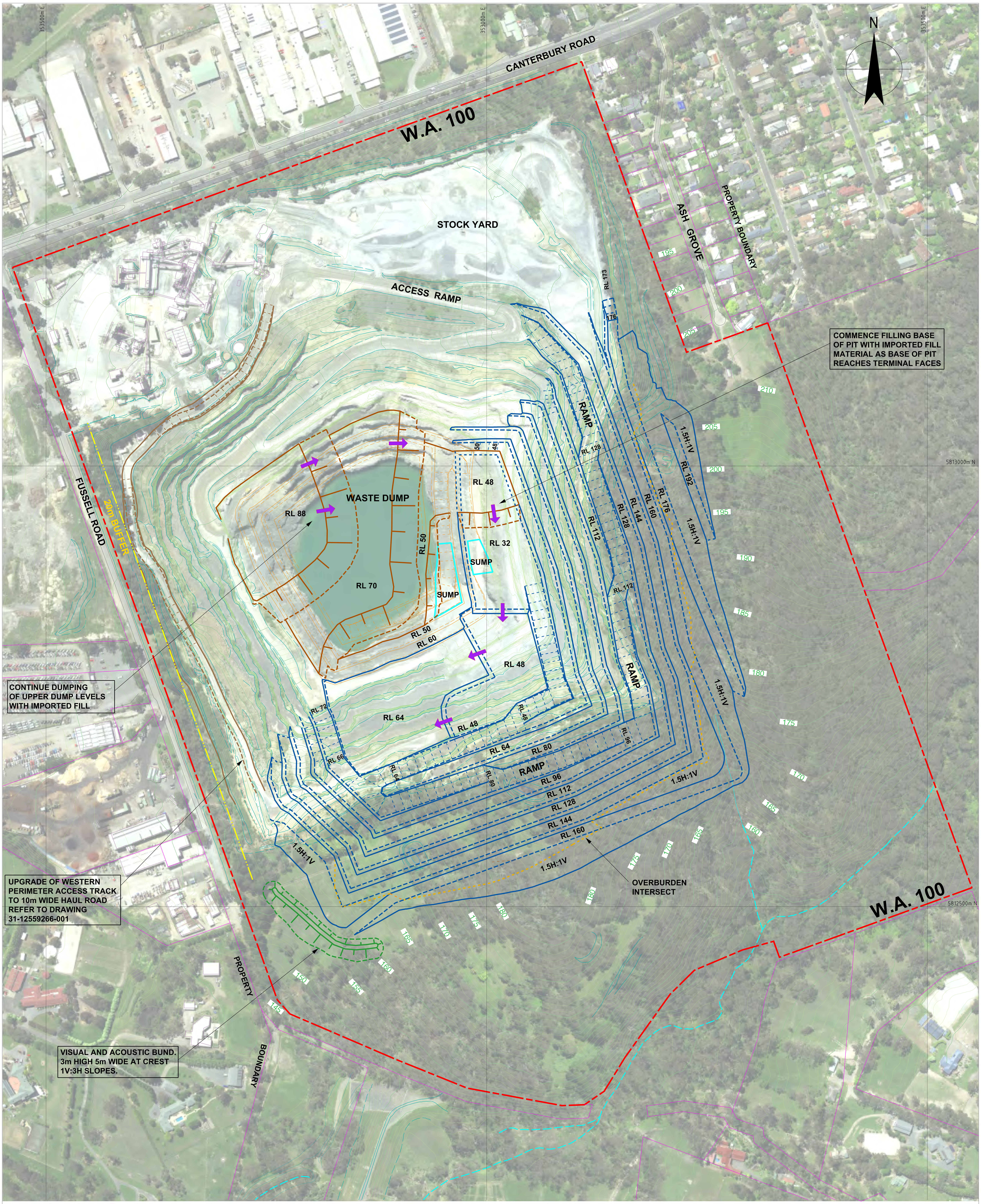

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Author S. Verhellen Drafting Check J Bohan

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Client **BORAL**

Project **MONTROSE QUARRY EXTENSION**

Drawing Title **Extraction and Dumping Sequence Stage 8**

Size A1

Status

Status Code

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Rev 0

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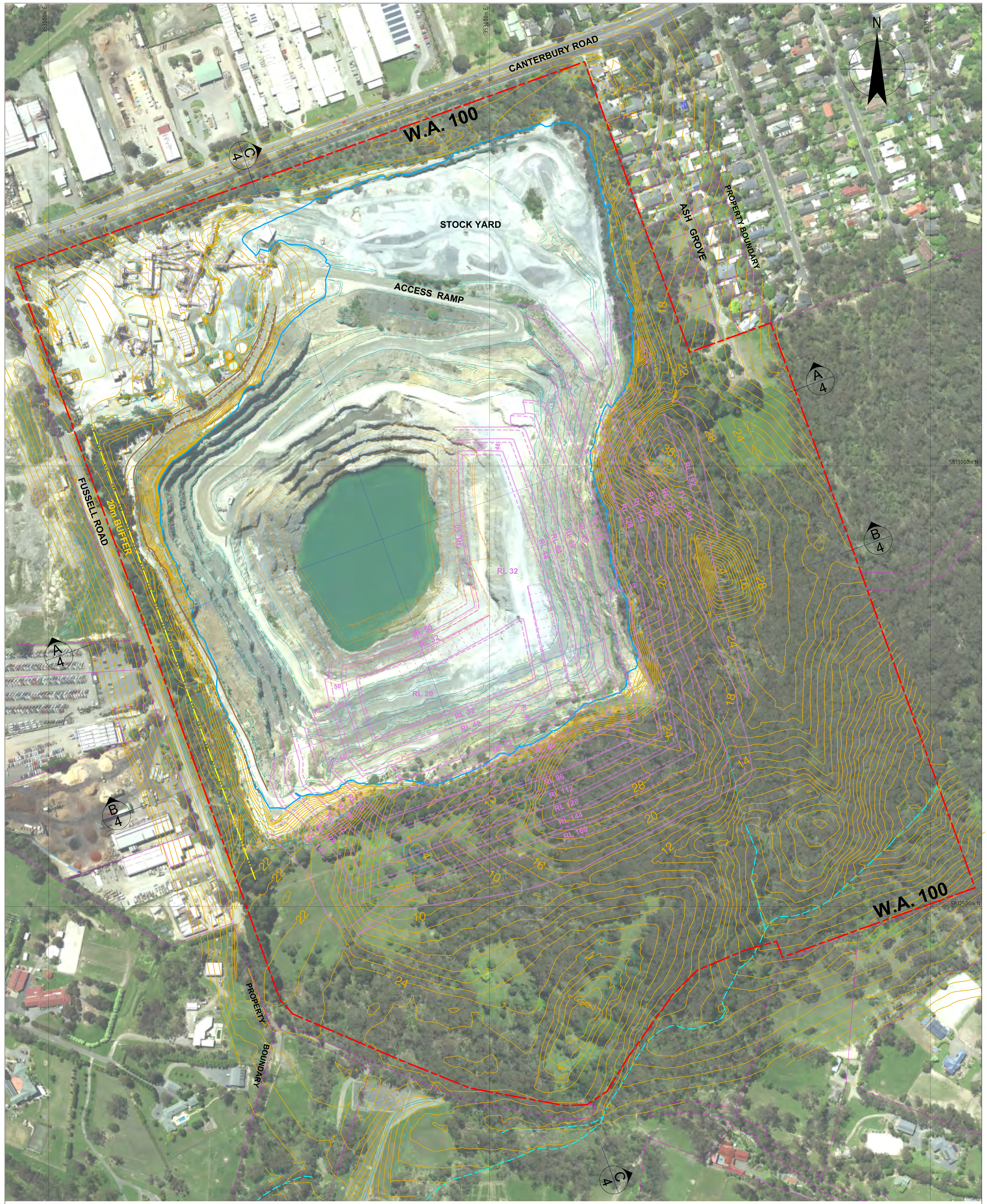

LEGEND:

28	Overburden Isopach (Contour of O/B Thickness)
RL 35	Current Design of Final Batters
RL 96	Proposed Expansion Final Batter

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Rev	Description	Checked	Approved	Date
0	Issued to Client	M Armstrong	M Laird	4/11/2022

Author S. Verhellen | Drafting Check J Bohan

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Project No.

Client **BORAL**

Project **MONTROSE QUARRY EXTENSION**

Status

Status Code

Drawing Title **Isopach of Overburden Thickness**

Size A1

Drawing No. 31-12559266-C012

Rev 0

Plot Date: - Plotted by: - File Name: \\ghdnet\ghd\AU\Traralgon\Projects\31\12559266\CADD\31-12559266-012_Overburden_Isopachs.dgn