



HEIDELBERG MATERIALS AUSTRALIA PTY LTD

Langwarrin Quarry Extension Surface Water Management

Report

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- Appendix A: ARR 2016 Rainfall Depths
- Appendix B: Functional Design Drawings
- Appendix C: Registration License for Water Extraction
- Appendix D: Rehabilitation Stage Functional Design
- Appendix E: Consultation Meeting Minutes
- Appendix F: Drainage Design Updates

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1. INTRODUCTION

1.1 Objectives

Heidelberg Materials Australia Pty Ltd (formally Hanson Construction Materials) has prepared a Work Plan Variation for the extension of their existing sand quarry in Langwarrin to the property of 60 Valley Road. The property is owned by Heidelberg Materials Australia Pty Ltd (Heidelberg Materials) and is located to the north of the existing quarried area that is managed under Work Authority WA13.

Engeny Australia (Engeny) have been engaged by Heidelberg Materials to undertake a Surface Water Management Plan (SWMP) for the proposed extension to address a Melbourne Water requirement for the Work Plan Variation that a SWMP must be prepared.

The SWMP includes:

- Documentation of the requirements of responsible authorities including Earth Resources Regulation and Melbourne Water.
- Estimation of stormwater flows derived from catchments internal and external to the proposed extraction area.
- Functional design of the open channel system required to convey external catchment flows around the proposed quarry pit extension during its operational phase.
- Functional design of the open channel connecting the upstream catchment to Boggy Creek, that is proposed for the rehabilitation phase of the quarry following in-fill of the quarry pit.

The site layout is illustrated in Figure 1.1.



FIGURE 1.1: SITE LAYOUT

1.2 Scope

The following tasks have been undertaken as part of this scope of works:

- Confirmation of existing drainage infrastructure and catchment area.
- Hydrologic modelling of the subject catchment area to estimate catchment flows.
- Concept design of the recommended drainage and erosion control infrastructure for both the work and rehabilitation stages.
- Preparation of a Surface Water Management Plan report with recommendations of works and concept plans

1.3 This Report

This version of the report was updated in June 2025 following a request by ESA2, on behalf of Heidelberg Materials. The updates to this report, from the previous version (7), which was issued on 18th October 2021, are as follows:

- Changes reflecting company legal entity and name changes:
 - Hanson Construction Materials (Hanson) to Heidelberg Materials Australia Pty Ltd (Heidelberg Materials).
 - Engeny Water Management (Engeny) to Engeny Australia (Engeny).
- Report template to reflect Engeny's latest report template.
- Updated Section 2.4 to identify that the existing site conditions that were observed in February 2021 are understood to be still applicable in June 2025.
- Updated the functional design drawings presented in Appendix B. The changes are understood to support the outcomes of additional site investigations and stakeholder engagement that was undertaken following the production of the previous version of this report.
- Added Appendix F which documents the reasons for the changes to the drainage design and the changes that were made to the drawings presented in Appendix B, summarised as follows:
 - Relocation of the northern drainage line further south to:
 - Reduce encroachment into the tree protection zones (TPZ) of trees on neighbouring properties to the north of the Site.
 - Provide space for the northern vehicle access track on the north side of the drainage line.
 - Relocation of the eastern drainage line further west to:
 - Reduce encroachment into the tree protection zones of trees on neighbouring properties to the east of the Site.
 - Provide space for the eastern pedestrian access track.
- Updated descriptions in Section 4.3 and Figure 4.2 to make relevant to the updated design.
- Added this section to the report.
- The updates to this report, including changes to the drainage design, do not impact the original water management strategy (as the flow paths are generally the same). No changes have been made to the original conclusions or recommendations.

1.4 Approach

The hydrological modelling has been undertaken using methods outlined in the Australian Rainfall and Runoff (ARR) 2016. All intensity-frequency duration (IFD) design rainfall intensities, temporal patterns, and associated approaches to hydrological losses have been obtained from this publication.

Hydrological modelling has been undertaken using RORB, hydraulic modelling has been undertaken using 12d (Drainage module) and spreadsheet-based calculation methods.

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1.5 Existing Conditions

The subject site, 60 Valley Road, is mostly undeveloped with some minor structures scattered throughout.

The site generally slopes from north to south, with a depression formed at approximately the centre of the site.

All stormwater flow that enters the site, as well as internal runoff is directed to a small dam, approximately at the centre of the lot at the boundary with the existing quarry. The dam outlet consists of a small diameter drain and weir overflow. Outlet flow is discharged into the existing quarry excavation below the waterline, to mitigate the risk of erosion (refer Figure 1.2). The current configuration was put in place after an erosion event that occurred during a large rainfall event in August 2019.



FIGURE 1.2: CURRENT CONFIGURATION OF THE DAM, AFTER REINSTATEMENT RESULTING FROM AN EROSION EVENT IN AUGUST 2019

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2. SITE REQUIREMENTS

2.1 Design Standards

Melbourne Water have been involved through the development of this SWMP, hence the proposed design has adopted Melbourne Water's guidelines and their requirements including Melbourne Water's Flood Mapping Guidelines (Melbourne Water, 2020) and Australian Rainfall and Runoff 2019 (ARR19).

Engeny have adopted a 1 % Annual Exceedance Probability (AEP) level of service for the diversion drainage around the proposed quarry pit for the works stage.

Engeny have adopted the Constructed Waterway Design Manual for designing the proposed constructed waterway that will connect the upstream external catchment to Boggy Creek following rehabilitation of the site.

The proposed design has also been reviewed by an external suitably qualified geotechnical engineer (CMW).

2.2 Connection to Boggy Creek

Prior to quarrying works being undertaken at the existing site, the proposed property (approximately 10 ha) and approximately 100 ha upstream catchment area, flowed into Boggy Creek. Prior to the existing works, Boggy Creek was not free flowing and consisted of a series of connected pools. At the commencement of quarrying a formal waterway was constructed in its current location.

As a part of the existing quarrying works, Boggy Creek was realigned and the catchment draining through 60 Valley Road, was cut off from the creek. All stormwater runoff from the proposed site is currently directed into the existing excavation zone and used for quarry operations. The extraction and use of this water is licenced by Southern Rural Water.

During previous stakeholder meetings, Melbourne Water expressed a desire to connect the catchment upstream of the site into Boggy Creek, to restore the previous natural flow patterns of the catchment. It is proposed that the upstream catchment will be reconnected to Boggy Creek during rehabilitation, which is estimated to take place 5 to 6 years after commencement of the excavation of 60 Valley Road.

Connection of the upstream catchment into Boggy Creek prior to rehabilitation of the site would require a land bridge across the existing excavation, with significant earthworks and impact to existing and proposed quarrying operations. Therefore it is proposed to only connect the upstream catchment to Boggy Creek at the time of rehabilitation.

Heidelberg Materials is in possession of an extraction licence from Boggy Creek from Southern Rural Water approved on 29 August 2009. The licence is for 400 megalitres. A copy of this licence is included in Appendix C.

Heidelberg Materials do not extract any water from Boggy Creek.

As reported in Section 5, the estimated average annual runoff from the proposed quarry site and the upstream catchment is 243 ML/yr.

2.3 Data Collection

Data for the study area has been obtained from the following sources:

- VicMap data
- Department of Environment, Land, Water and Planning (DELWP)
- BoM – Rainfall data
- Site visits

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2.4 Site Visit and Meetings

Engeny undertook a site visit on 6/09/2018 to meet with Heidelberg Materials and Heidelberg Materials' facilitating consultant, Ricardo, to inspect the study area to:

- Gain an understanding of the catchment and the different land uses
- Gain an appreciation of the proposed works, including remediation of the existing quarry site
- Verify data for key sections of the drainage system particularly upstream inflow locations

Below are photographs of key stormwater outlets taken during the site visit.

Additionally, a consultation meeting between Melbourne Water, Ricardo, Heidelberg Materials and Engeny was undertaken on 12th February 2021 as required as part of the process to vary the works authority. Refer to Appendix E for meeting minutes. Engeny has been informed by Heidelberg Material's planning consultant, ESA2, that for the purpose of the SWMP, the existing site conditions that were observed in 2021 remain applicable.



FIGURE 2.1: EXISTING EXCAVATION (FOREGROUND) AND 60 VALLEY ROAD PROPERTY (BACKGROUND)

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FIGURE 2.2: DAM WALL WITHIN THE 60 VALLEY ROAD PROPERTY (PRIOR TO REINSTATEMENT WORKS FOLLOWING AN EROSION EVENT THAT DRAINED THE POND IN AUGUST 2019)

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3. HYDROLOGY

3.1 Purpose

A RORB hydrologic model has been developed to determine the peak flow rates generated by the subject site and its contributing catchments. The peak flow rates were recorded at locations relevant for the sizing of the proposed stormwater assets. These flow rates serve as an estimate of the external catchment inflows against which the design development is based. These flows inform the preliminary sizing of the stormwater channel drainage assets for the 10 % and 1 % AEP flood event.

3.2 Model Development

3.2.1 Catchment Delineation

RORB modelling of existing conditions flow was completed by delineating the catchment and sub-catchment boundaries for the site. The delineation was undertaken using LiDAR, aerial imagery, local council drainage information and property boundaries. The study site sits in between Melbourne Water's Little Boggy Creek (Quarry/Pines Res) catchment and the Upper Eastern Contour Drain Catchment.

The subject site has five potential flow paths for stormwater ingress around its boundaries. These inflow points are marked J, O, P, Q and R in Figure 3.1. Flows draining to the site from all subcatchments will be captured by a proposed open drain on the northern and eastern boundary and discharged directly to the existing excavation during the operational phase. This is consistent with the current operating conditions.

During the rehabilitation works all flows will be reconnected to Boggy Creek via an open channel.

Flow output values were recorded at each of the five ingress points. Each ingress location of interest has at least 4 subareas upstream to enable sufficient routing through the subcatchment.

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Legend

- ★ Recorded Flow Locations
- RORB node
- RORB reach
- ▭ RORB subarea
- ▭ RORB Catchment Boundary
- ▭ Development_Site
- ▭ Parcel Boundaries

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99 0 99 m
Scale in metres (1:5,000 @ A3)
Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Valley Road Quarry Langwarrin

RORB Model

Job Number: V1259_001
Revision: 0
Drawn: TN
Checked: DB
Date: 13/12/2018

FIGURE 3.1: RORB MODEL SHOWING RECORDED FLOW LOCATIONS

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RORB is a hydrological model that subtracts losses from rainfall to produce runoff which is routed through the model. The losses applied depend on inputs such as the weighted fraction impervious of each of the subareas. Impervious fraction values (FI) adopted in the model was applied to parcels to reflect its land use type. These FI values were guided by Melbourne Water’s Technical Specifications, Melbourne Water’s MUSIC guidelines, and the Victorian planning scheme zones. The catchment mainly comprises rural conservation zones (FI = 0.1) and pockets of residential zones on its north-western boundary. FI values for the residential areas were broken down further to reflect their corresponding allotment size. Typical lot sizes found in the area ranged between 350 m² to 800 m². Visual inspection of aerial imagery verified the FIs that were adopted for the allotments. Residential parklands were identified during this inspection and their FIs were adjusted accordingly. Table 3.1 summarises the FI values that were adopted in the final model for the different zones.

TABLE 3.1: TABLE OF FI VALUES ADOPTED FOR LAND USE TYPES FOUND IN THE CATCHMENT

Land use type	Zone Code	Adopted Fraction Impervious
Residential Zone 1	R1Z	
	< 350 m ²	0.8
	350 – 600 m ²	0.75
	600 m ² - 800 m ²	0.7
Rural Conservation Zone 2	RCZ2	0.1
Road Zone	RDZ	0.6
Public Park and Recreation Zone	PPRZ	0.35 (based on visual inspection)

3.2.3 Model Parameters

The hydrological model was initially run with RORB version 6.40. Since submission of this report in 2019, an updated version was released (6.45) which has been used to determine the results, including peak flows. The model change has resulted in a slight increase in peak flows compared to the previous run which is understood to be due to an update in the model processing methodology for pre-burst rainfall.

The RORB models developed by Engeny were created in accordance with ARR 2019 and use an initial loss/continuing loss model. Since there is no information available on pre-burst rainfall for storm durations less than 60 min, the pre-burst rainfall for storm durations less than 60 min was taken as the value for a storm of 60 min duration.

Duration loss factors were determined by subtracting the median pre-burst depth for each duration from the rural initial loss to determine the duration loss factor for that particular duration.

There are no gauging stations against which the flow levels determined by the model can be compared to against measured data. A range of KC values were trialled to determine the peak flow values that are comparable to the regional flood frequency estimated value (RFFE) also shown in the tables. A KC value based on the AR&R 2016 guidelines was adopted based on the region receiving roughly 800 mm/yr of rainfall. The following formula was adopted:

$$K_c = 0.49A^{0.65}$$

With a total catchment area of 1.04 km², the KC value adopted was 0.50.

Table 3.2 and lists the model parameters that were adopted for the Langwarrin Quarry RORB model and Table 3.3 lists the duration factors:

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TABLE 3.2: RORB MODEL INPUT PARAMETERS

Model Input	Value
m	0.8
K _c	0.5
Rural Initial Loss (Provided by ARR Data Hub)	30 mm
Rural Continuing Loss (Provided by ARR Data Hub)	5.1 mm/h
Impervious Losses	
• Directly Connected IL	1.5 mm
• Directly Connected CL	0 mm
• Indirectly Connected IL	21 mm
• Indirectly Connected CL	2.5 mm
Filtered temporal patterns (removes embedded bursts)	Yes

TABLE 3.3: AERIAL REDUCTION FACTORS USED IN RORB MODELLING

Duration	10 % AEP	1 % AEP
10 min	0.93	0.96
15 min	0.93	0.96
30 min	0.93	0.96
60 min	0.93	0.96
120 min	0.91	0.96
180 min	0.90	0.90
360 min	0.92	0.85
720 min	0.93	0.77
1440 min	1.00	0.97
2880 min	1.00	1.00
4320 min	1.00	1.00

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3.3 Results

Table 3.4 and Table 3.5 summarises the RORB peak flow results at each of the recorded locations for the 10 % and the 1 % AEP respectively.

Peak flow results are within confidence limits specified in the RFFE estimate. The peak flow values produced by the RORB model are comparable with those values measured from the RFFE tool. An additional check was undertaken using the Melbourne Water Rule of Thumb estimate (Melbourne Water Flood Mapping specifications July 2020) which was found to provide additional validation for the 1 % AEP RORB results (refer to Table 3.5). The peak flow values from RORB were adopted for the concept design of the stormwater assets.

TABLE 3.4: 10 % AEP PEAK FLOW RESULTS

10 % AEP RORB Flow Results						
Ingress Location	Point O	Point J	Point P	Point Q	Point R	Outfall
RFFE estimate (m ³ /s)	2.31	0.58	0.24	0.46	0.21	2.48
ARR2019 estimate adopting $K_c = 0.49A^{0.65}$ for regions with annual rainfall < 800 mm (m ³ /s)	2.63	0.46	0.13	0.38	0.11	3.64
Difference (+ / -)	+ 0.32	-0.12	-0.11	-0.08	-0.10	+ 1.16

TABLE 3.5: 1 % AEP PEAK FLOW RESULTS

1 % AEP RORB Results						
Ingress Location	Point O	Point J	Point P	Point Q	Point R	Outfall
RFFE estimate (m ³ /s)	4.8	1.21	0.51	0.95	0.44	5.16
Rule of thumb estimate (m ³ /s)	4.7	0.7	0.15	0.4	0.1	6.5
ARR2019 estimate adopting $K_c = 0.49A^{0.65}$ for regions with annual rainfall < 800 mm (m ³ /s)	6.06	1.30	0.41	0.86	0.30	8.20
Difference (+ / -) ARR 2019 versus RFFE	+ 1.26	+ 0.09	-0.10	-0.09	-0.14	+ 3.04

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4. DESIGN

4.1 Surface Water Management System

The site includes a number of significant upstream catchments that currently drain through the property at 60 Valley Road before discharging directly into the existing quarry excavation. See Figure 3.1 for illustration of major flow paths.

The proposed quarry operation will include excavation of material from the southern portion of the property. The main access from Valley Road, and a 20 m wide buffer to all adjoining properties will remain unexcavated.

As per Section 2.1, the 1 % AEP flows from the upstream catchments are proposed to be diverted around the proposed active excavation and discharged into the existing excavation to the south of the site.

The proposed surface water management system does not provide stormwater quality treatment (beyond any incidental pollutant removal within the open channels) or attenuation to the upstream catchment runoff.

Direct rainfall within the site, as well as external catchment flow entering the excavation will be managed onsite by the quarry operations.

A schematic of the flow management provided by the proposed surface water management system is included Figure 4.1.



FIGURE 4.1: PROPOSED SURFACE WATER MANAGEMENT SYSTEM FLOW PATHS

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4.2 Modelling and Calculations

Hydraulic modelling was undertaken using a combination of 12d for the terrain modification, HY-8 for the culvert and Manning’s method for the open channel portion of the drain. The proposed design is included in Appendix B.

An assessment of a retarding basin, located at the inflow of Catchment O (as shown on Figure 3.1), was undertaken to investigate whether the diversion channel size could be reduced. It was found that the maximum reasonable volume able to be accommodated within the topography would reduce flow rates by a negligible amount, and not have a meaningful impact on the proposed channel size. The inclusion of a basin would also introduce additional design and construction complexity with additional risks during the operation phase. A retarding basin has therefore been excluded from the design.

4.3 Proposed Layout

4.3.1 June 2025 Drawing Updates

The design drawings of the proposed stormwater management strategy, including the design updates documented in Section 1.3, are presented in Appendix B. The general arrangement for drainage works is included in Figure 4.2 below.

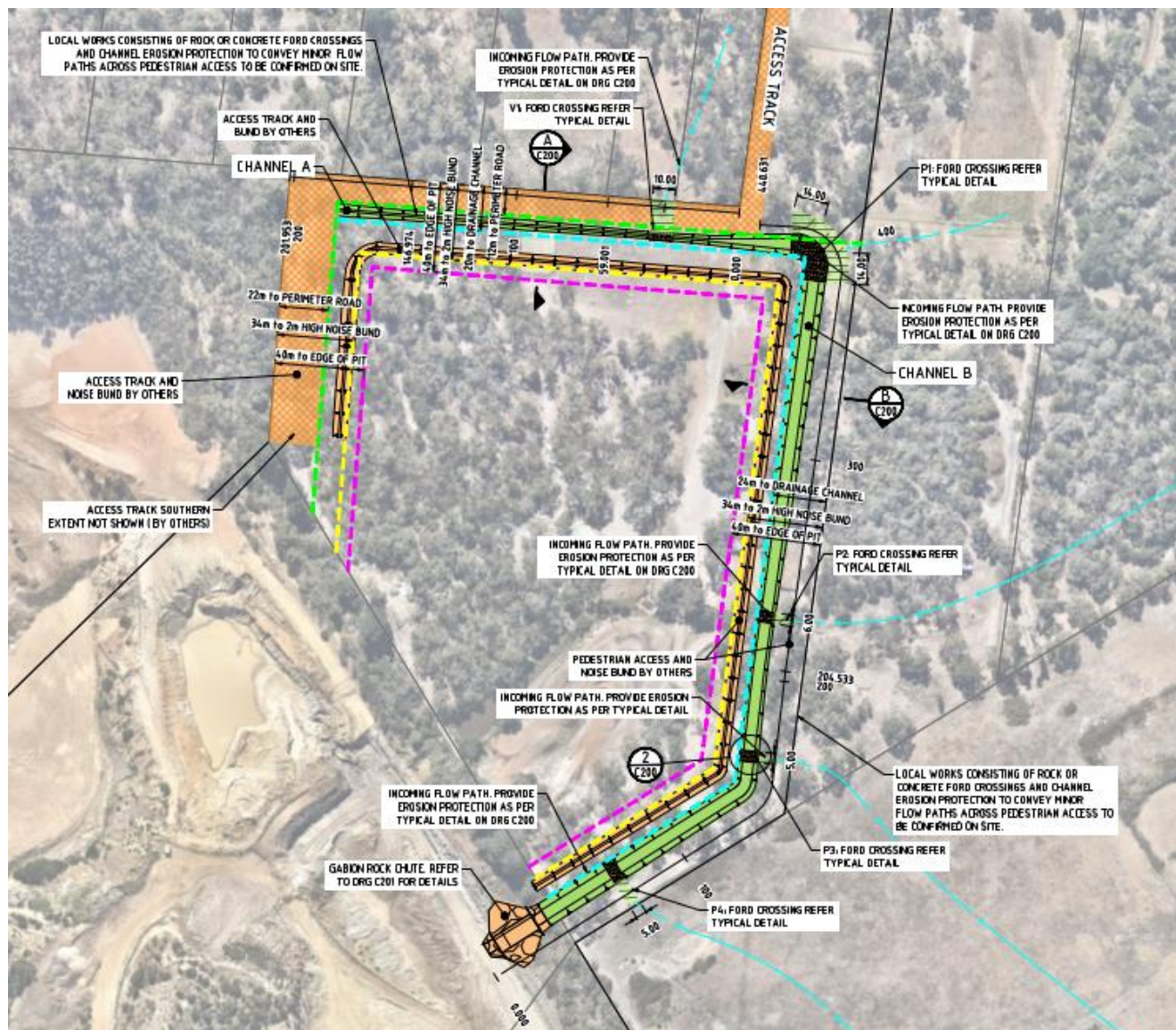


FIGURE 4.2: PROPOSED SURFACE WATER MANAGEMENT SYSTEM LAYOUT

4.5 Open Channels

The proposed open channels (swales) are to be constructed with a minimum 1V:1.5H batter slopes for stability and generally cut into the existing surface. At all locations the swale is proposed to be between the property boundary and the proposed noise bund, within the proposed buffer zone.

The in-situ soil at the site is sandy in nature and highly permeable and due to the potential of liquefaction from water infiltrating into the ground from the proposed channels, they are to be lined with an impermeable (HDPE) liner underlain by a clay liner. The details of the clay liner including depth is subject to a geotechnical assessment. The HDPE liner will be in accordance with Geosynthetic Institute RAI-GM13 Standard Specification for Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes. Details are provided within the design drawings in Appendix B.

Flow velocities within the channel are not expected to be in excess of scour rates of 1.5 m/s and therefore the HDPE liner is considered to be suitable to manage these erosive flows. At lateral stormwater inflow locations a geosynthetic cementitious composite mat such as Concrete Canvas or equivalent is proposed to provide some additional protection to the HDPE liner, primarily from debris carried by external flows discharging onto the surface. Concrete cut-off walls are also proposed at these locations to reduce the risk of head-cut erosion forming at the interface between the lined channel and unlined external catchment flow path.

Groundwater monitoring is required to ensure that the proposed cut face is not compromised by water leakage from perforations in the HDPE liner during storm events. Refer to the Ground Control Management Plan for the proposed groundwater monitoring methodology.

Functional level design of the longitudinal section and typical cross sections for the proposed channels is included in Appendix B.

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5. VOLUMETRIC ANALYSIS

A high-level volumetric analysis of stormwater has been carried out using the software program MUSIC. The purpose of the investigation was to determine the approximate annual runoff volume that will be discharged into the quarry pit prior to its rehabilitation and connection with Boggy Creek.

MUSIC is a continuous simulation model that analyses historical rainfall data with soil infiltration properties and produces runoff volumes based on the corresponding climate conditions.

The stormwater pollutant aspect of MUSIC was not analysed for this project.

As per Melbourne Water Guidelines, the rainfall data for Koo Wee Rup from 1981 to 1990 was used as the historical data set. This data set is the industry accepted set for the Langwarrin area, as it is considered representative of the climate zone.

The catchments modelling in MUSIC are shown below in Figure 5.1 and correspond to those used in the RORB modelling.

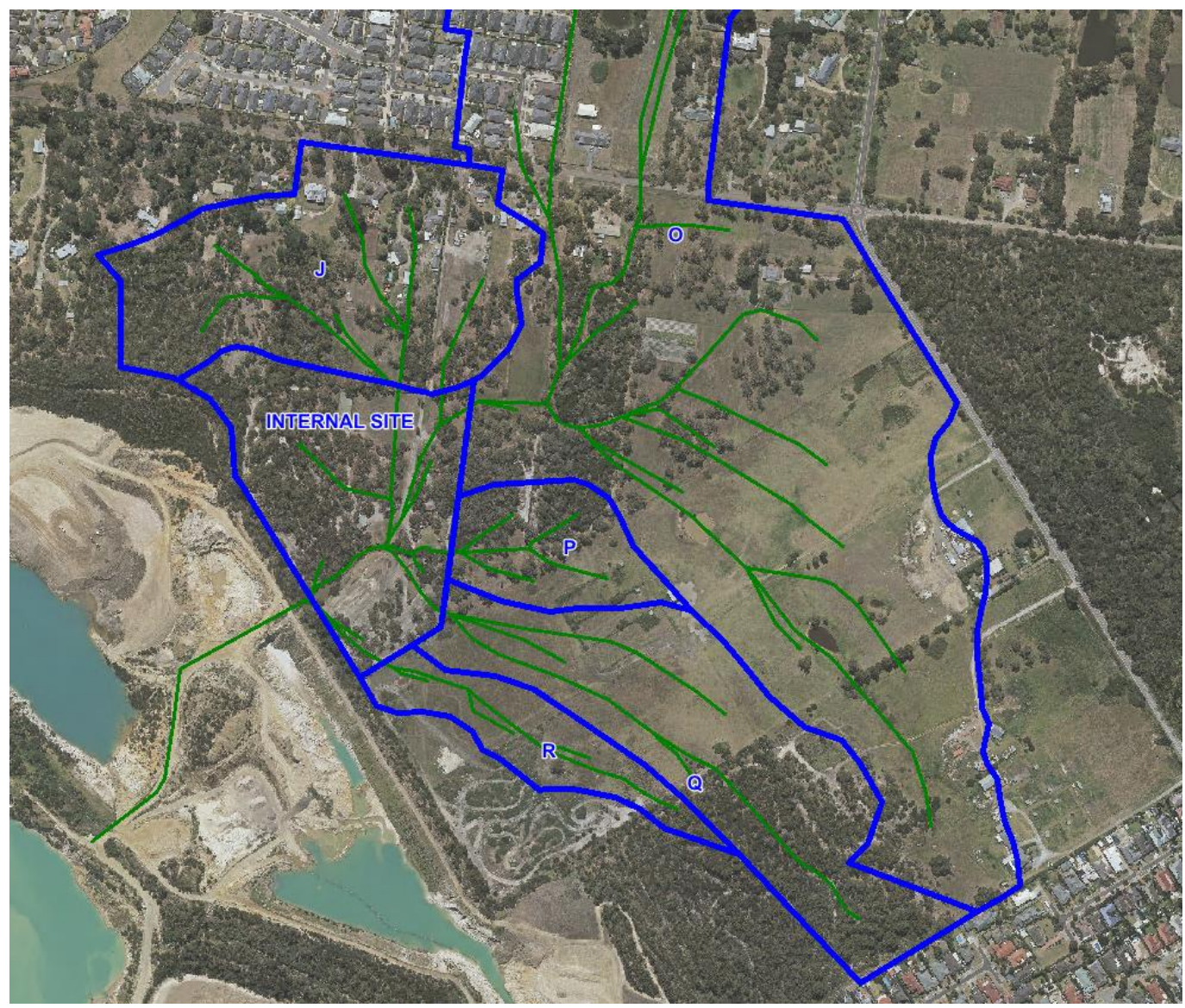


FIGURE 5.1: MUSIC MODELLING CATCHMENT LAYOUT

Internal site water balance, including groundwater are contained in the Hydrogeological Assessment prepared by Ricardo, 2021. The direct rainfall into the proposed excavation site has been provided to inform the Hydrogeological Assessment.

Table 5.1 summarises the average runoff volumes at the upstream catchments surrounding the site.

TABLE 5.1: UPSTREAM CATCHMENT ANNUAL STORMWATER RUNOFF

Catchment	Catchment Area (ha)	Annual Runoff (ML/Yr)	Direction of Flow	Notes
J & O	81.7	180	From north of the site	Volume of surface water runoff from the catchment
P, Q & R	15.2	25	From the east of the site	Volume of surface water runoff from the catchment
Internal Site	5.0	38	Proposed excavation	The value of 38 ML/Yr is the total volume of direct rainfall. This does not account for evaporation or infiltration and is intended for use in the groundwater management assessment, which does not form part of this report

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6. CLIMATE CHANGE

Climate change scenarios have not been included as a part of this project.

The expected life span of the interim quarrying stage of this project is less than 6 years, and therefore subject to limited climate change effects.

As per ARR 2019, the design rainfall intensities used in the hydrology of this design are expected to increase within the life span of the quarry. However, the increase is not expected to be significant. Any increase will be able to be accommodated within the freeboard of the design.

No analysis has been undertaken for the climate change effect on the water balance of the site, included in Section 5. It is expected that average annual rainfall will decrease in South Eastern Australia as a result of climate change and therefore the total average volume of runoff is also expected to decrease.

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7. REHABILITATION PHASE

7.1 Overview

At the conclusion of quarrying works within 60 Valley Road, rehabilitation works will be undertaken for the proposed and existing excavation. As a part of these works, the excavation will be filled with offsite material and the surface level reinstated to approximately the pre-works level.

7.1.1 Decommissioning of Rock Gabion Structure

During the rehabilitation phase, it is proposed that the rock gabion chute is retained and backfilled around and on top of. This is the most simple and practical option. CMW Geosciences have assessed the proposed design and determined that the risk of leaving the structure in place is low.

As a part of the rehabilitation works, a constructed waterway will be formalised between the northern extent of the quarry works and Boggy Creek. This ephemeral waterway is to provide a connection between the upstream catchments and Boggy Creek that has been disconnected by the quarry operations.

Melbourne Water have confirmed that Earth Resources Regulation (ERR) will lead and oversee the rehabilitation plan, whilst Melbourne Water will be a referral authority to provide comment and conditions where appropriate.

7.2 Melbourne Water Requirements

Melbourne Water have provided the following advice that is to be adopted as part of the rehabilitation phase:

- The Boggy Creek waterway corridor is to be defined by width of Boggy Creek and a minimum 30 metres setback from the top of bank on both sides of Boggy Creek.
- The constructed waterway corridor is to be defined by the width of the constructed waterway and a minimum 10 metres setback from the top of bank on both sides of the constructed waterway.
- Proposed fill material for the rehabilitation of the site is to be clean fill that meets the EPA guidelines and specifications set out in the Outline Backfill Specification (CMW Geosciences, 2021).
- Melbourne Water's constructed waterway guidelines is to be utilised to inform the functional design of the constructed tributary waterway.
- A project specific assessment is to be undertaken by a suitably qualified geotechnical consultant to inform the fill compaction requirements for the constructed tributary waterway.

Refer to *Rehabilitation Plan* (Ricardo, 2021) for further requirements and details.

7.3 Waterway Functional Design

7.3.1 Functional Description

The existing open channels, bunds and other drainage infrastructure including culverts that are proposed during the interim stage (during the proposed extension of quarry works) will be removed as part of the rehabilitation. However as noted in Section 4.4, the rock gabion structure will be retained and backfilled.

The proposed design of the constructed waterway has been based on Melbourne Water's Constructed Waterway Design Manual (2019). The location of the upstream end of the waterway has been located in the thalweg of the existing waterway to intersect flow from the upstream catchment. Inflows from major flow paths at intermediate locations on the constructed waterway have been considered by placing rock protection to protect against scouring flows. The following summarises the constructed waterway design basis:

- A compound channel is required, including a pilot channel and main channel. The pilot channel is sized to convey the 1 EY peak flow (rainfall event with a 12 month recurrence interval) and the main channel is sized to convey the gap flow between the 1 EY and 1 % AEP peak flow.

- A minimum freeboard of 300 mm has been adopted within the main channel to the top of bank. A minimum freeboard of 600 mm is required between the 1 % AEP peak level within the constructed waterway and the proposed building floor levels within the future employment area.
- The channel will be vegetated with ephemeral and low-shrubby vegetation.
- A side slope of 1V:6H has been adopted for the main channel.
- The longitudinal slope of the main channel varies between 1:215 and 1:190. Therefore, a chain of pools and riffles is not required. However, a series of rock chutes which make up approximately 25 % of the total area is required. These rock chutes will be based on Melbourne Water's standard drawings.

7.3.2 Hydrological Modelling

The existing conditions RORB model that was prepared to inform the Surface Water Management Plan during the interim stage has been utilised to determine the design flows for the rehabilitation stage. The following updates were required:

- Adjustment of reach type along the constructed waterway from Type 1 (natural) to Type 2 (unlined channel) to allow for an increase in runoff
- Diverting upstream catchment discharging to the filled quarry pit area into the constructed waterway utilising the open channel constructed for the interim stage.
- Extend the total catchment area to include the proposed employment area, within the existing quarry site. A fraction impervious of 0.9 has been adopted, noting that the site will mostly comprise of impervious area. As the average distance (d_{av}) has been increased due to the increased catchment area to the outlet, k_c (routing parameter) has been adjusted to 0.64, based on a k_c/d_{av} ratio, to ensure that routing is consistent for both the existing and developed scenarios.

At each location (A, B and C) as shown in Figure 7.1, the 1 % AEP peak flow has been sourced from the RORB model to inform the geometry of the constructed waterway. Refer to Table 7.1 for a summary of 1 % AEP peak flows at each location.

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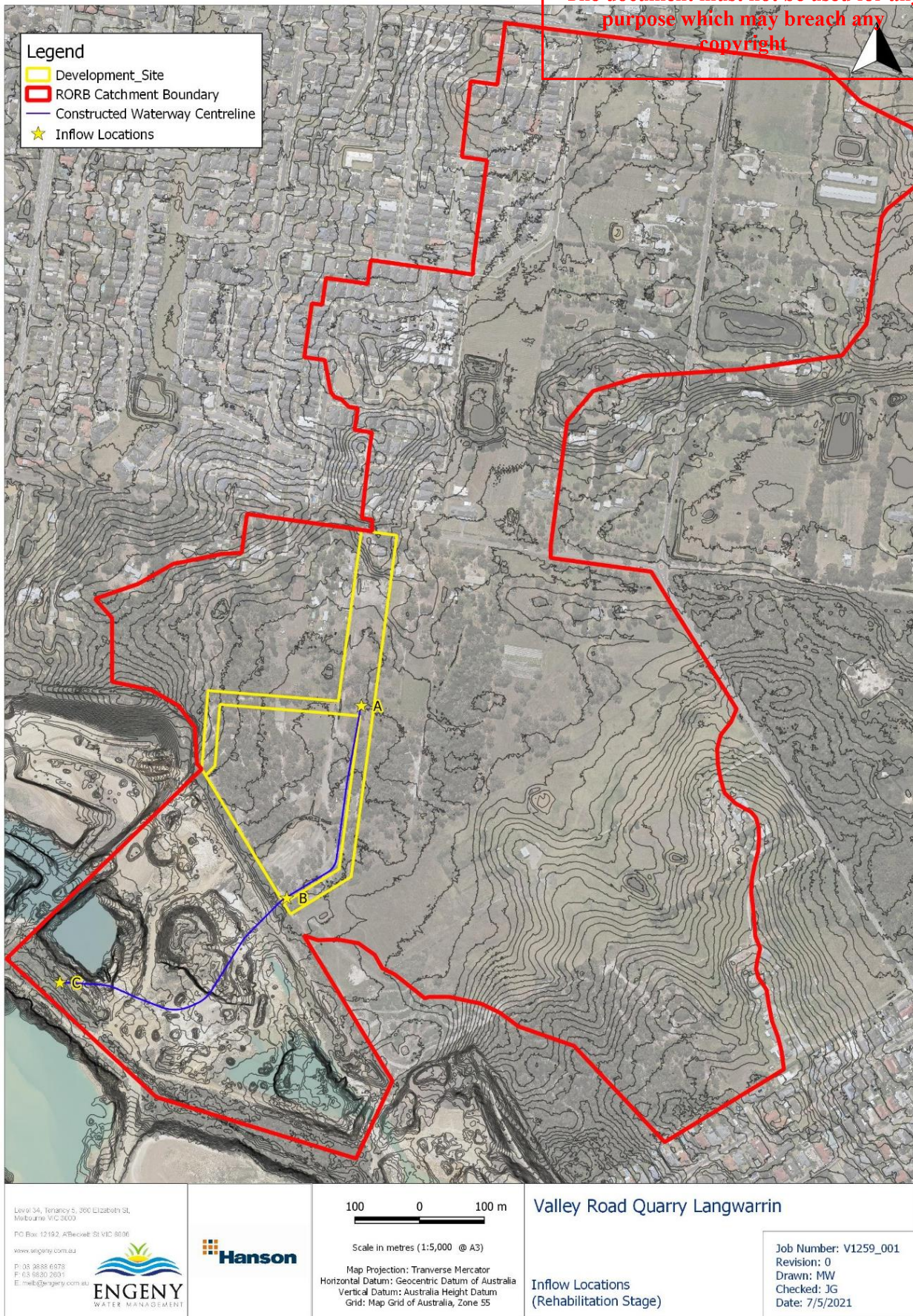


FIGURE 7.1: INFLOW LOCATIONS

TABLE 7.1: SUMMARY OF 1 % AEP PEAK FLOWS AT EACH LOCATION

Location	1 % AEP Peak Flow (m ³ /s)
Point A	6.1
Point B	8.7
Point C	8.8

7.3.3 Hydraulic Modelling

To inform the functional design of the constructed waterway, a HEC-RAS model was developed to determine whether the peak flow velocities through the low flow and main channels were sufficient to allow plant growth and also reduce erosion, along with optimising the total depth of the channel to maintain a minimum freeboard of 300 mm between the 1 % AEP peak flood level and the top of bank.

A manning’s roughness coefficient of 0.05 has been adopted, noting that the constructed waterway will a winding stream alignment including rock chutes that produce bed irregularities, along with low vegetation that will be maintained.

The downstream boundary condition has been based on the 35.3 m AHD 1 % AEP flood level within Boggy Creek.

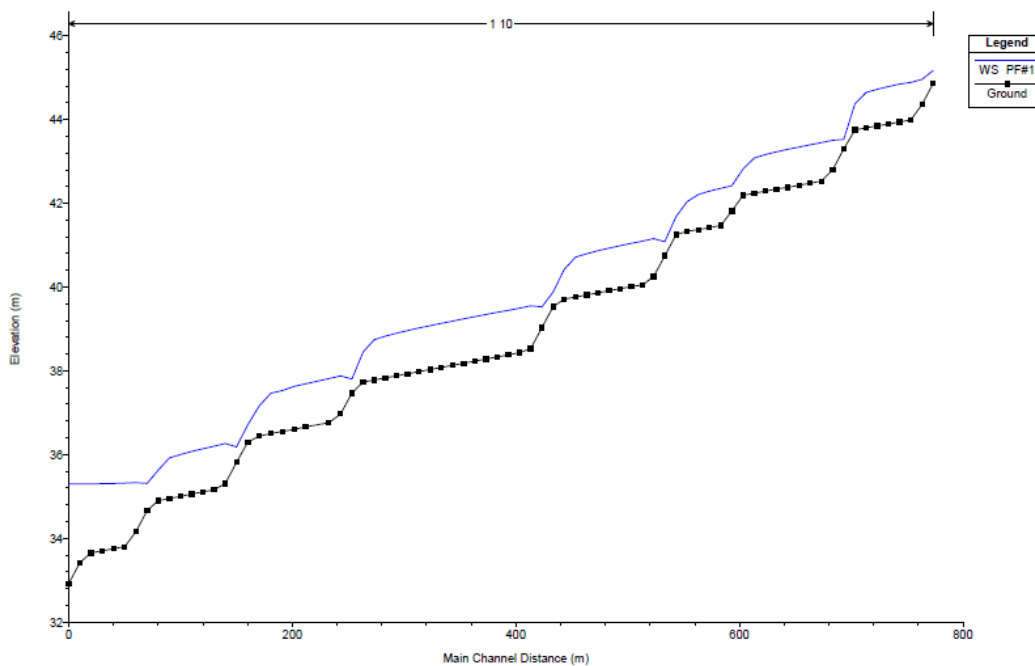


FIGURE 7.2: LONGITUDINAL SECTION OF CONSTRUCTED WATERWAY IN HEC-RAS

7.3.4 Design Drawings

Refer to Appendix D for functional design drawings for the proposed constructed waterway.

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8. CONCLUSIONS AND RECOMMENDATIONS

Engeny have prepared a surface water management plan to address the requirements for the Work Plan Variation of the extension of Heidelberg Materials' Langwarrin Quarry into 60 Valley Road, Langwarrin. The surface water management plan includes a functional design of the interim quarrying phase diversion channels. It also includes a separate functional design for the proposed waterway connection to Boggy Creek to inform the rehabilitation plan for the site.

The following conclusions were drawn with respect to the interim conditions scenario:

- (1) The external catchment flow will be diverted around the perimeter of the site via a proposed open channel.
- (2) Flows are proposed to be discharged into the existing quarry excavation, away from the operation location of extraction works, where it will be used for quarry operations.
- (3) A gabion wall structure is proposed to convey the surface water flow from the diversion drains to the base of the existing excavation.
- (4) Further design iterations, including stakeholder consultation, will be required for this element of the design.
- (5) The location of the proposed extraction works will be protected from direct external flows up to and including the 1 % AEP event.
- (6) Water balance modelling has been undertaken using the software program MUSIC for all external catchments draining through the proposed site. Water balance modelling has also been carried out for the existing quarry site and its operations within the hydrogeological assessment review.
- (7) Appendix B provides the interim conditions stormwater management drawings

The following conclusions were drawn with respect to the rehabilitation plan for the site:

- (1) Engeny has undertaken a functional design for surface water management to address the required rehabilitation works. The plans included in Appendix D are at functional design.
- (2) Detailed design is required prior to construction of the proposed works.
- (3) The proposed works involve decommissioning of the existing drainage assets proposed for the interim stage, along with backfill of the quarry site and construction of a constructed waterway in accordance with Melbourne Water's Constructed Waterway Design Manual (2019).
- (4) The waterway has the capacity to convey the 1 % AEP peak flow to Boggy Creek and contains a meandering low flow channel, along with multiple rock chutes have been proposed to improve aesthetic, maintain plant growth and reduce erosion impacts.

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APPENDIX A: ARR 2016 RAINFALL DEPTHS

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Duration	Design Rainfall Depth (mm)	
	10 % AEP	1 % AEP
10 min	13.5	21.9
15 min	16.5	26.9
30 min	21.9	35.0
1 hour	27.5	42.5
2 hour	34.0	50.9
3 hour	38.6	57.2
6 hour	48.5	72.1

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APPENDIX B: FUNCTIONAL DESIGN DRAWINGS

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HANSON CONSTRUCTION MATERIALS VALLEY ROAD QUARRY FUNCTIONAL DESIGN



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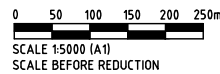


LOCALITY PLAN
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V1259-001-C001	LOCALITY PLAN & DRAWING INDEX
V1259-001-C100	LAYOUT PLAN
V1259-001-C200	TYPICAL SECTIONS - DRAINAGE CHANNELS
V1259-001-C201	TYPICAL SECTIONS - GABION ROCK CHUTE
V1259-001-C300	LONGITUDINAL SECTIONS - CHANNEL A
V1259-001-C301	LONGITUDINAL SECTIONS - CHANNEL B

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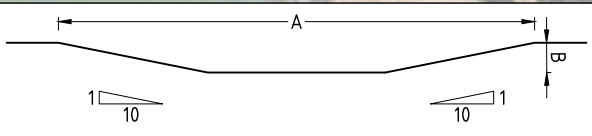
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VALLEY ROAD QUARRY FUNCTIONAL DESIGN LOCALITY PLAN AND DRAWING INDEX		A1	V1259-001-C001	F

LEGEND - PROPOSED WORKS

-  OUTFALL ROCK WORK
-  ACCESS TRACK
-  LINED CHANNEL
-  NOISE BUND
-  CHANNEL EROSION PROTECTION
-  FORD CROSSING
-  FLOW PATH
-  EDGE OF PIT
-  HIGH NOISE BUND (INNER TOE)
-  DRAINAGE CHANNEL (INNER EXTENT)
-  PERIMETER ROAD (INNER EXTENT)



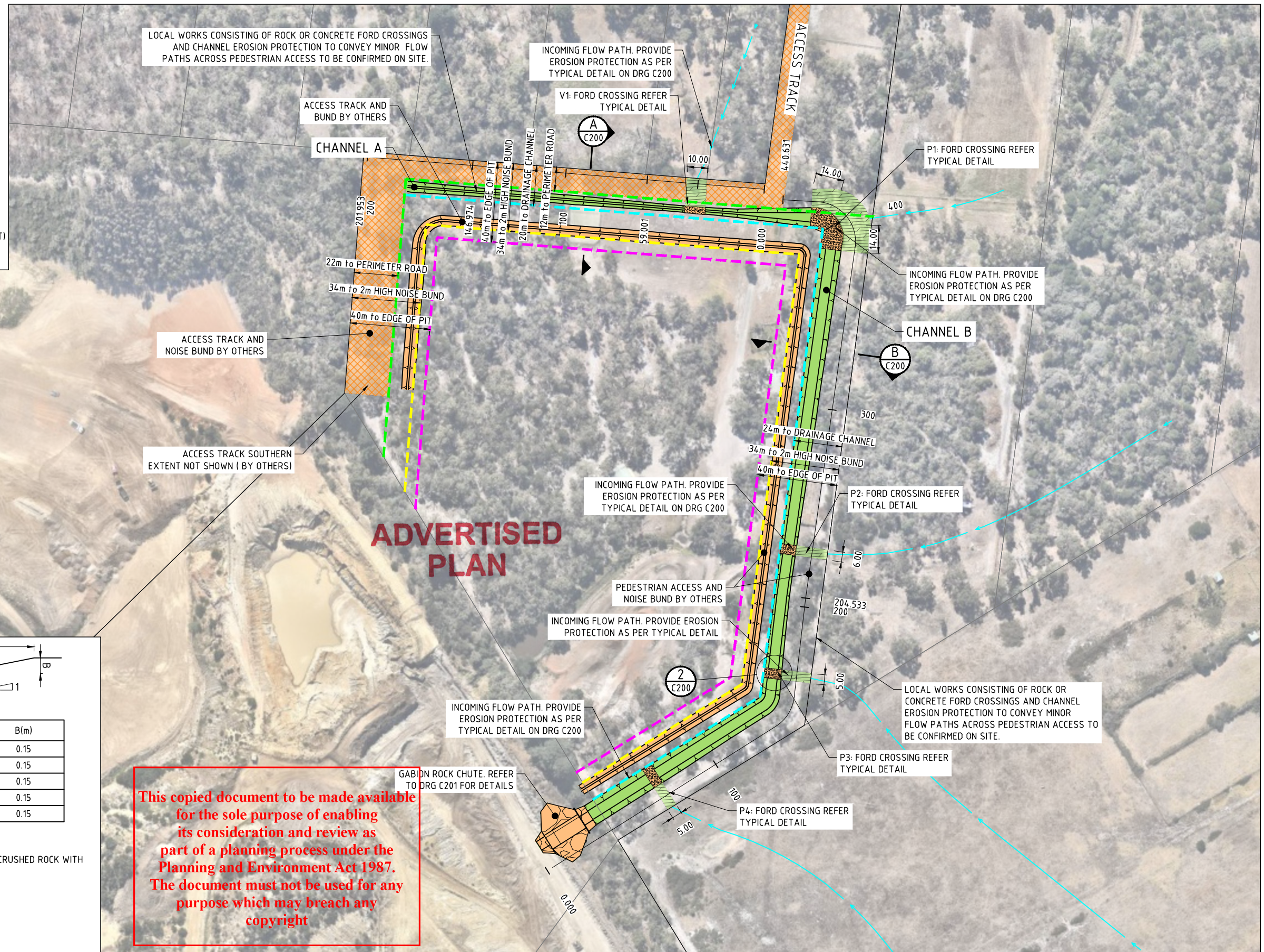
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V1	1.30	10.00	0.15
P1	6.06	28.00	0.15
P2	0.41	5.00	0.15
P3	0.86	6.00	0.15
P4	0.30	5.00	0.15

FORD CROSSING - TYPICAL DETAIL

SURFACE TREATMENT: CONCRETE OR 200mm DEEP D50=100mm CRUSHED ROCK WITH VOIDS FILLED. TBC AT DETAILED DESIGN

NOTE
EROSION PROTECTION LOCATIONS AND EXTENT SUBJECT TO CONFIRMATION AT DETAILED DESIGN

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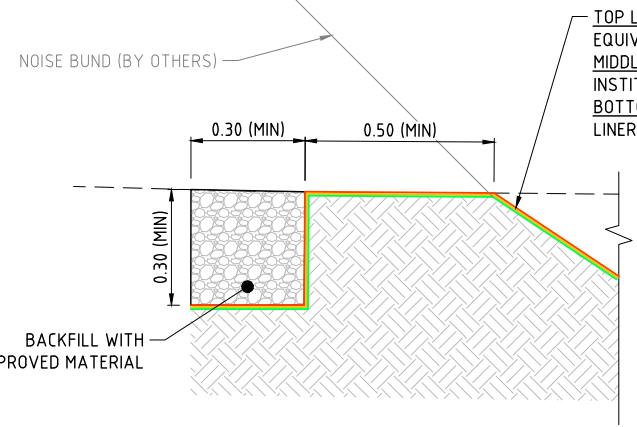
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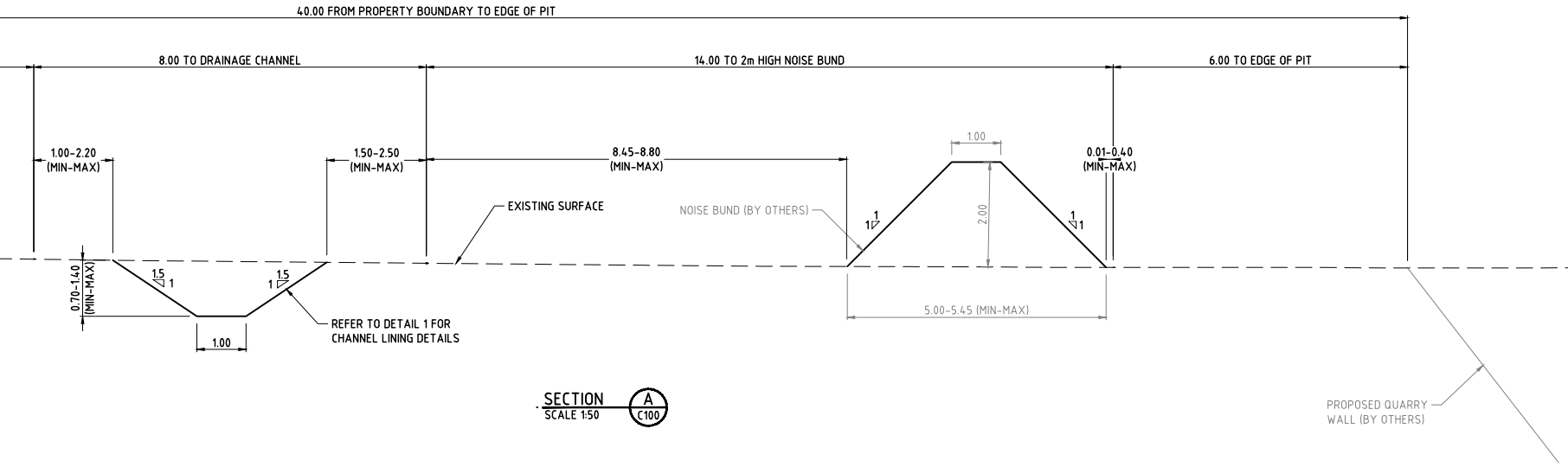
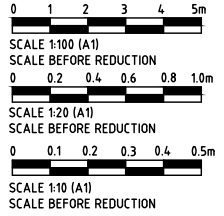
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VALLEY ROAD QUARRY FUNCTIONAL DESIGN KEY PLAN	
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- NOTES**
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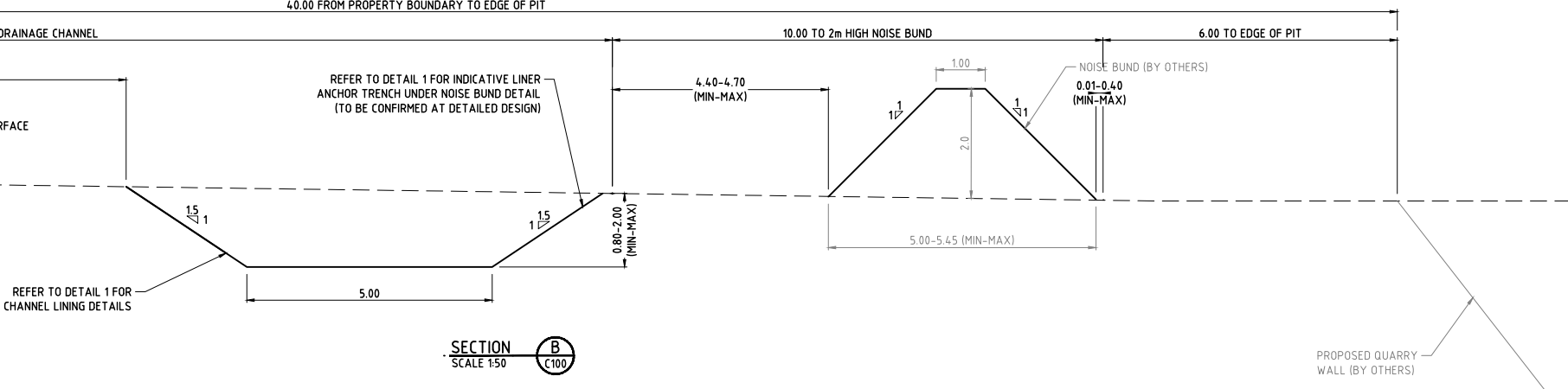
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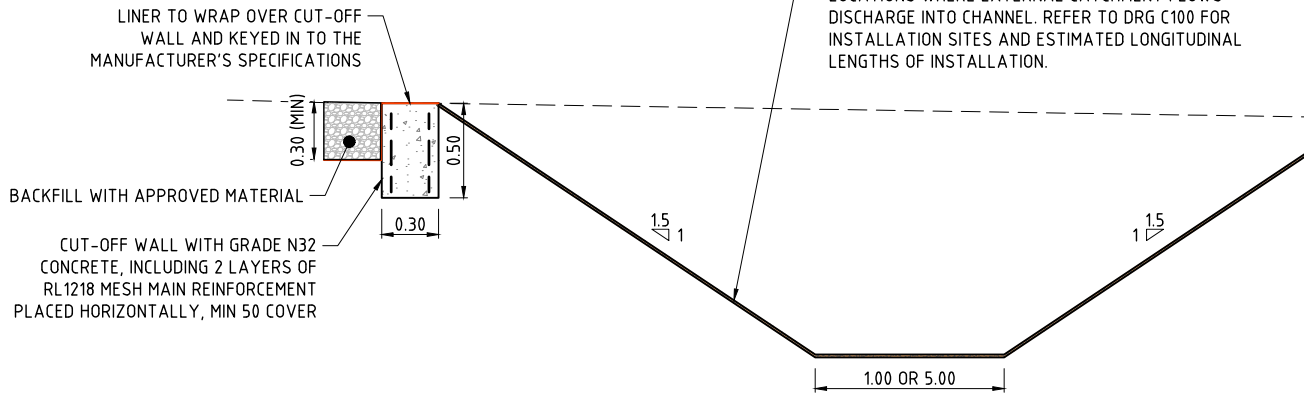
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TYPICAL ANCHOR TRENCH AND LINER DETAIL



SECTION A
SCALE 1:50
C100



SECTION B
SCALE 1:50
C100



DETAIL 2
SCALE 1:20
C100

EROSION PROTECTION AT INCOMING FLOW PATH

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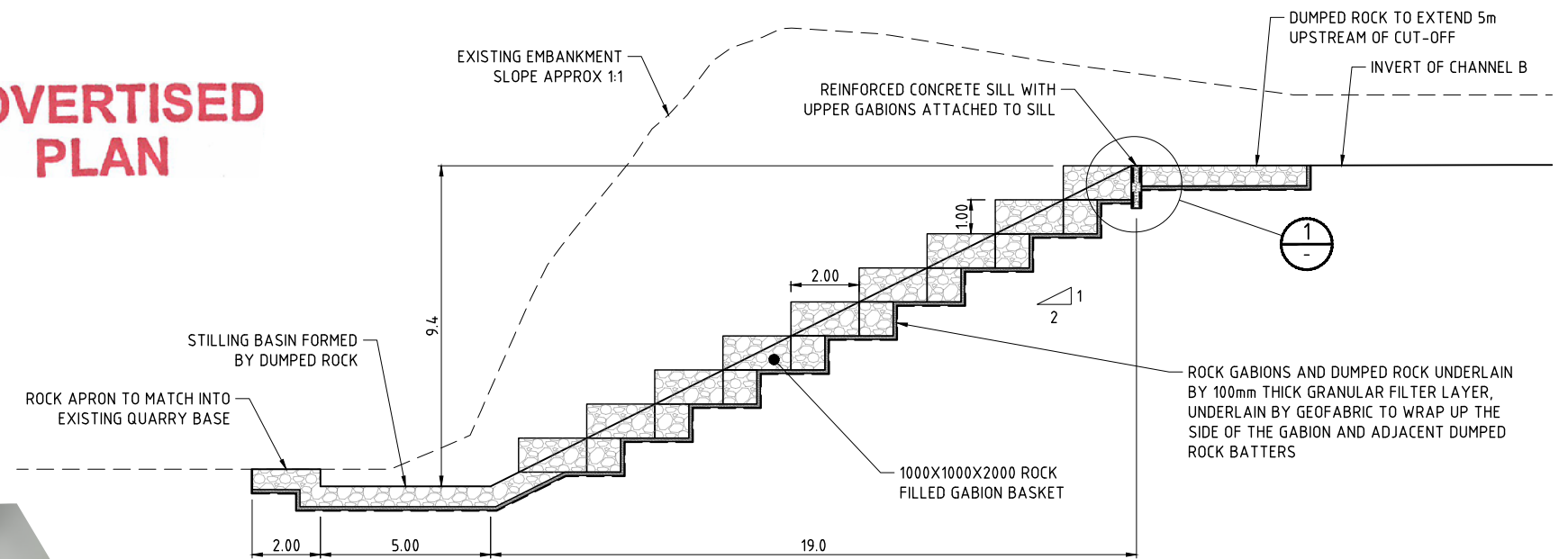
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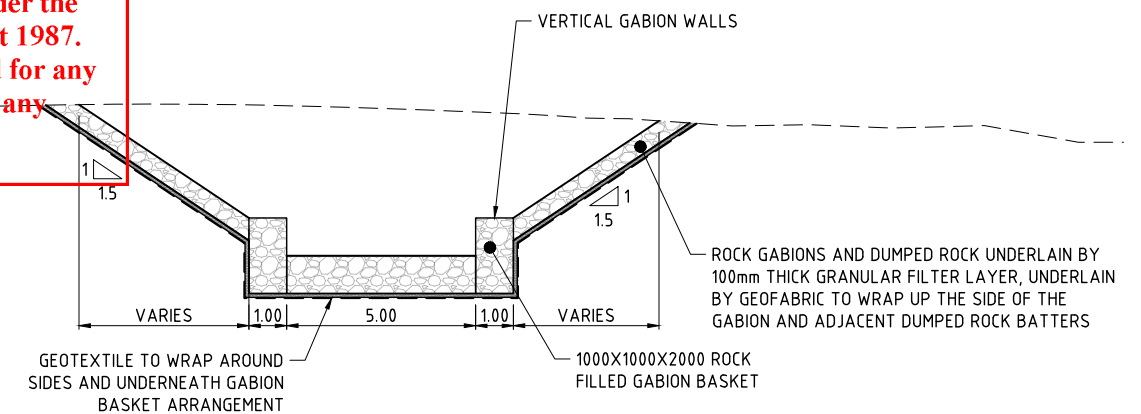
IMAGE - ROCK CHUTE EXAMPLE

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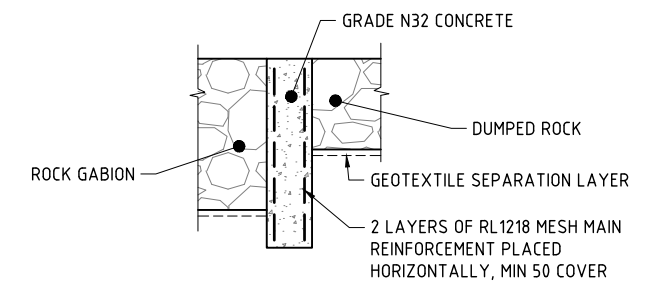


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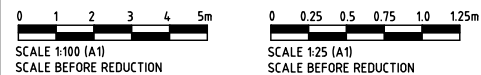
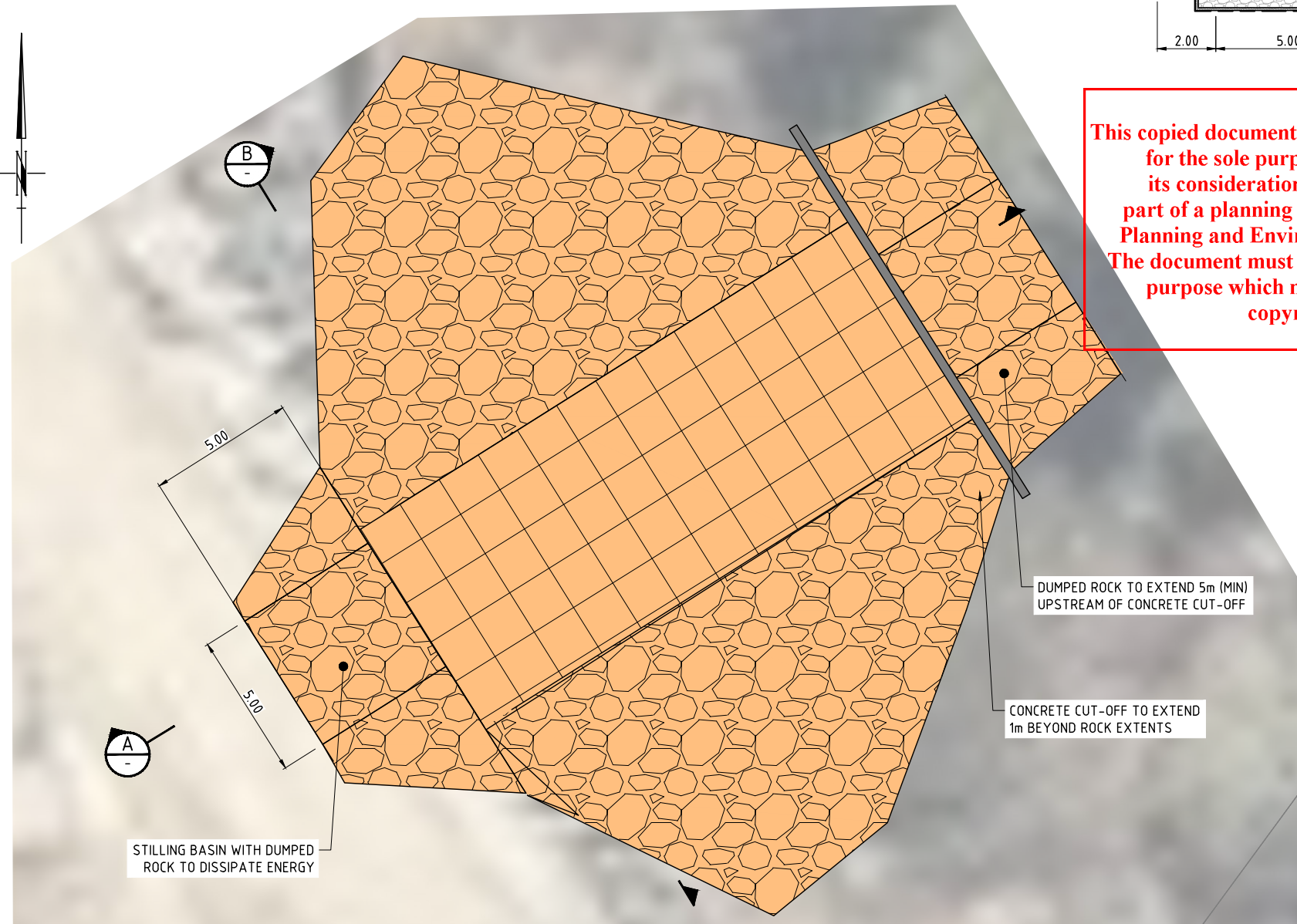


SECTION B
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DETAIL 1
SCALE 1:25

TYPICAL CONCRETE SILL DETAIL (ROCK CHUTE)



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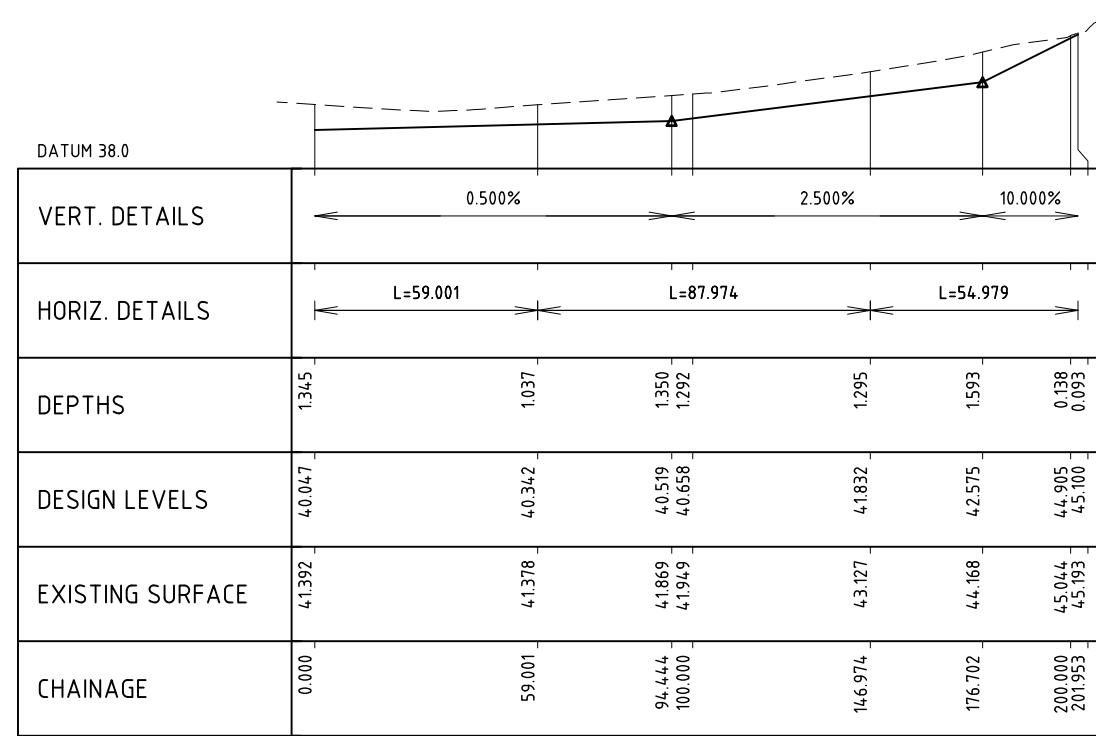
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TYPICAL SECTIONS AND DETAILS

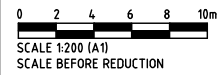
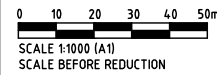
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CONTROL LINE CONTROL MCD06 (CHANNEL A)
SCALE 1:1000 HORIZ
SCALE 1:200 VERT

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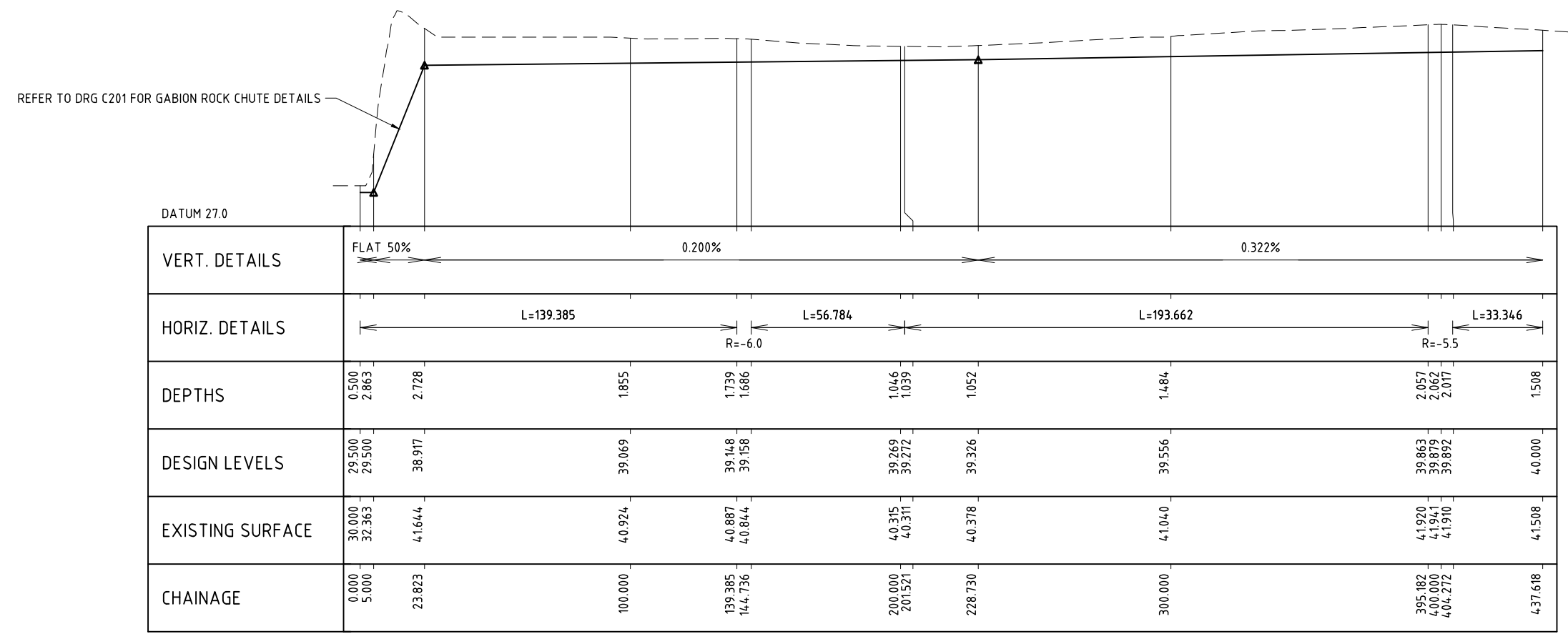
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PM APPD.	NEA	PD APPD.	JG
RPENG	NEA	RPENG No.	PE0007879

HANSON CONSTRUCTION MATERIALS	
VALLEY ROAD QUARRY FUNCTIONAL DESIGN LONGITUDINAL SECTIONS - CHANNEL A	
ORIGINAL SIZE A1	DWG NO. V1259-001-C300
REV. F	

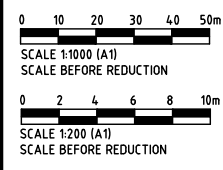
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CONTROL LINE CONTROL MCD03 (CHANNEL B)
SCALE 1:1000 HORIZ
SCALE 1:200 VERT

EXISTING SURFACE AS SHOWN IS BASED ON SURVEY DATED 25/09/2018

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LAST MODIFIED: 2/2/2025 10:56 AM C:\D:\BEO\01_MEL_PROJECTS\MEL0255_HANSON CONSTRUCTION MATERIALS PTY LTD\BML0255_001 VALLEY ROAD QUARRY DRAINAGE DESIGN\UPDATE\DESIGN\AUTOCAD\DRAWINGS\1255-001-C301.DWG

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F	KB	14.03.25	REDUCED PIT EXTENT
E	JG	22.09.21	FOR REVIEW
D	PB	05.05.21	FOR REVIEW
C	LZ	25.10.19	FOR REVIEW
B	LZ	15.01.18	FOR REVIEW
A	JG	13.12.18	FOR REVIEW
REV	BY	DATE	REVISION DESCRIPTION
			PM APPD.
			REFERENCE DOCUMENTS

Client Dwg No.

www.engeny.com.au

STATUS: NOT FOR CONSTRUCTION - FOR REVIEW			
DESIGNED	DBB	CHECKED	NEA
DRAWN	KB	CHECKED	DBB
PM APPD.	NEA	PD APPD.	JG
RPENG	NEA	RPENG No.	PE0007819

HANSON CONSTRUCTION MATERIALS	
VALLEY ROAD QUARRY FUNCTIONAL DESIGN	
LONGITUDINAL SECTIONS - CHANNEL B	
ORIGINAL SIZE	DWG NO.
A1	V1259-001-C301
REV.	F

APPENDIX C: REGISTRATION LICENSE FOR WATER EXTRACTION

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Entitlement ID: BEE026611

Printed on: 19 Aug 2016 3:56:48 pm

COPY OF RECORD IN THE VICTORIAN WATER REGISTER
REGISTRATION LICENCE

under Section 51(1A) of the Water Act 1989

The information in this copy of record is as recorded at the time of printing. Current information should be obtained by a search of the register. The State of Victoria does not warrant the accuracy or completeness of this information and accepts no responsibility for any subsequent release, publication or reproduction of this information.

This licence does not remove the need to apply for any authorisation or permission necessary under any other Act of Parliament with respect to anything authorised by the registration licence.

Water used under this entitlement is not fit for any use that may involve human consumption, directly or indirectly, without first being properly treated.

The Authority does not guarantee, by the granting of the licence, that the licensee will obtain any specific quantity or quality of water. The Authority is not liable for any loss or damage suffered by the licensee as a result of the quantity of water being insufficient or the quality of the water being unsuitable for use by the licensee at any particular time or for any particular purpose.

This registration licence entitles its holders to take and use water as set out under the licence description, subject to the conditions that are specified.

Licence Holder(s)

HANSON CONSTRUCTION MATERIALS PTY LTD of LEVEL 10, 35 CLARENCE STREET SYDNEY NSW 2000

Licence Contact Details

HANSON CONSTRUCTION MATERIALS PTY LTD LEVEL 10, 35 CLARENCE STREET SYDNEY NSW 2000

Licence Description

Table with 2 columns: Licence Description and details. Rows include: Expiry date (Ongoing), Status (Active), Authority (Southern Rural Water), Name of waterway, aquifer or works (BOGGY CREEK-Bunyip), Water system type (Unregulated waterway, spring or run-off), River basin or groundwater unit (Bunyip), Licence volume (400.0 megalitres), Licence volume adjusted for temporary trade (400.0 megalitres), Method of taking (Harvesting using an off-waterway dam), Period during which water can be taken (01 Jul - 30 Jun inclusive), Use of water (Industrial or commercial use - as well as domestic and stock use).

3196.12.1

Licence Volume Details

Licence volume 400.0 megalitres
Licence volume adjusted for temporary trade 400.0 megalitres

Temporary volume transaction details

<i>Approval date</i>	<i>Volume traded (ML)</i>	<i>Expiry date</i>
Nil		

Extraction Point Details

<i>Easting</i>	<i>Northing</i>	<i>Zone MGA</i>	<i>Location description</i>
Nil			

Land on which the Water is to be Used

Land description

Volume 8922 Folio 738
CA 17A Section B Parish of Langwarrin

Property address

150 QUARRY ROAD LANGWARREN VIC 3910

This entitlement runs with the land and as such it may not be transferred to another parcel of land.

Related Instruments

Related entitlements Nil
Related works licences WLE033076
Other related entities Nil

Application History

<i>Reference</i>	<i>Type</i>	<i>Status</i>	<i>Lodged date</i>	<i>Approved date</i>	<i>Recorded date</i>
PTA018616	Address amendment	Recorded			14 Jan 2013
BEI476634	Issue	Approved	29 Aug 2009	29 Aug 2009	

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Conditions

This registration licence is subject to the following conditions:

Operation and maintenance

- 1 The licence holder must maintain all works and appliances used to take water under this licence in a safe and efficient working order including any dam if water is taken from a dam under this licence.

Preventing pollution

- 2 The licence holder must not pollute any water, or the environment, through the spillage of fuel or lubricant or any gaseous, liquid or solid matter used in connection with the works and appliances associated with this licence.

Take volume and location

- 3 The licence holder must not use any water in excess of the annual entitlement volume in any twelve month period from 1 July to 30 June.

END OF COPY OF RECORD

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APPENDIX D: REHABILITATION STAGE FUNCTIONAL DESIGN

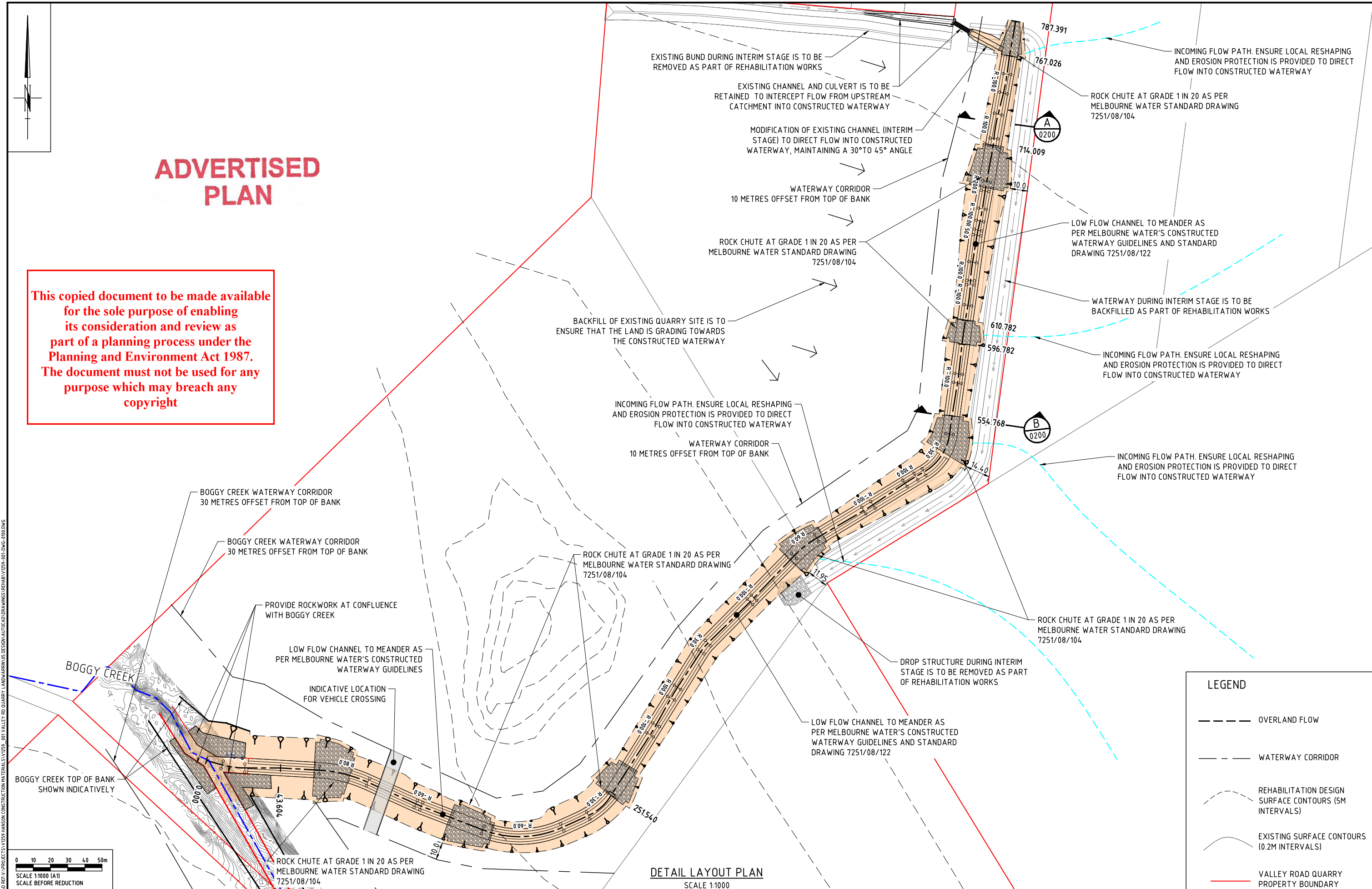
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LEGEND

- OVERLAND FLOW
- WATERWAY CORRIDOR
- REHABILITATION DESIGN SURFACE CONTOURS (5M INTERVALS)
- EXISTING SURFACE CONTOURS (0.2M INTERVALS)
- VALLEY ROAD QUARRY PROPERTY BOUNDARY

DETAIL LAYOUT PLAN
SCALE 1:1000

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REV	BY	DATE	REVISION DESCRIPTION	PM APPD	REFERENCE DOCUMENTS
B	JG	21.09.2021	INLCUDED VEHICLE CROSSING	NEA	
A	PB	04.05.2021	FOR REVIEW	NEA	DOC. NUMBER DOCUMENT TITLE



STATUS: **NOT FOR CONSTRUCTION - FOR REVIEW**

DESIGNED	JG	CHECKED	NEA
DRAWN	PB / MW	CHECKED	NEA
PM APPD.	NEA	PD APPD.	GO
CPENG		CPENG No.	

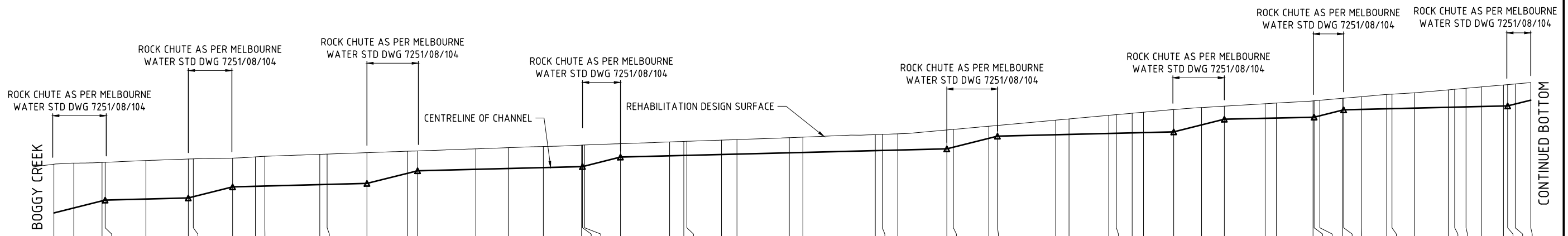
Ph: 03 9888 6978
Level 34
360 Elizabeth St
Melbourne VIC
www.engeny.com.au

HANSON CONSTRUCTION MATERIALS

VALLEY ROAD QUARRY REHABILITATION
FUNCTIONAL DESIGN
LAYOUT PLAN

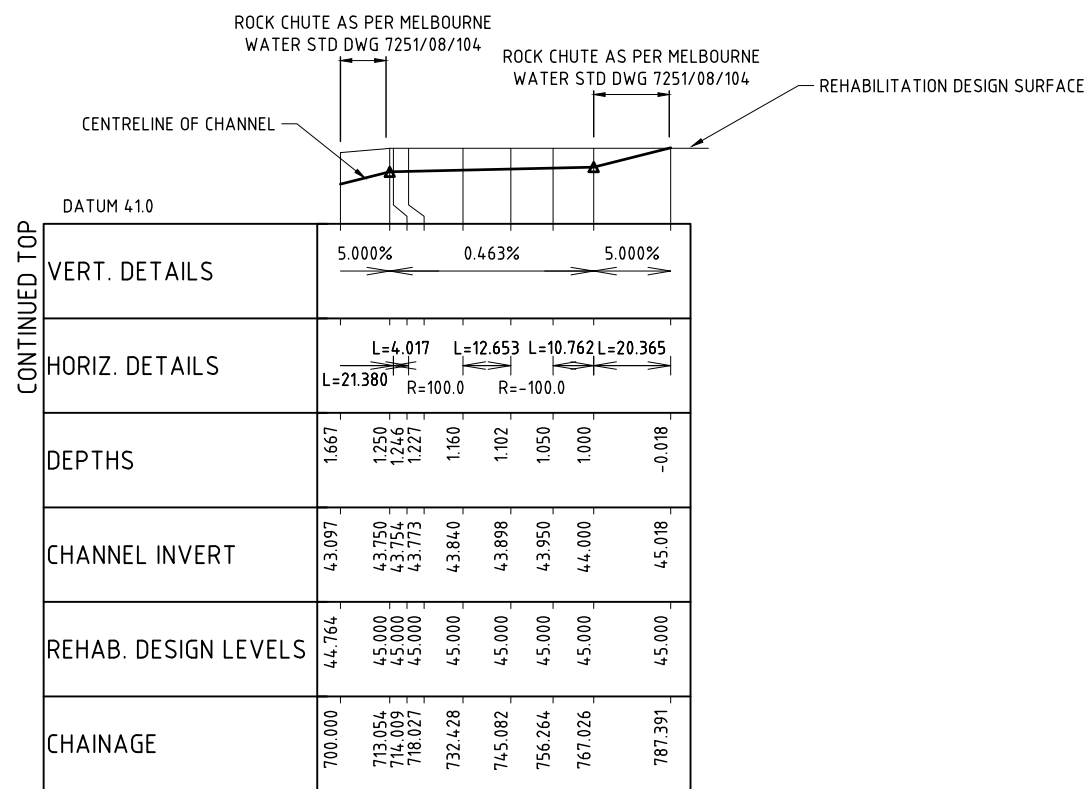
ORIGINAL SIZE	DWG NO.	REV.
A1	V1259-001-DWG-0100	B

C:\01-REV\PROJECTS\1259 HANSON CONSTRUCTION MATERIALS\1259_001\VALLEY RD QUARRY LAND\ASB\1259_001-DWG-0100.DWG



VERT. DETAILS	5.000%	0.507%	5.000%	0.518%	5.000%	0.512%	5.000%	0.504%	5.000%	0.488%	5.000%	0.452%	5.000%	0.476%	5.000%																																																				
HORIZ. DETAILS	L=9.433 R=-50.0	L=20.765 R=-80.0	L=22.461 R=-80.0	L=30.537 R=-60.0	L=38.223 R=-60.0	L=16.641 R=-30.0	L=1.432 R=-100.0	L=4.0284 R=100.0	L=17.862 R=100.0	L=24.802 R=30.0	L=34.298 R=-100.0	L=33.679 R=60.0	L=31.740 R=-100.0	L=22.422 R=100.0	L=5.398 R=-30.0	L=10.786=19.328 R=-100.0	L=17.324 R=100.0	L=8.920 R=-100.0	L=2.476 R=100.0	L=15.908 R=50.0	L=5.380 R=-100.0	L=10.442 R=200.0	L=21.380 R=200.0																																												
DEPTHS	4.620	4.250	3.642	3.582	3.654	3.694	3.593	2.728	2.792	2.825	2.872	2.880	2.918	2.089	1.881	1.938	1.974	1.997	2.033	2.035	1.997	1.268	1.318	1.332	1.335	1.365	1.379	1.432	1.451	1.519	1.526	1.541	1.789	1.689	1.151	1.020	1.385	1.469	1.718	1.766	1.865	1.936	2.119	1.648	1.236	1.383	1.422	1.547	1.554	1.467	1.117	1.100	1.209	1.361	1.377	1.455	1.655	1.695	1.767	1.862	1.995	2.020	1.905	1.667			
CHANNEL INVERT	32.406	32.877	33.548	33.620	33.718	33.820	33.938	34.870	34.926	34.949	35.084	35.102	35.200	36.167	36.400	36.541	36.620	36.705	36.798	36.800	36.846	36.849	37.700	37.817	37.851	37.859	37.942	37.978	38.103	38.136	38.309	38.326	38.363	38.480	38.634	39.474	39.680	39.815	39.846	39.938	39.955	41.721	39.992	41.954	40.018	40.088	40.748	41.288	41.375	41.399	41.478	41.480	41.614	42.153	42.180	42.220	42.277	42.289	42.340	42.416	42.431	42.456	42.491	42.540	42.550	42.729	43.097
REHAB. DESIGN LEVELS	37.025	37.127	37.189	37.202	37.372	37.514	37.531	37.598	37.718	37.774	37.956	37.962	38.118	38.256	38.281	38.479	38.594	38.702	38.831	38.835	38.846	38.849	38.968	39.307	39.357	39.535	39.587	39.828	39.851	39.904	40.269	40.323	40.625	40.700	41.200	41.314	41.656	41.721	41.857	41.954	42.206	42.397	42.524	42.758	42.821	43.025	43.034	43.081	43.270	43.280	43.429	43.638	43.666	43.795	44.071	44.126	44.223	44.352	44.535	44.570	44.633	44.764					
CHAINAGE	0.000	9.433	22.839	24.287	43.604	63.704	66.066	84.704	95.486	100.000	126.023	129.503	148.391	167.726	172.391	200.000	215.347	231.989	250.108	250.556	251.540	268.556	291.824	298.587	300.000	316.450	323.758	348.560	355.021	389.319	392.636	400.000	423.237	426.315	443.120	447.237	474.860	481.155	500.000	503.577	511.078	516.476	530.768	543.983	554.768	574.096	579.458	596.782	597.324	600.000	610.782	611.324	619.701	631.737	634.213	644.992	660.900	663.950	669.330	676.598	687.040	689.054	692.629	700.000			

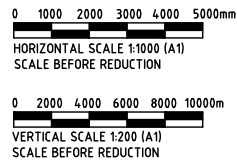
STAGE 2 CHANNEL CENTRELINE LONGITUDINAL SECTION



STAGE 2 CHANNEL CENTRELINE LONGITUDINAL SECTION (CONTINUED)

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REV	BY	DATE	REVISION DESCRIPTION	PM APPD	REFERENCE DOCUMENTS
A	PB	04.05.2021	FOR REVIEW	NEA	DOC. NUMBER
					DOCUMENT TITLE



STATUS	NOT FOR CONSTRUCTION - FOR REVIEW			
DESIGNED	JG	CHECKED	NEA	
DRAWN	PB / MW	CHECKED	NEA	
PM APPD.	NEA	PD APPD.	GO	
CPENG		CPENG No.		

HANSON CONSTRUCTION MATERIALS	
VALLEY ROAD QUARRY REHABILITATION	
FUNCTIONAL DESIGN	
LONGITUDINAL SECTION	
ORIGINAL SIZE	DWG NO.
A1	V1259-001-DWG-0300
REV.	A

C:\01-REF-V-PROJECTS\1259-HANSON CONSTRUCTION MATERIALS\1259_001-VALLEY RD QUARRY LANDWARRINUS DESIGN\AUTOCAD\DRAWINGS\DRHAB\1259-001-DWG-0300.DWG

APPENDIX E: CONSULTATION MEETING MINUTES

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MINUTES OF MEETING

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Project:	Valley Road Quarry, Langwarrin - MWA-1067240	Date:	12/02/2021	Start Time:	2:00pm
Chaired by:	NEA	Recorded by:	JG	Finish Time:	3:00pm
		Location:	Virtual		
Attendees					
Company	Name				
Melbourne Water	Indi Prathapasinghe				
Melbourne Water	Sarah Harris				
Melbourne Water	Mark Warren				
Ricardo	Kathy MacInnes				
Engeny Water Management	Nick Andrewes				
Engeny Water Management	Julian Giannetti				
Hanson	Robert Francis				
Apologies:	N/A				

MEETING MINUTES AND ACTION ITEMS

Action items	Responsible	Due date
Definitions		

Existing: The current state of the quarry, managed and operated by Hanson

Interim Stage: The current state of the quarry, managed and operation by Hanson, including the additional development of the quarry area shown in the image below.



Note

Rehabilitation Stage: Once extraction works are complete, the existing quarry to be filled to levels to match with pre-development levels, including reconnection of the upstream tributary to Boggy Creek

Interim Stage

Hanson has an approved licence from Southern Rural Water (SRW) to discharge stormwater from the upstream catchment into existing quarry pit. Discharge of flow will continue during the interim stage	Note	
There is no change in hydrology and hydraulics between the existing state and the interim stage, therefore it is understood that Melbourne Water do not need to provide in-principle support for the proposed works, from a stormwater management perspective	Note	
Earth Resources Regulation (ERR) have requested an in-principle support from Melbourne Water for the proposed extension of quarry works, during the interim stage. Ricardo to send Melbourne Water request from ERR to inform their response	Ricardo	Complete
Melbourne Water have requested information regarding potential impacts to flora and fauna. Ricardo to send flora and fauna investigation report to Melbourne Water for review and comment	Ricardo	Complete

Rehabilitation Stage

Current rehabilitation plan to be send to Melbourne Water	Ricardo	26/02/21
Melbourne Water to provide comment on expected rehabilitation requirements. This includes, buffer zones (20 metre was advised as acceptable), the required fill material and planting	Melbourne Water	05/03/21
Melbourne Water to confirm whether they will take ownership and manage/maintain Boggy Creek	Melbourne Water	05/03/21
Melbourne Water to confirm the approval process associated with the rehabilitation works and handover	Melbourne Water	05/03/21
Engeny to include in the Stormwater Management Plan, a note that the quarry will be filled to pre-developed levels. Waterway is to be designed in accordance with Melbourne Water's constructed waterway guidelines	Engeny	12/03/21

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APPENDIX F: DRAINAGE DESIGN UPDATES

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Statement of Changes

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VCAT Proceeding: P1252/2023
Planning Permit Application Number: 754/2022/P
Permit Applicant: Hanson Construction Materials Pty Ltd
Site: 60 Valley Road and 150 Quarry Road Langwarrin VIC 3910

1 Reasons for Changes / Explanation for Changes

- 1.1 The Permit Applicant is seeking to amend the engineering drawings prepared by Ricardo and dated 10 May 2021 and 11 May 2021, which form part of the Planning Permit Application as lodged with Frankston City Council on 12 April 2022 (**Original Drawings**).
- 1.2 We provide the following summary of changes between the Original Drawings and amended drawings, prepared by Dartmouth Consulting, (dated 14 February 2024) (**Amended Drawings**), along with an explanation of how the changes improve the proposal:
- (1) relocation of the northern drainage line further south to reduce encroachment into the tree protection zones (**TPZ**) of trees on neighbouring properties to the north of the Site;
 - (2) relocation of the eastern drainage line further west to reduce encroachment into the tree protection zones of trees on neighbouring properties to the east of the Site; and
 - (3) inclusion of a three (3) metre noise wall on top of the northern three (3) metre earth bund to reduce noise emissions to neighbouring properties to the north of the Site.
- 1.3 The changes between the Original Drawings and Amended Drawings for each figure/sheet are detailed in table 1 below. No changes have been made to following figure/sheets within the Original Drawings but for completeness they have been included in the Amended Drawings set:
- (1) Figure WP01 (location), dated 10 May 2021;
 - (2) Figure WP02 (site plan), dated 10 May 2021;
 - (3) Figure WP03 (site detail), dated 10 May 2021; and
 - (4) Cross section – current, dated 11 May 2021.

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Table 1

Original Drawings sheet number/title and date	Amended Drawings sheet number and date	Description of change(s)	Why the change(s) has been made / benefit of the change(s)
Figure WP04 (extraction) dated 10 May 2021	Figure WP04 (extraction) dated 14 February 2024	The drainage line on the northern and eastern sides of the pit have been moved to be adjacent to the bund.	This has been done to reduce encroachment (from excavation to construct the drainage line) into the TPZs of neighbouring trees to the north and east of the Site.
		The eastern pedestrian access track has been shifted to the eastern boundary so the eastern drainage line can be adjacent to the eastern bund. Eastern access track is now marked as pedestrian access.	This has been done to reduce encroachment (from excavation to construct the drainage line) into the TPZs of neighbouring trees to the east of the Site. Clarifies eastern access track is not for vehicles.
		The northern vehicle access track has been shifted to the northern boundary so the northern drainage line can be adjacent to the northern bund.	This has been done to reduce encroachment (from excavation to construct the drainage line) into the TPZs of neighbouring trees to the north of the Site.
		The vehicle access track on the western side has been moved closer to the western bund and the bund closer to the western edge of the pit.	This creates a larger area for vegetation along the western Site boundary.
Cross section – end of prequarry dated 11 May 2021	Cross section – end of prequarry dated 14 February 2024	The eastern drainage line has been moved to be adjacent to the bund on the eastern side of the pit and the eastern pedestrian access track has been shifted to the eastern boundary.	This has been done to reduce encroachment (from excavation to construct the drainage line) into the TPZs of neighbouring trees to the east of the Site.

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		Eastern access track is now marked as pedestrian access.	
Cross section – end of stage 1 dated 11 May 2021	Cross section – end of stage 1 dated 14 February 2024	The eastern drainage line has been moved to be adjacent to the bund on the eastern side of the pit and the eastern pedestrian access track has been shifted to the eastern boundary. Eastern access track is now marked as pedestrian access.	This has been done to reduce encroachment (from excavation to construct the drainage line) into the TPZs of neighbouring trees to the east of the Site.
Cross section – end of stage 2a dated 11 May 2021	Cross section – end of stage 2a dated 14 February 2024	The eastern drainage line has been moved to be adjacent to the bund on the eastern side of the pit and the eastern pedestrian access track has been shifted to the eastern boundary. Eastern access track is now marked as pedestrian access.	This has been done to reduce encroachment (from excavation to construct the drainage line) into the TPZs of neighbouring trees to the east of the Site.
Cross section – end of stage 2b dated 11 May 2021	Cross section – end of stage 2b dated 14 February 2024	The eastern drainage line has been moved to be adjacent to the bund on the eastern side of the pit and the eastern pedestrian access track has been shifted to the eastern boundary. Eastern access track is now marked as pedestrian access.	This has been done to reduce encroachment (from excavation to construct the drainage line) into the TPZs of neighbouring trees to the east of the Site.
N/A	Cross section – Northern bund dated 14 February 2024	The northern drainage line has been moved to be adjacent to the bund on the northern side of the pit and the northern vehicle access track has been shifted to the northern boundary. A three (3) metre noise wall is now shown on top of the northern three (3) metre earth bund. Notation included on plans that northern edge of the earth bund will be vegetated for screening.	This has been done to reduce encroachment (from excavation to construct the drainage line) into the TPZs of neighbouring trees to the north of the Site. This has been done to reduce noise emissions to neighbouring properties to the north of the Site. This has been done to reduce the visual impact of the northern bund and noise wall to neighbouring properties to the north of the Site.

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