APPENDIX Q

RESOURCE AVAILABILITY ASSESSMENT

Application to Expand Dalswinton Quarry

Rosebrook Sand and Gravel

Lot 72 DP1199484, Dalswinton

Environmental Impact Statement

Assessment of Available Resource

Dr Christopher J Gippel

October 2020

Rosebrook Sand and Gravel Pty Ltd

FLUVIAL SYSTEMS

Application to Expand Dalswinton Quarry, Rosebrook Sand and Gravel, Lot 72 DP1199484, Dalswinton

Environmental Impact Statement, Assessment of Available Resource

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Executive Summary

Rosebrook Sand and Gravel Pty Ltd (RSG), have identified potential to expand the operations to the eastern part of Dalswinton Quarry site. RSG estimates significant quantities of reserves in the existing footprint as well as adjoining areas which would allow for operations to continue for another 25 years. The quarrying operation will expand across approximately 35.5 ha of the existing site to Work Area 2. The proposed development will also include reworking of approximately 47.4 ha of land in Work Area 1, corresponding to the previous Stages 1 and 2.

As the proposed development is expected to exceed the 5 million tonnes threshold within the State Environmental Planning Policy (State and Regional Development) 2011 the development is considered to be State or Regionally significant and therefore requires the submission of an EIS as part of the assessment process. HDB Town Planning & Design, Maitland is managing the EIS process. Fluvial Systems Pty Ltd was commissioned to undertake investigations to determine the volume, mass and quality of the available resource.

This investigation used stratigraphic descriptions from four drill holes, as well as soil descriptions from three soil profiles, provided in the previous EIS by Resource Planning (1994). These data were used to inform the estimate of the size of the resource and to help describe its composition, grainsize, grading, clay content and contaminants. These data were supplemented by two new sets of samples, one set from an undisturbed area within Work Area 2 and the other from material discarded by previous mining within Work Area 1. A site on the wall of the current mining pit provided the samples from Work Area 2. Surface topography of the site was surveyed in 1993 for the previous EIS. This data provided the benchmark surface elevation for the drill holes, which then allowed the depth of the stratigraphic layers to be determined. Current surface topography was represented by a 2 m grid downloaded from ELVIS - Elevation and Depth - Foundation Spatial Data FSDF Version 0.1.10, a service provided by Geoscience Australia in partnership with NSW Government Spatial Services. The data were collected using LiDAR technology, flown in February or March 2018. Resource volume was calculated using GIS tools in Global Mapper V20.0.0. For all cells (2 × 2 m) within the boundaries of Work Areas 1 and 2, elevations of the sand and gravel layers were subtracted from the ground surface elevations to give thickness, and therefore volume, of each layer. Volume was converted to mass on the basis of bulk dry density measured from samples. For Work Area 1, the density was 1.84 tonne/m^3 and for Work Area 2 it was 1.96 tonne/m^3. The volume of material required to fill the excavated pit and create the final landform surface was calculated.

The sediment profile data indicated the presence of a sandstone/claystone base, a gravel layer above that, and an overlying sandy layer. The total mass of resource in Work Area 1 was estimated to be 6,673,825 tonne, and the total mass of resource in Work Area 2 was estimated to be 7,714,076 tonne.

1 Introduction

Dalswinton Quarry (Figure 1) has been extracting decorative gravel and aggregates from the western part of the subject site under previous consents since 1986. The extraction and processing operation that existed in the early 1990s was approved by Muswellbrook Council in July 1988. In 1994 the previous leaseholder, Cross Pastoral Company Pty Ltd., proposed to relocate quarry 1 km west, to its current site. Resource Planning (1994) undertook the EIS for this proposal, which was approved.

As the existing operation at Dalswinton Quarry approaches the end of its approval period, the current owners, Rosebrook Sand and Gravel Pty Ltd (RSG), have identified potential to expand the operations to the eastern part of the site. RSG is seeking to vary the footprint of Dalswinton Quarry and continue the extraction operation post-2022.

RSG estimates significant quantities of reserves in the existing footprint as well as adjoining areas which would allow for operations to continue for another 25 years. The quarrying operation will expand across approximately 35.5 ha of the existing site to Work Area 2 (Figure 2). The proposed development will also include reworking of approximately 47.4 ha of land in Work Area 1, corresponding approximately with the existing Stages 1 and 2 (Figure 2). Previously, there was strong demand for aggregates 10 mm diameter, which led to selective removal of this size grade and return of the majority of the extracted material to pits in Stages 1 and 2. Changing market demand has created the opportunity to recover valuable resource from this previously discarded material. The extraction rate will likely vary through time in response to market dynamics.

As this development is expected to exceed the 5 million tonnes threshold within the State Environmental Planning Policy (State and Regional Development) 2011 the development is considered to be State or Regionally significant and therefore requires the submission of an EIS as part of the assessment process. HDB Town Planning & Design, Maitland is managing the EIS process. Fluvial Systems Pty Ltd was commissioned to undertake investigations to determine the volume, mass and quality of the available resource.

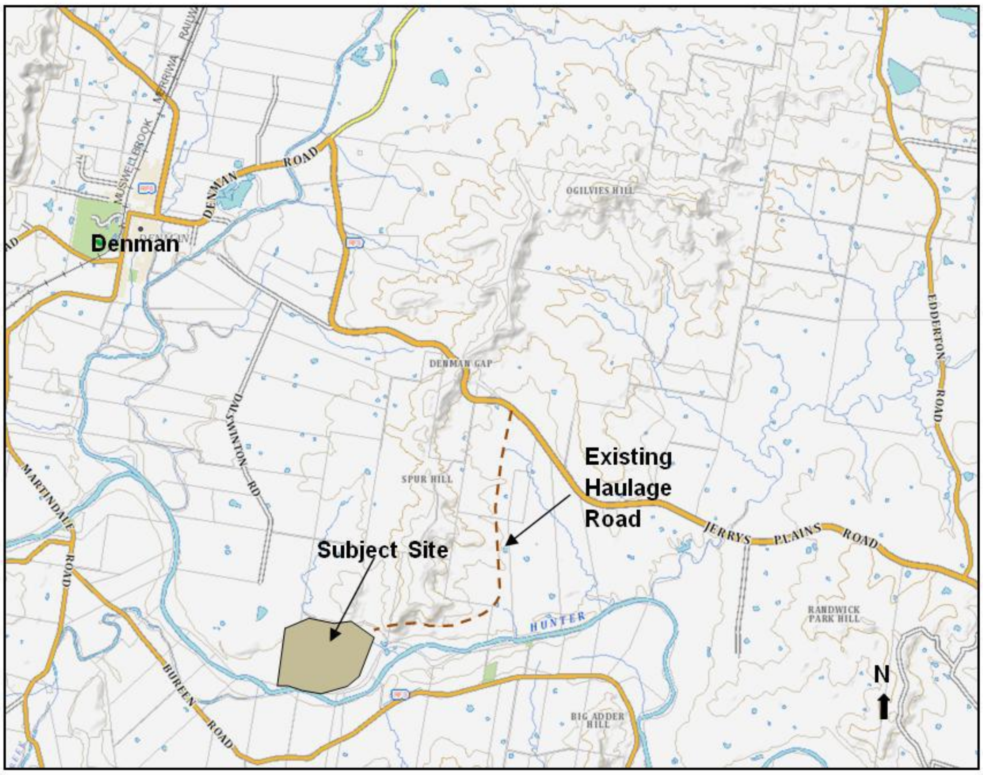

Figure 1. Site location, Dalswinton Quarry, Lot 72 DP1199484, 511 Dalswinton Road, Dalswinton.

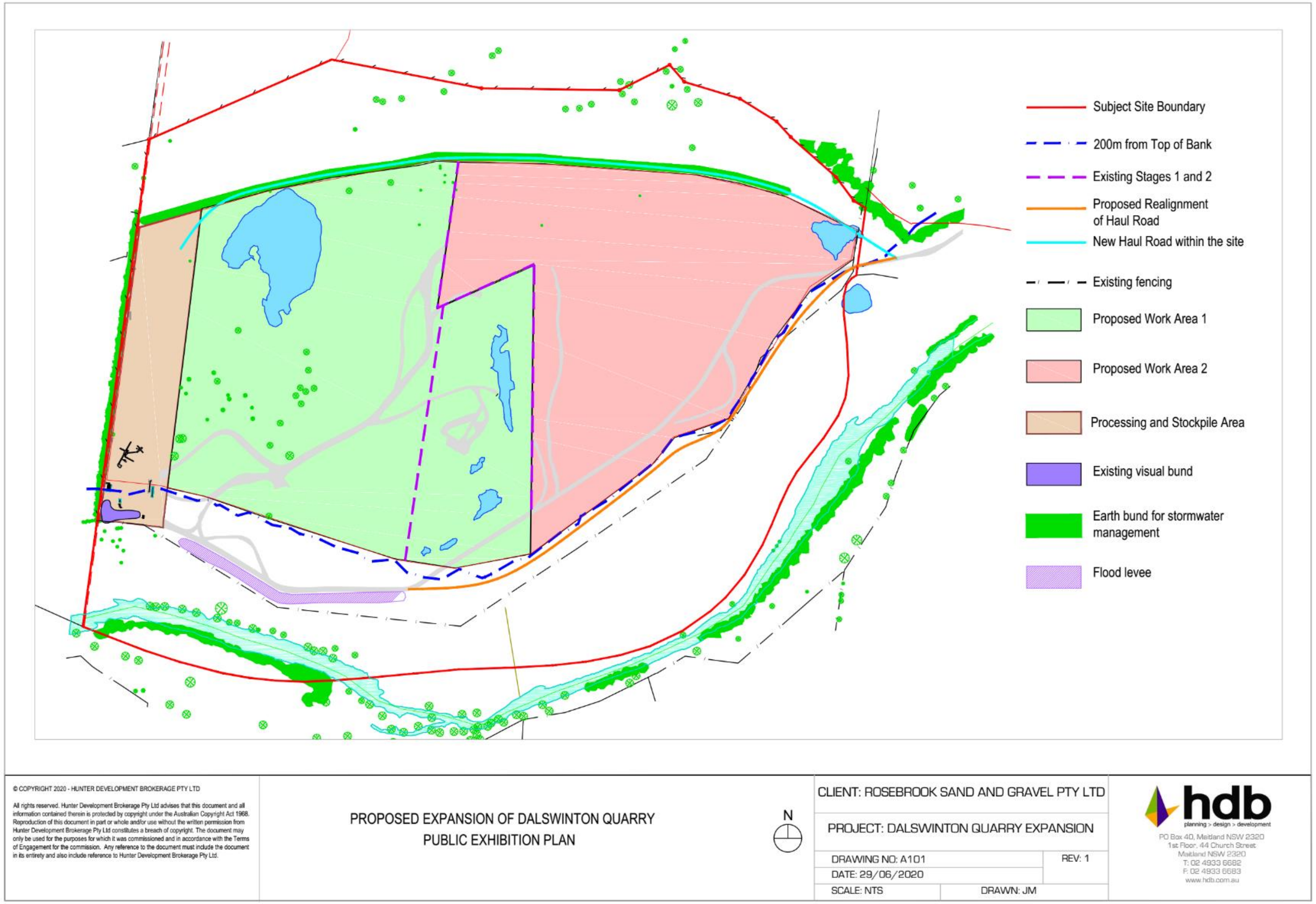

Figure 2. Main elements of existing operations and proposed expansion at Dalswinton Quarry. Source: HDB Town Planning & Design.

2 Requirements and Scope

As a State Significant Development, the proponents have sought Secretary's Environmental Assessment Requirements (SEARs) from the Department of Planning and Environment (DoPE). Revised SEARs were issued on 14 August 2018. With respect to resource assessment, the requirements are to provide:

- Description of the resource to be extracted, including the amount, type and composition
- Description of the site layout and extraction plan, including cross-sectional plans.

In a letter dated 4 February 2020, the Resources and Geoscience Division of DoPE indicated that the environmental impact statement (EIS) include a resource assessment that:

- Documents the size and quality of the resource and demonstrates that both have been adequately assessed; and
- Documents the methods used to assess the resource and its suitability for the intended applications.

The Environmental and Work Health & Safety Assessment Requirements for Construction Material Quarry Proposals lists the issues that need to be addressed when preparing an environmental assessment (EA) or EIS for a proposed construction materials (extractive materials) quarry. The issues are listed under three headings, Resource Assessment, Health and Safety Issues and Mineral Ownership. Health and Safety and Mineral Ownership issues are not within the scope of this report. The listed Resource Assessment issues are:

1. A summary of the regional and local geology including information on the stratigraphic unit or units within which the resource is located.
2. The amount of material to be extracted and the method or methods used to determine the size of the resource (e.g. drilling, trenching, geophysical methods). Plans and cross-sections summarising this data, at a standard scale, showing location of drillholes and/or trenches, and the area proposed for extraction, should be included in the EA or EIS. Relevant supporting documentation such as drill logs should be included or appended. Major resource proposals should be subject to extensive drilling programs to identify the nature and extent of the resource.
3. Characteristics of the material or materials to be produced:
    a. For structural clay/shale extraction proposals, ceramic properties such as plasticity, drying characteristics (e.g. dry green strength, linear drying shrinkage), and firing characteristics (e.g. shrinkage, water absorption, fired colour) should be described.
    b. For sand extraction proposals, properties such as composition, grainsize, grading, clay content and contaminants should be indicated. The inclusion of indicative grading curves for all anticipated products as well as the overall deposit is recommended.
    c. For hard rock aggregate proposals, information should be provided on properties such as grainsize and mineralogy, nature and extent of weathering or alteration, and amount and type of deleterious minerals, if any.
    d. For other proposals, properties relevant to the range of intended uses for the particular material should be indicated.

Details of tests carried out to determine the characteristics of the material should be included or appended. Such tests should be undertaken by NATA registered testing laboratories.

4. An assessment of the quality of the material and its suitability for the anticipated range of applications should be given.
5. The amount of material anticipated to be produced annually should be indicated. If the proposal includes a staged extraction sequence, details of the staging sequence needs to be provided. The intended life of the operation should be indicated.
6. If the proposal is an extension to an existing operation, details of history and past production should be provided.
7. An assessment of alternative sources to the proposal and the availability of these sources. The impact of not proceeding with the proposal should be addressed.
8. Justification for the proposal in terms of the local and, if appropriate, the regional context.
9. Information on the location and size of markets to be supplied from the site.
10. Route(s) used to transport quarry products to market.
11. Disposal of waste products and the location and size of stockpiles.
12. Assessment of noise, vibration, dust and visual impacts, and proposed measures to minimise these impacts.
13. Proposed rehabilitation procedures during, and after completion of, extraction operations, and proposed final use of site.
14. Assessment of the ecological sustainability of the proposal.

The above list of issues is comprehensive and would be expected to be covered by the EIS in its entirety. The scope of this report is limited to assessment of the size and quality of the resource, so of the above items, only 1, 2 and 3b are covered here.

3 Methodology

3.1 Regional and local geology

Information on regional and local geology was sourced from geological maps of the area and the previous EIS by Resource Planning (1994).

3.2 Stratigraphic description

The previous EIS by Resource Planning (1994, Appendix 2) included stratigraphic descriptions from four drill holes (PDH1, PDH2, PDH3 and PDH4) dug at the site, as well as soil descriptions from three soil profiles (Resource Planning, 1994, Appendix 3) (Figure 3). These data were used to inform the estimate of the size of the resource and to help describe its composition, grainsize, grading, clay content and contaminants.

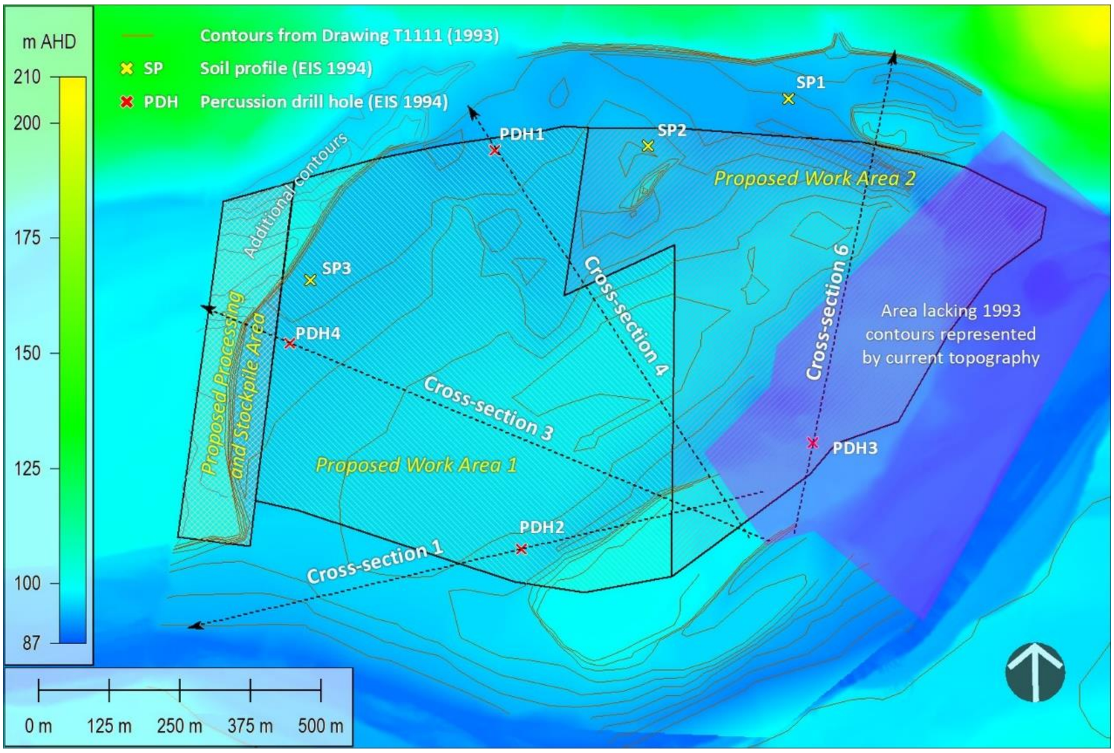

Figure 3. Locations of soil profiles and percussion drill holes undertaken for the previous EIS (Resource Planning, 1994). Also shown are estimated positions of four cross-sections from Umwelt (1993). Contours are reproduced from original Drawing T1111 of Johnson and Pearson (1993). Topography represents elevation of 1994 surface, rendered from DEM derived from contours on Drawing T111 supplemented outside the site boundary by data from 10 m contours taken from the 1:25,000 topographic sheet and ELVIS FSDF 2 m DEM (current topography). No hill-shading.

The Dalswinton Conceptual Extraction Plan (Umwelt, 1993), presented as Appendix 7 of the previous EIS (Resource Planning, 1994), cited MacRae (1988) as the source of the drill holes labelled PDH1 to PDH4. Umwelt (1993) used height and spatial information from the topographic survey of Johnson and Pearson (1993) and drill log information from MacRae (1988) to conclude that the underlying gravel was in a relatively horizontal layer approximately 3.5 m thick across the entire site (Table 1). Umwelt (1993) reported that the gravel layer extended from approximately 84.5 mAHD to 88 mAHD with its upper level approximately 1 m below low flow level in the Hunter River at the upstream end of the site.[1] The cross-section data provided by Umwelt (1993, Figs 3 – 8) are inconsistent with this generalisation, indicating that the gravel layer varied in thickness from 3 to 7 m (Table 1). The thickness of the overburden (also referred to as the sand layer) indicated in Umwelt (1993, Table 1) was reasonably consistent with the elevation data they plotted in Figs 3 – 8 (Table 1).

[1] . On Hunter River Section 1 in Umwelt (1993, Fig 2, p. 4), the deepest point was 88.6 m AHD and the river bed was fully wetted at approximately 89 m AHD.

Table 1. Grading analysis for four drill holes at Dalswinton, sampled in 1988. Source: Top six rows from Umwelt (1993, Table 1). Lower two rows added from information in Umwelt (1993, Figs 3 – 8).

Particle Size	PDH1	PDH2	PDH3	PDH4
<2.0 mm	52%	74%	67%	40%
2.0 to 4.75 mm	8%	6%	6%	6%
4.75 to 11.0 mm	10%	7%	7%	8%
>11.0 mm	30%	13%	20%	46%
Overburden Thickness	5.0 m	7.0 m	10.0 m	5.0 m
Gravel Thickness	3.5 m	3.5 m	3.5 m	5.0 m
Elevation (m AHD) (and thickness) of Sand Layer on cross-sections Figs 3 – 8	88.0– 93.1 5.1 m	88.0– 95.2 7.2 m	88.0– 97.7 9.7 m	88.0– 93.6 5.6 m
Elevation (m AHD) (and thickness) of Gravel Layer on cross-sections Figs 3 – 8	84.5 – 88.0 3.5 m	82.5 – 88.0 5.5 m	85.0 – 88.0 3.0 m	81.0 – 88.0 7.0 m

For this investigation, the drill hole data from 1988 provided in the previous EIS (Resource Planning, 1994) was supplemented by two new sets of samples, one from an undisturbed area within Work Area 2 and the other from material discarded by previous mining within Work Area 1.

The sample from Work Area 1 was taken on 29 October 2018 following the method of AS1141.3.1 cl 8.4.3. (sampling aggregates). A site on the wall of the current mining pit provided the samples from Work Area 2. Eight samples were taken from this location on 25 September 2018 following the method of AS1289.1.2.1 cl 6.5 (sampling and preparation of soils—disturbed samples). Two samples were taken from within each of four excavated bench levels on the wall at the north eastern corner of the pit (Figure 4, Table 2, Figure 5). The elevation of the samples was determined from estimated depth relative to ground surface elevation (Table 2). The samples were analysed for particle size distribution using AS 1289.3.6.1 sieve method by Qualtest Laboratory (NSW), Muswellbrook, a NATA accredited laboratory.

In addition to the sediment sampling and analysis, a visual field examination was undertaken at the site.

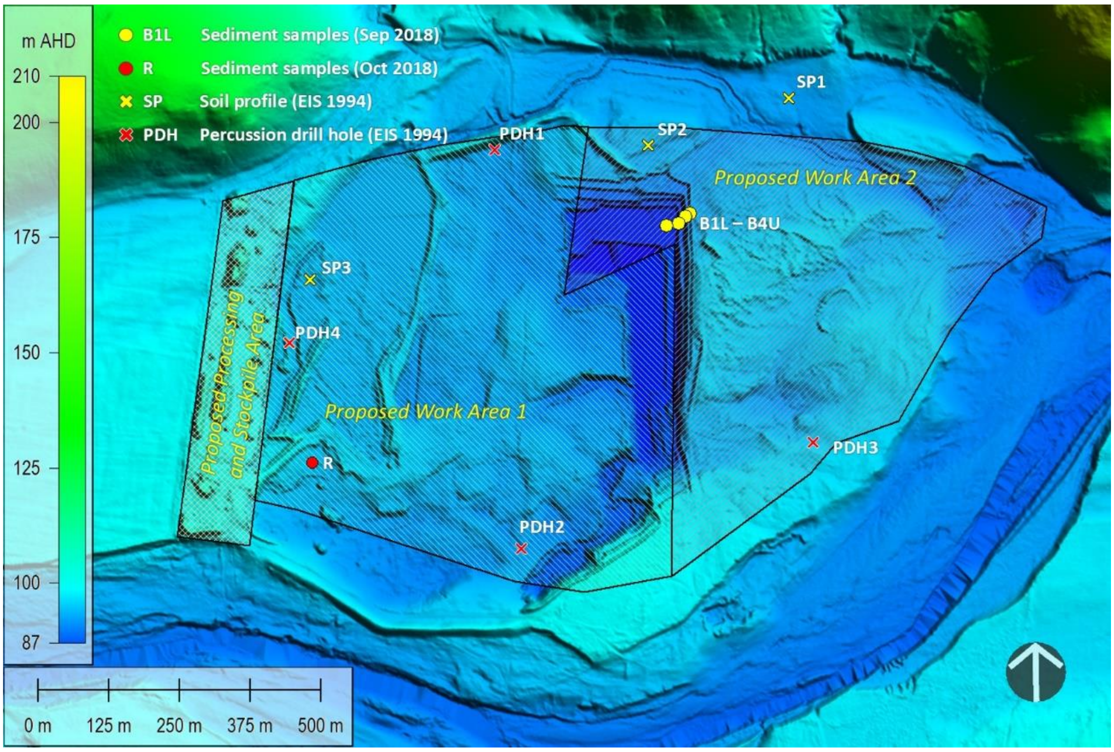

Figure 4. Locations of sediment samples taken in September and October 2018. Also shown are locations of soil profiles and percussion drill holes undertaken for the previous EIS. Topography is represented by elevation data from early-2018 from ELVIS FSDF 2 m DEM. Image rendered with hill-shading.

Table 2. Location and estimated elevation of sediment sampled from the wall of the current mining pit in September 2018, and from the reworked area in October 2018.

Sample	Latitude (degrees)	Longitude (degrees)	Elevation (m AHD)
Bench 4 – Upper (B4U)	-32.450187	150.722596	93.330
Bench 4 – Lower (B4L)	-32.450187	150.722596	91.878
Bench 3 – Upper (B3U)	-32.450237	150.722514	89.459
Bench 3 – Lower (B3L)	-32.450237	150.722514	87.523
Bench 2 – Upper (B2U)	-32.450351	150.722378	86.071
Bench 2 – Lower (B2L)	-32.450351	150.722378	84.136
Bench 1 – Upper (B1U)	-32.450382	150.722157	83.168
Bench 1 – Lower (B1L)	-32.450382	150.722157	82.200
Reworked area (R)	-32.454036	150.715403	93.976

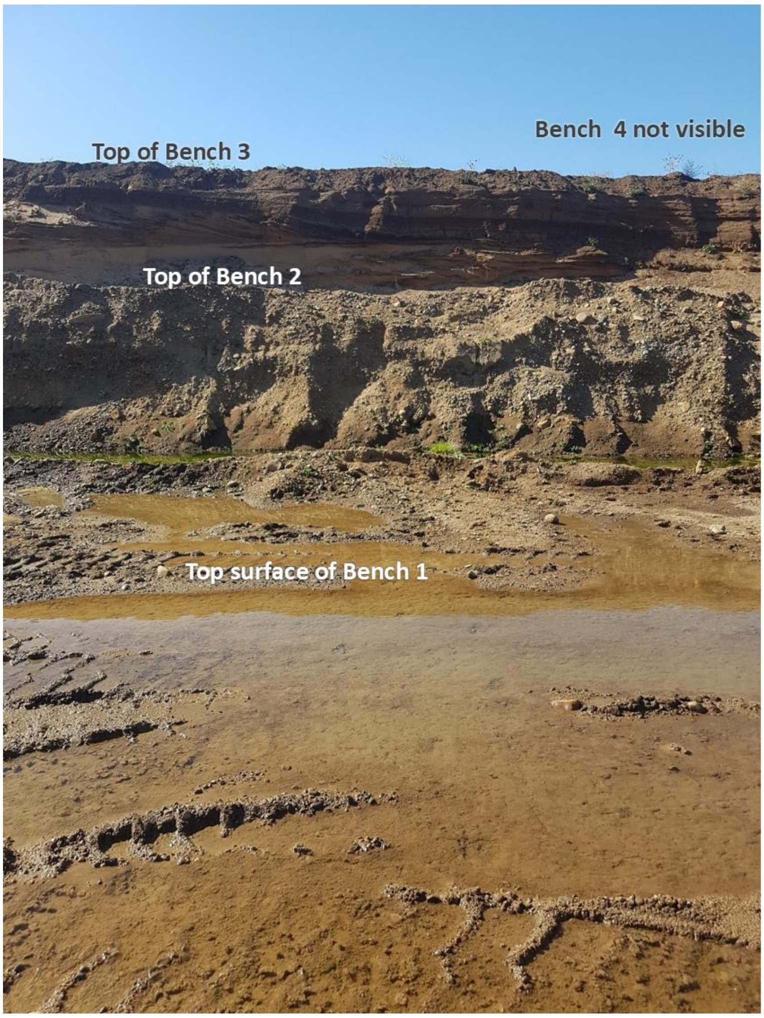

Figure 5. View from Bench 1 – Upper sampling site location towards benches on pit wall where sediment samples were taken in September 2018.

3.3 Surface topography

Surface topography of the site was surveyed in 1993 for the previous EIS (Resource Planning, 1994) by Johnson and Pearson, Drawing T1111 (date of survey 18/06/1993). This data provided the benchmark surface elevation for the drill holes, which then allowed the depth of the stratigraphic layers to be determined. A printed paper version of the original plan was sourced from the office of RSG, scanned, and rectified (Figure 6).

Drawing T1111 was also cited as the source of contours depicted on plans in the previous EIS (Resource Planning, 1994, Fig 2 Site topography, Soils and Drill Hole Locations, Fig 7 Extraction Plan, and Fig 8 Conceptual Final Landform) (Figure 6). While the contours on the plans in the previous EIS were faithfully rendered, they were assigned elevations 1 metre lower than those on the original Drawing T1111. Either this is an error, or Resource Planning (1994) became aware of an error in the original drawing and corrected it. Also, the plans in the previous EIS included additional contour lines to the north and west that were not depicted on the original Drawing T1111 (Figure 6). The survey did not include the area to the south east of the property where the original mining operations occurred, so there are no contours for this area (Figure 6).

Umwelt (1993, Figs 3 – 8) plotted six cross-sections that traversed the site, four of them intersecting the drill holes PDH1 to PDH4. Unfortunately, the Plan 1 referred to by Umwelt (1993) that provided the location of these cross-section transects was missing from the available copy of the EIS. Despite this, it was possible, through a process of: (i) drawing transects of the same length as Cross-sections 1, 3, 4 and 6, (ii) positioning them with respect to the drill holes they intersected, and then (iii) rotating them to match the topography on the plots in Umwelt (1993), to estimate the alignment of the Cross-sections 1, 3, 4, and 6 (Figure 3, Figure 7). This process could not be followed for Cross-sections 2 and 5, which had no spatial reference points (Figure 7).

It appears that Umwelt (1993) used the same contour elevations that appear on plans provided in the main text of the previous EIS (Resource Planning, 1994), as they are in the order of 1 m lower than the surface derived from contours on the original 1993 Johnson and Pearson Drawing T1111 (Figure 7). The land traversed by Cross-section 6 from chainage 0 to 480 m was within the area of the mining operations that existed at the time, which was not surveyed by Johnson and Pearson in 1993, and thus lacks contours on Drawing T1111 (Figure 3). The elevations of the four points plotted by Umwelt (1993) from chainage 0 to 216 m, including PDH3, appear to be 2.0 – 2.5 m higher than the elevation of the current surface. It is possible that mining operations decreased the elevation of this area after 1993. Although the source and reliability of the data on the plot in Umwelt (1993) is not known, in this report, the data were accepted as best available.

The Umwelt (1993, Figs 3 – 8) cross-section plots also show surface elevations from a 1937 Water Conservation and Irrigation Commission topographic survey (Figure 7). With the exception of Cross-section 1, in shape, the cross-sections drawn from the 1937 data roughly correspond with those drawn from the 1993 data, but the 1937 data are generally 2 – 4 m lower in elevation. This could be explained by massive deposition of sediment in the period between the surveys. It is possible that sediment deposition of this magnitude occurred in the February 1955 flood event, but without corroborating evidence, here the 1937 data were regarded with caution. Note that it is possible that a local datum different to AHD was used in the 1937 survey.

In this report, the contour elevations that appear on plans provided in the main text of the previous EIS by Resource Planning (1994) and in cross-sections in Umwelt (1993) were adopted to represent the 1993 land surface, although it is noted that they are 1 m lower than the contours on the copy of the original Johnson and Pearson 1993 Drawing T1111 that was sighted.

Current surface topography was represented by a 2 m grid (Figure 4) downloaded from ELVIS - Elevation and Depth - Foundation Spatial Data FSDF Version 0.1.10 (http://elevation.fsdf.org.au/), a service provided by Geoscience Australia in partnership with NSW Government Spatial Services. The 2 m Digital Elevation Model (DEM) was produced using the TIN (Triangular Irregular Network) method of averaging ground heights to formulate a regular grid. This data set contains a ground surface model in grid format derived from Spatial Services Category 2 (Classification Level 3) LiDAR (Light Detection and Ranging) from an ALS80 (SN8250) sensor. The model is not hydrologically enforced. The data used to create this DEM has an accuracy of 0.3 m (95% Confidence Interval) vertical and 0.8 m (95% Confidence Interval) horizontal (note: less control points are used to validate this accuracy than Spatial Services Category 1 LiDAR data). For the data tiles covering the subject site, the data capture start date was 02/11/2017 and the end date was 11/03/2018. The majority of the data used here were collected towards the end of the data capture period, i.e. February or March 2018.

3.4 Topography of final landform

The topography of the final landform was supplied by HDB Town Planning & Design as a .dxf file. This was converted to a 1 m DEM (Figure 8).

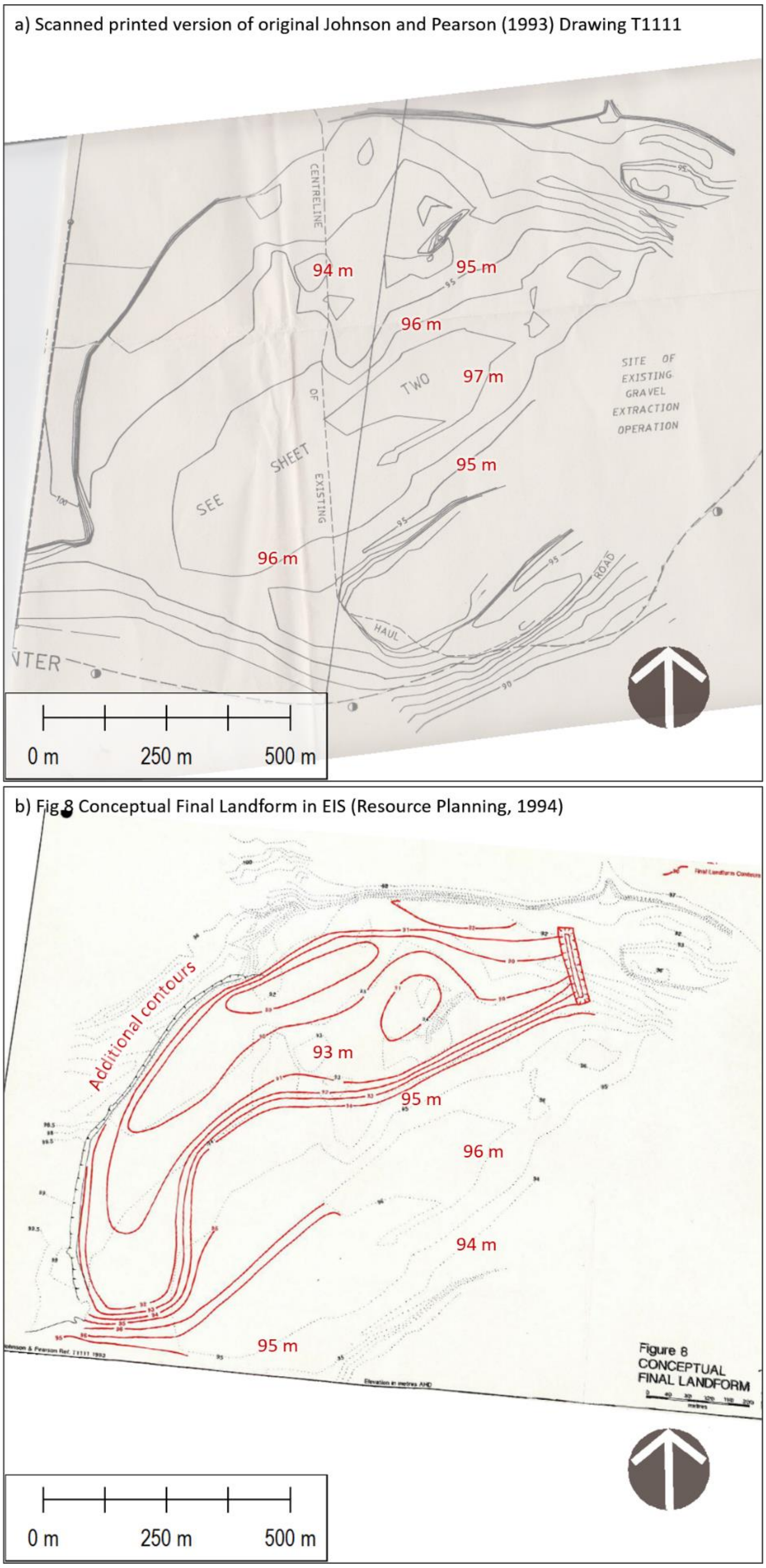

Figure 6. Extracts from rectified versions of: a) original contour plan T1111 by Johnson and Pearson (1993) and, b) contours depicted in Resource Planning (1994) citing Plan T1111, but with contours labelled 1 metre lower in elevation. Also, additional contours were included to the north and west of the site. The red contours were added by Resource Planning (1994) to represent the final landform.

Figure 7. Cross-sections of surface elevation in 1937 (with drill hole locations) and 1993 plotted in the previous EIS by Umwelt (1993, Figs 3 – 8). For cross-sections 1, 3, 4 and 6, the surface in 1993 derived from contour elevations on the original Drawing T1111, and the current surface derived from the ELVIS FSDF 2 m DEM, are shown for comparison.

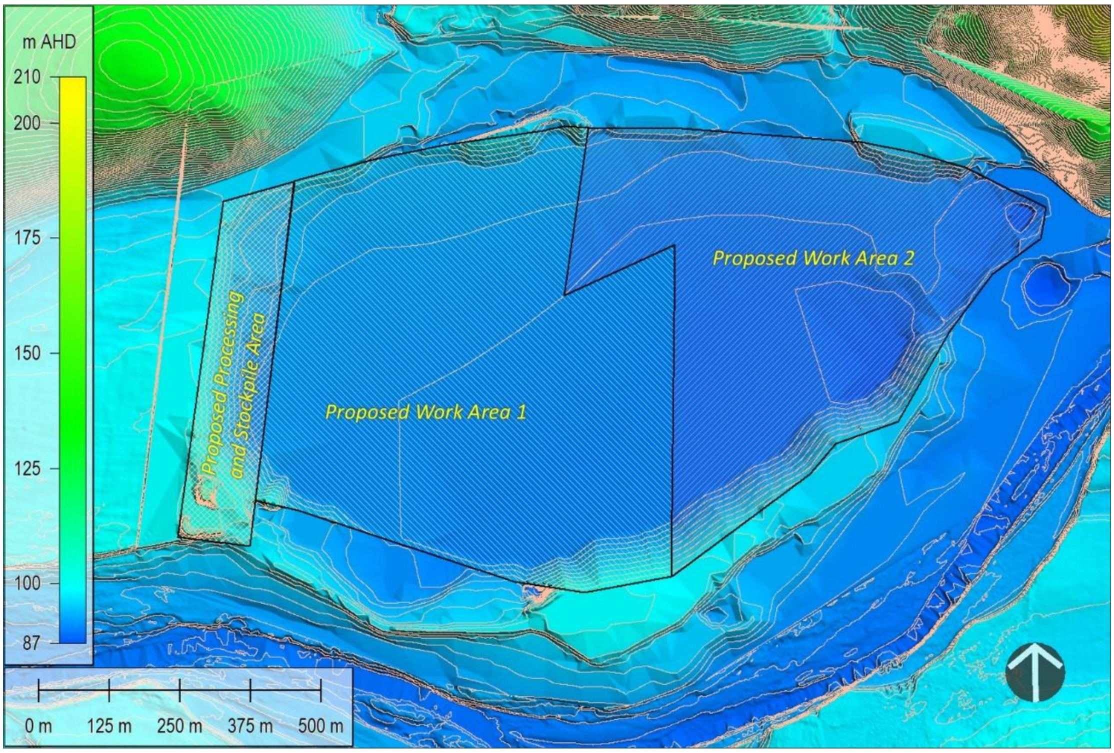

Figure 8. Topography of the proposed final landform. Contours are at 1 metre intervals. Derived from .dxf file supplied by HDB Town Planning & Design. Some elevation discontinuities occur at intersection of DEMs.

3.5 Topography of underlying bedrock and gravel layer surfaces

The stratigraphic data from the Site was compiled to generate points of known elevation of bedrock, at the percussion drill holes and the exposed bed of the current pit. The same was done for the upper elevation of the gravel layer, with data from the percussion drill holes and the exposed wall of the current pit. Lines were drawn crossing the site, intersecting these known data points and extending beyond the extent of the Site. Points were established at the ends of these lines. The slope of the lines was used to extrapolate the elevation of these points. These points, plus the known points within the Site, were then used to generate two surfaces, one for the bedrock and one for the top of the gravel later. These surfaces were then cropped to the Site boundary.

The previous EIS (Resource Planning, 1994) assumed horizontal planar surfaces to represent bedrock and gravel layer topography. In this report, the surface topographies were based on observed elevations, supplemented by extrapolation of observed elevations to the Site boundary.

3.6 Calculation of resource volume

Resource volume was calculated using GIS tools in Global Mapper V20.0.0 (Blue Marble Geographics). For all cells (2 × 2 m) within the boundaries of Work Areas 1 and 2, elevations of the sand and gravel layers were subtracted from the ground surface elevations to give thickness, and therefore volume, of each layer. Volume was converted to mass on the basis of bulk dry density measured from samples.

Work Area 1 was sampled on 29/10/2018. Sample MUS18W-1683—S01 had dry compacted bulk density 1.84 tonne/m^3 (Appendix: Material Test Reports). The material was assumed to be in a compacted state in the ground.

Work Area 2 was sampled on 2/11/2020. The majority of the extraction area was represented by samples MUS20W-1734-S01 and S02. These two samples had field dry bulk density 2.11 and 1.81 tonne/m^3 respectively (Appendix: Material Test Reports), for a mean value of 1.96 tonne/m^3.

The resource volume and mass calculations were done separately for Work Areas 1 and 2. The calculations for Work Area 2 were done separately for the two distinct layers of gravel above bedrock, and sandy material above the gravel. Work Area 1 comprises a single homogeneous body of material returned to the pit after previous mining.

The quarrying process will involve extraction of bulk material, screening, and return of reject material to the pit. The return of material to the pit achieves the objective of creating a final landform that is above the level of the Hunter River. The volumes of material required to fill the excavated pits of Work Area 1 and 2 to achieve the final landform were calculated.

4 Results

4.1 Regional and local geology

Soil Landscapes of Central and Eastern NSW mapping provides an inventory of soil and landscape properties of the area and identifies major soil and landscape qualities and constraints. Dalswinton Quarry is within the Hunter Soil Landscape (A-hu), described on Singleton 1:250,000 Soil Landscape map (Kovak and Lawrie, 1991) as: “*This soil landscape covers the floodplains of the Hunter River and its tributaries. The main soils are all formed in alluvium*”, with the landform described as “*Level plains and river terraces of the Hunter River with elevations of 20 - 60 m. Slopes are 0 - 3%. The width of the plains ranges from 200 - 3200 m. Local relief is generally less than 10 m*”.

Soil and Land Resources of the Hunter Region is a digital dataset that upgrades 1:250,000 soil landscape mapping for the Singleton area providing a standardised and seamless land and soil information across the region at 1:100,000 scale. Dalswinton Quarry is located within the unit Singleton (sgw) Alluvial. The geological description was taken from DMR (2002) and Colquhoun et al. (2015) as: “*Quaternary alluvium valley deposits consisting mostly of clays and silts with minor sands and gravels*”. The landscape is described as: “*Level plain to gently undulating plain on Quaternary alluvium in the central part of the Hunter Region. Slopes <3%, local relief <10 m, elevation 10 - 200 m*”. The soils on terraces and plains of this unit include Prairie Soils and Chernozems, Red Earths and Brown Earths, Black Earths, Red Podzolic Soils and Red Soloths, and on recent sediments and channels the soils are: “*deep (100 - <150 cm), imperfectly to well-drained Stratic Rudosols, also known as Alluvial Soils*”.

The highest resolution geological mapping for the area including Dalswinton Quarry is the Hunter Coalfield Regional Geology 1:100,000 geological map (Glen and Beckett, 1993). The relevant unit on this map is Quaternary alluvium (Qa), described on the legend as: “*Silt, sand, gravel* [occurring as] *Point bar, levee, overbank; includes some relict Tertiary alluvial terrace deposits*”.

The above geological mapping is consistent with the description in Resource Planning (1994, p. 19, citing MacRae, 1989): “*The Hunter River meanders generally east depositing Quaternary silt, sand, and gravel over Permian coal measures. The Quaternary silt, sand and gravels form point bars, levee banks and overbank deposits. Recent sediments were deposited in the 1955 floods and form at least part of the overburden layers in the proposed site*.”

4.2 Stratigraphic description

4.2.1 Percussion Drill Holes (1988)

Drill holes PDH1, PDH2 and PDH4 were located in what was Stages 1 and 2 of previous mining, now known as Work Area 1 (Figure 3), where material rejected after harvesting the 10 mm fraction was used to refill the excavation. Thus, the sediment profiles characterised at these locations in 1988 do not apply to the material currently found in Work Area 1. However, the data from these drill holes provide information that is indicative of the type of material that is likely to be found in Work Area 2, so it was reproduced here in modified form. Drill hole PDH3 was located in an area mined prior to 1993. The depth of extraction, the fraction of material extracted and the method of infill were unknown, so the origin of the sediment layers described in the borehole log from 1988 are uncertain;

the profile could represent naturally deposited sediment, or be composed entirely or partly of post-extraction infill.

Data from the percussion drill hole borehole logs (Resource Planning (1994, Appendix 2) were reproduced in three categories of information: soil or rock substance description (Figure 9), gravel percentage composition (Figure 10) and sand percentage composition and texture class (Figure 11). On the borehole logs, the “grain size” information was assumed to refer to the sand/silt/clay sized material. The data were used to identify the boundaries of the underlying bedrock, the overlying dominantly gravel layer and the overlying dominantly sandy layer. PDH3 had an upper layer described as “gravelly” (Figure 9), but which comprised mainly sand (Figure 11). This layer could be fill from previous mining. The criteria gravel ≥ 25% and sand ≤ 50% were used to categorise the gravel layer, and the criterion > 50% sand was used to categorise sandy layer (Figure 10 and Figure 11).

The sandy layer, gravel layer and basement rock surface of the site were characterised on the basis of the information from the previous surveys and drill hole observations (Table 3).

Table 3. Summary of main sediment layer properties in four drill holes at Dalswinton, sampled in 1988. na is data not available.

Layer	Characteristic	PDH1	PDH2	PDH3	PDH4
Upper sandy layer	Elevation range (mAHD	88.54-93.54	90.0-96.0	88.72-97.72	89.31-94.31
	Thickness	5.0	6.0	9.0	5.0
	Mean %sand	na	84%	87%	na
Gravel layer	Elevation range (mAHD)	85.54-88.54	85.5-90.0	83.72-88.72	83.31-89.31
	Thickness	3.0	4.5	5.0	6.0
	Mean %gravel	44%	32%	48%	56%
	Mean %sand	47%	38%	29%	29%
Basement rock	Surface elevation (mAHD)	85.54	85.5	83.72	83.31

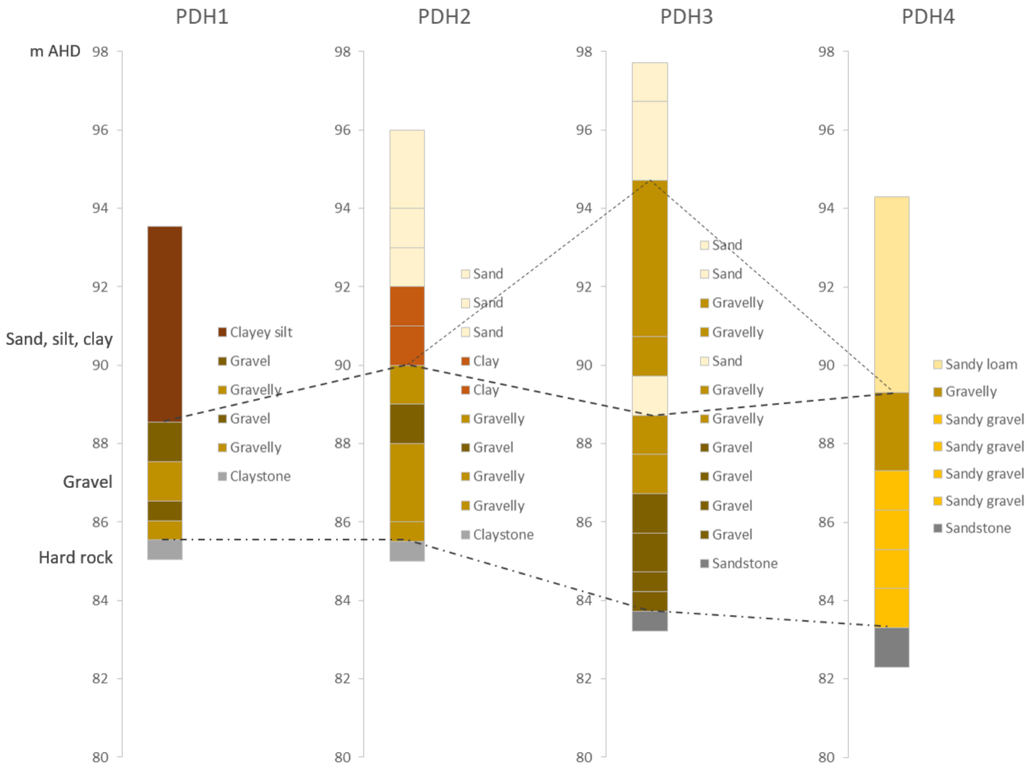

Figure 9. Soil or Rock Substance Description (abbreviated) on percussion drill hole Borehole Logs. Dotted line indicates an uncertainty in definition of top of the gravel layer on PDH3 that was resolved with other data (see text of this report). Source: Resource Planning (1994, Appendix 2). Elevations were converted from depths using surface elevations in Umwelt (1993).

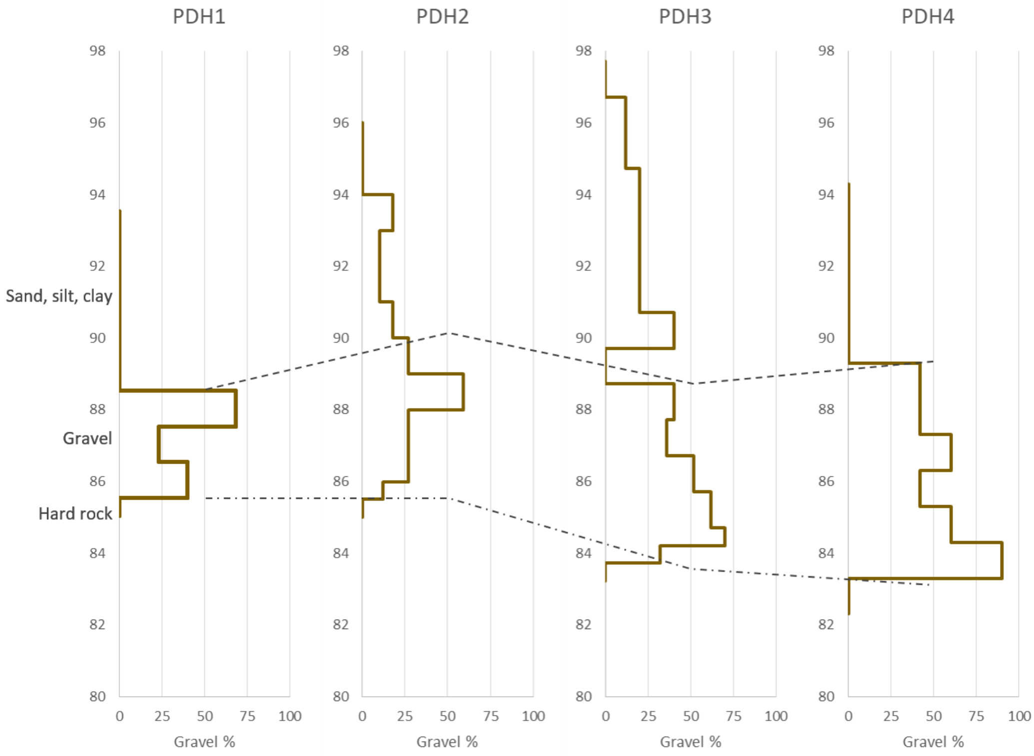

Figure 10. Gravel percentage composition on percussion drill hole Borehole Logs. Source: Resource Planning (1994, Appendix 2). Elevations were converted from depths using surface elevations in Umwelt (1993).

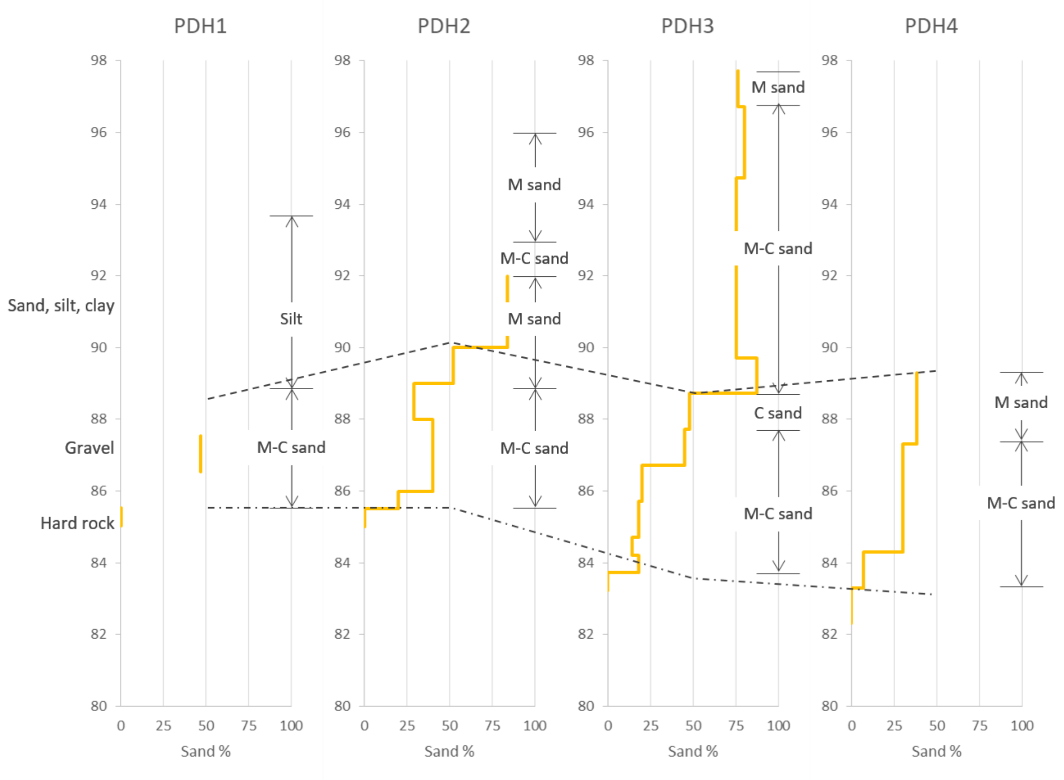

Figure 11. Sand percentage composition and texture class on percussion drill hole Borehole Logs. Source: Resource Planning (1994, Appendix 2). Elevations were converted from depths using surface elevations in Umwelt (1993). M = medium; C = Coarse.

4.2.2 Soil profiles (1994)

Three soil profiles were described in the previous EIS (Resource Planning, 1994, Appendix 3) (Figure 3). Soil Profiles 1 and 2 were in what is now known as Work Area 2 and are likely to represent current conditions in those locations, while Soil Profile 3 was in Work Area 1 and is now disturbed. These soil profiles are consistent with the data from the drill holes, indicating the undisturbed surface layer at the site comprises a shallow layer of loamy soil overlying a mostly sandy sub-soil (Table 4).

Table 4. Summary of descriptions of soil profiles from previous EIS (Resource Planning, 1994, Appendix 3).

Profile	Soil type	Description	Layers
Profile 1	Alluvial Soil	Profile occurs on completely cleared depression within the floodplain. Unimproved pasture with no signs of past or present erosion. Erosion hazard low. No salting evident. Very high run-on rate. No water table observed.	0 – 38 cm Silt loam 38 – 48 cm Fine sand 48 – 60 cm Silty clay loam
Profile 2	Alluvial Soil	Profile occurs on a completely cleared rise within floodplain. Surface hummocky due to deposition. Low quality unimproved pasture with high weed component and poor ground coverage. Water erosion hazard low, wind erosion hazard moderate. No salting evident. Very high run-on rate. No water table observed.	0 – 5 cm Silt loam 5 – 100 cm Coarse sand
Profile 3	Alluvial Soil	Profile occurs in completely cleared depression within the floodplain. Unimproved pasture with no signs of past or present erosion. Erosion hazard low. No salting evident. No water table observed. Very high run-on rate.	0 – 15 cm Silt loam 15 – 100 cm Sandy loam

4.2.3 Sediment profiles (September 2018)

The sieving procedure determined the particle size grading across the sand and gravel range (Figure 12). Samples from Bench 1 and Bench 2 were coarse grained, while the samples from Bench 3 and Bench 4 were fine grained. Information from the site inspection and estimated depth of sampling suggested that the boundary of the sand and gravel layers occurred at 87.5 m AHD.

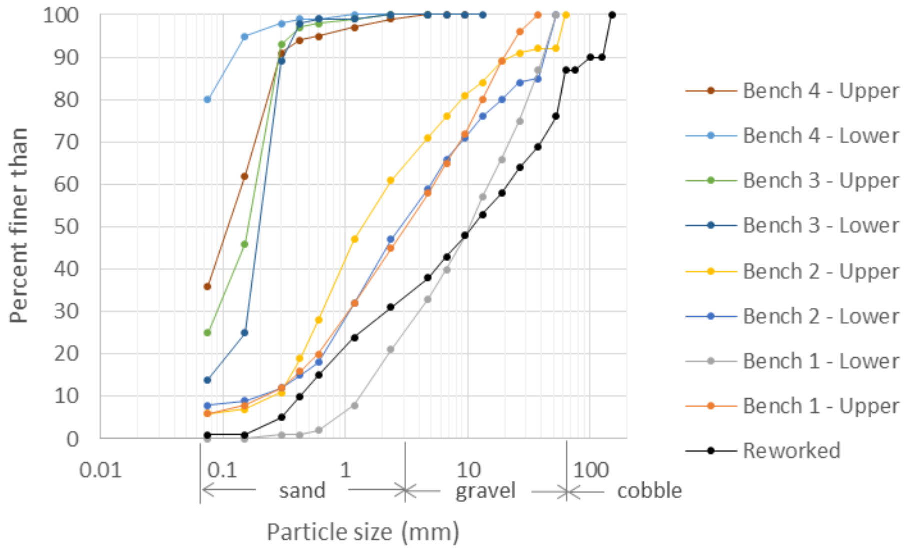

Figure 12. Particle size distributions of sediment sampled from the wall of the current mining pit in September 2019 representing proposed Work Area 2, and the reworked material sampled from proposed Work Area 1 in October 2018

Based on the Krumbein (Wentworth) classification, whereby silt <0.0625 mm, sand <2 mm, and gravel <64 mm, interpolation was used to determine the percent silt/clay, sand and gravel of the particle size distributions (Table 5). The coarse-grained unit varied from approximately 42% to 82% gravel and 18% to 52% sand. This is consistent with the estimates of the composition of the lower layers based analysis of samples from drill holes made at the site in 1988 (Table 3). The fine-grained unit had very little gravel and was nearly all sand, or in one case, nearly all silt/clay (Table 5). Again, this is consistent with the estimates of the composition of the upper layers based analysis of samples from drill holes made at the site in 1988 (Table 3).

The sample taken from the reworked sediment indicated this material was coarse grained, mostly gravel and cobble size, with 28.3% sand and only 1% silt /clay (Table 3). All of the reworked material coarser than 150 µm (98% of material) is currently considered usable.

Table 5. Particle size class composition of sediment sampled from the wall of the current mining pit in September 2019 representing proposed Work Area 2, and the reworked material sampled from proposed Work Area 1 in October 2018.

Sample	% silt/clay	% sand	% gravel	% cobble
Bench 4 – Upper (B4U)	35.3	63.3	1.5	0.0
Bench 4 – Lower (B4L)	78.4	21.6	0.0	0.0
Bench 3 – Upper (B3U)	24.5	75.3	0.2	0.0
Bench 3 – Lower (B3L)	13.7	86.0	0.2	0.0
Bench 2 – Upper (B2U)	5.9	51.8	42.3	0.0
Bench 2 – Lower (B2L)	7.8	35.6	56.6	0.0
Bench 1 – Upper (B1U)	5.9	36.0	58.1	0.0
Bench 1 – Lower (B1L)	0.0	17.9	82.1	0.0
Reworked	1.0	28.3	57.7	13.0

4.3 Topography of the bedrock, top of gravel, and existing ground surfaces

Five transects were drawn left bank to right bank (labelled A to E in downstream direction) across the Site, extending beyond the Site boundaries and including the Hunter River channel (Figure 13). The elevations of the bedrock, top of gravel layer and current surface were rendered on the cross-sections (Figure 14). Cross-sections A and B do not indicate a distinct gravel and sandy layer because they are located in Work Area 1, which is filled with material discarded from previous mining. Cross-section C passes through the current, exposed mining pit, the floor of which was observed to be a planar, relatively horizontal sandstone surface. Within the pit, the elevations of the bedrock and the top of the gravel layer are known with certainty, but are less certain elsewhere.

The sharp 2 m rise in the elevation of the bedrock surface on the right (southern) wall of the pit on Cross-section C is an artefact of triangulation of a limited number of estimated bedrock elevation data points used to generate the bedrock surface. The observation of a relatively flat and smooth bedrock surface on the floor of the pit at 82.2 m AHD elevation is inconsistent with the variable elevation of other bedrock data from the drill hole borelogs (Figure 9). If the bedrock surface elevation is consistently 82.2 m AHD across the Site, then the estimates of resource volume made here will be conservative (i.e. under-estimate).

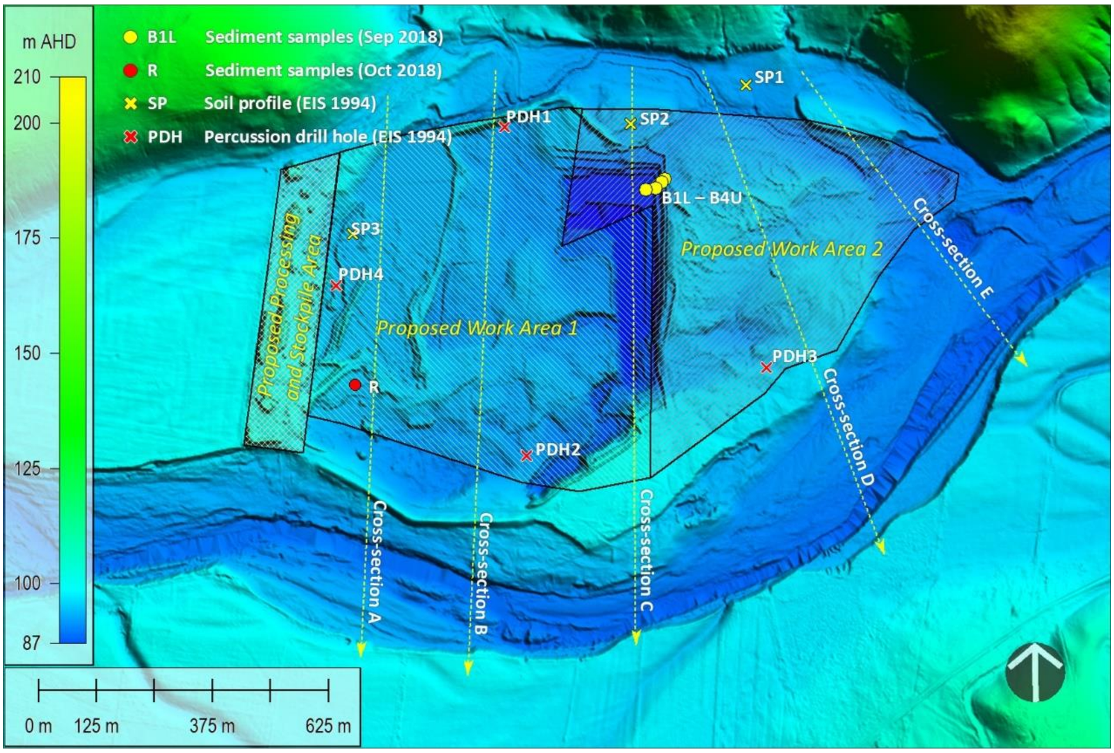

Figure 13. Location of transects across the Site under current conditions. Topography is represented by elevation data from early-2018 from ELVIS FSDF 2 m DEM, rendered with hill-shading. Locations of sediment samples taken in September and October 2018 and locations of soil profiles and percussion drill holes undertaken for the previous EIS also shown.

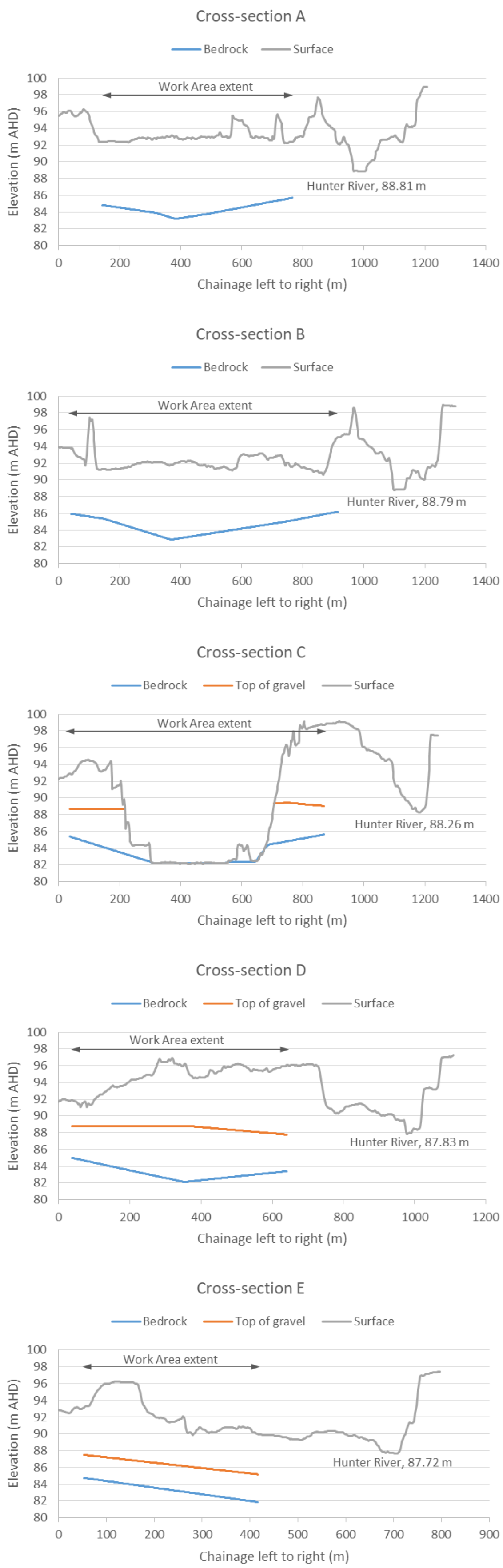

Figure 14. Cross-sections across the Site, showing profiles of the main layers and the Hunter River.

4.4 Estimated volume and mass of resource

The total volume and mass of available resource within Work Areas 1 and 2 were calculated, assuming all of the material could be extracted (Table 6 and Table 7).

The surface of the proposed final landform was subtracted from the surface of the existing landform to obtain an estimate of the net volume and mass after the resource has been extracted and the pit infilled and the final landform shaped. The amount of fill required to create the final landform is the volume extracted minus this volume.

Table 6. Volume of sand and gravel resource available at the Site.

Resource layer	Resource volume (m^3)	
	Work Area 1	**Work Area 2**
Sand/gravel reject material	3,627,079	-
Gravel lower layer	-	1,762,116
Sandy upper layer	-	2,173,637
Total resource available	3,627,079	3,935,753
Existing landform surface minus final landform surface	1,158,872	1,519,980
Fill required if all resource is extracted	2,468,207	2,415,773

Table 7. Mass of sand and gravel resource available at the Site.

Resource layer	Resource mass (tonne)	
	Work Area 1	**Work Area 2**
Sand/gravel reject material	6,673,825	-
Gravel lower layer	-	3,453,747
Sandy upper layer	-	4,260,329
Total	6,673,825	7,714,076
Existing landform surface minus final landform surface	2,132,324	2,979,161
Fill required if all resource is extracted	4,541,501	4,734,915

5 References

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Umwelt 1993. Dalswinton conceptual extraction plan. Appendix 7 in Resource Planning 1994. Environmental impact statement for gravel extraction and processing operation - Dalswinton Road, Denman, New South Wales. Umwelt (Australia) Pty Ltd., September.

Appendix: Material Test Reports

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Material Test Report

Report No: MAT:MUS18W-1683--S01
Issue No: 2
This report replaces all previous issues of report no 'MAT:MUS18W-1683--S01'

Client: Rosebrook Sand & Gravel
88 Campbells Road
Maitland Vale NSW 2320

Principal:
Project No.: MUS16P-0013
Project Name: Dalswinton Quarry

NATA WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Results provided relate only to the items tested or sampled.
This report shall not be reproduced except in full.

Approved Signatory: Steven Post
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 5/11/2018

Sample Details

Sample ID: MUS18W-1683--S01
Sampling Method: AS1141.3.1 cl 8.4.3
Date Sampled: 29/10/2018
Source: Dalswinton Quarry
Material: Raw Material
Specification:
Project Location: Dalswinton, NSW
Lot. No -
TRN -
Sample Location: Raw Material

Test Results

Description	Method	Result	Limits
Uncompacted Bulk Density (t/m³)	AS 1141.4	1.68	
Compacted Bulk Density (t/m³)		1.84	
Aggregate Moisture Condition		As Received	
Nominal Size of Sample (mm)		100	

Comments

Report re-issued due to incorrect material name.

Form No: 18909, Report No: MAT:MUS18W-1683--S01

Page 1 of 1

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Report No: HDR:MUS20W-1734

HILF Density Ratio Report

Client: Rosebrook Sand & Gravel
88 Campbells Road
Maitland Vale NSW 2320

Principal:
Project No.: MUS16P-0013
Project Name: Dalswinton Quarry

Date of Issue:

Sample Details

Location:	Dalswinton, NSW
Client Request ID:	-
Specification Requirements:	-
Field Test procedures:	AS 1289.5.8.1
Laboratory Test procedures:	AS 1289.2.1.1, AS 1289.5.7.1
Sampling Method:	AS1289.1.2.1 cl 6.4b
Source:	On-Site
Material:	Raw Material

Sample Data

Sample ID:	MUS20W-1734--S01	MUS20W-1734--S02	MUS20W-1734--S03	MUS20W-1734--S04	MUS20W-1734--S05	MUS20W-1734--S06
Date Tested:	2/11/2020	2/11/2020	2/11/2020	2/11/2020	2/11/2020	2/11/2020
Time Tested:	12:40	12:58	13:07	13:16	13:23	13:29
Location:	Expansion Pit	Expansion Pit	Expansion Pit	Expansion Pit	Expansion Pit	Expansion Pit
Soil Description:	Gravelly SAND	Gravelly SAND	Gravelly SAND	Gravelly SAND	Gravelly SAND	Gravelly SAND
Field and Laboratory Data						
Depth of Test (mm)	300	300	300	300	300	300
Depth of Layer (mm)	300	300	300	300	300	300
Field Moisture Content (%)	3.6	7.6	4.6	17.7	22.2	2.0
Field Wet Density (t/m³)	2.18	1.95	1.50	1.50	1.50	1.77
Field Dry Density (t/m³)	2.11	1.81	1.44	1.27	1.23	1.74
Peak Converted Wet Density (t/m³)	0.00	0.00	0.00	0.00	0.00	0.00
Optimum Moisture Content (%)	3.5	7.5	4.5	17.5	22.0	2.0
Moisture Ratio (%)	100.0	100.0	100.0	100.0	100.0	100.0

Comments