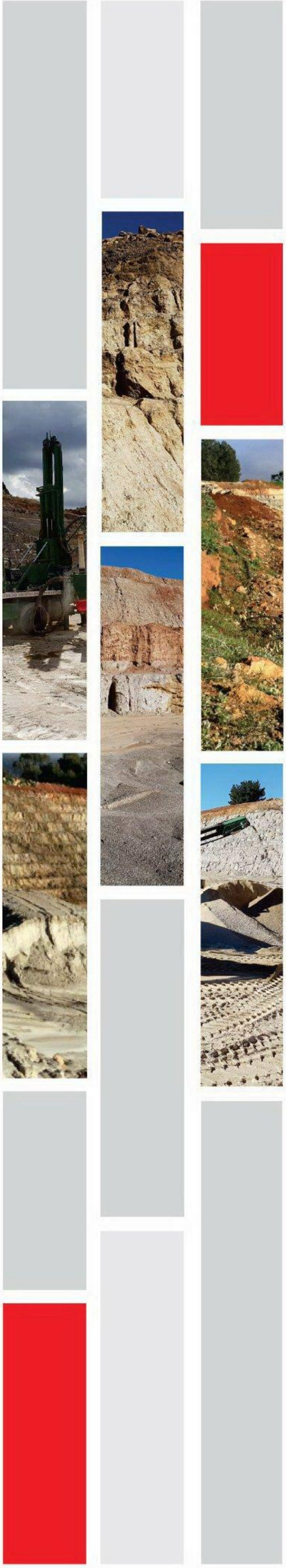

APPENDIX H

Water Management Plan

PGH BRICKS & PAVERS™

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PGH Bricks & Pavers Ltd

Water Management Plan
for:
Andersons Clay Mine
Environmental Impact Statement

November 2018

Prepared by:

VGT Environmental Compliance Solutions Pty Ltd

DOC18/188649

PGH Bricks & Pavers Ltd

Water Management Plan
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November 2018

Prepared by:	
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Report Date:	27/11/2018	
Report Number:	3618_AN_EIS_WMP_F0	
Report Authorised by:	Tara O'Brien	27/11/2018
	Joe Gauci	27/11/2018
Checked by:	Rich Mason	27/11/2018

Revision Table

Date	Version
2/08/2018	3618_AN_EIS_WMP_D0
3/10/2018	3618_AN_EIS_WMP_D1
27/11/2018	3618_AN_EIS_WMP_F0

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Appendices

Section 1. Introduction

1.1. Background

The subject land is described as Lot 2, DP 856969, 253 Shaw Road, Springdale Heights, located in the suburb of Springdale Heights, approximately 7km north east of Albury, see *Figure One.*

The land contains a functioning mine known as Anderson's Clay Mine.

The property is owned by PGH Bricks and Pavers Pty Ltd under freehold title.

A development application is being sought for the proposed expansion of an existing clay mine located at 253 Shaw Street, Springdale Heights. The proposed development is deemed to be a Designated Development in Schedule 3 of the Environmental Planning and Assessment Regulation 2000 and a request for the Secretary's Environmental Assessment Requirements (SEARs) was made in April 2017. The SEARs were issued by the Secretary on the 18th of May 2017.

The aim of this report is to provide additional information, as guided by the SEARs to assist the Department and relevant authorities in determining the development application.

1.2. Secretary's Requirements

1.2.1. SEARs

The SEARs require that the EIS, which will include this report, shall address the following issues relating to water.

Table 1. SEARs Water Issues to be Addressed

Key Issue	Where Addressed in this Document
A detailed water balance and an assessment of any volumetric water licencing requirements, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures.	Section 5, Section 3.4, e
Identification of any licencing requirements or other approvals required under the Water Act 1912 and/or Water Management Act 2000.	Section 2.1.4 & Section 5.8
Demonstration the water for the construction and operation of the development can be obtained from as appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing plan (WSP).	Section 2.1.4 & e
A description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant Water Sharing Plan of water source embargo.	Section e
An assessment of activities that could cause erosion or sedimentation issues, and the proposed measures to prevent of control these impacts.	Section 6.4.2
An assessment of potential impacts on the quality and quantity of existing surface and groundwater resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives.	Section 3.5, Section 3.5.2, Section 5, Section 6 Section 3.6, Section 7
A detailed description of the proposed water management system, water monitoring program and other measures to mitigate surface and groundwater impacts.	Section 6, Section 7 & Section 8

1.2.2. Council Requirements

Table 2. Albury City Council Water Issues to be Addressed

Key Issue	Where Addressed in this Document
The EIS should include an assessment of all potential impacts of the proposed development on the existing environment (including cumulative impacts where relevant and appropriate).	Section 6 & Section 7

Particular areas/issues of focus:
• Stormwater collection, management and disposal,
• Water management including:
  o Current water quality on site- including leachate ponds.
  o Surface water management
  o Groundwater management
  o Wash down bays for equipment.
• Chemical storage
	Section 3, Section 4, Section 6, Section 7 & Section 8

1.2.3. DPE Royalties and Advisory Services Requirements

Table 3. DPE Water Issues to be Addressed

Key Issue	Where Addressed in this Document
Where a void is proposed to remain as part of the final landform, include: iii) Outcomes of the surface and groundwater assessments in relation to the likely final water level in the void. This should include an assessment of the potential for fill and spill along with measures required to be implemented to minimise associated impacts to the environmental and downstream water users.	Section 5.8

1.2.4. EPA Requirements

Table 4. EPA Water Issues to be Addressed

Key Issue	Where Addressed in this Document
<u>Potential Environmental Impacts of the Project</u> The objectives of the proposal should be clearly stated and refer to and include the following: • Environment protection measures, including noise mitigation measures, dust control measures and **erosion and sediment control measures** (*emphasis added*). • Mitigation and management options that will be used to prevent, control, abate or mitigate identified potential environmental impacts associated with the project and to reduce risks to human health and prevent the degradation of the environment. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.	Section 6, Section 7, Section 8 & Section 9
<u>Potential Impacts on Water Quantity and Quality</u> The EIS should provide details of the project that are essential for predicting and assessing impacts to waters including (but not limited to the following). • The site layout with details of site drainage and any natural or artificial waters within or adjacent to the development.	Figure Two, Figure Three, Figure Four, Figure Five & Figure Six
• Drainage works and associated infrastructure showing areas of modification to contours and drainage, land forming and excavations, working capacities of structures and water resource requirements of the proposal. Total water cycle considerations are to be addressed showing total water balances for the development including water requirements (quantity, quality and sources(s)) and proposed stormwater and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.	Figure Two, Figure Three, Figure Four, Figure Five & Figure Six Section 5, Section 6
• The quantity and physio-chemical properties of all potential water pollutants and the risks they pose to the environment and human health.	Section 3
• The identification of any proposed water pollution control measures and their performance including how the proposal will avoid	Section 3, Section 4 & Section 6

Key Issue	Where Addressed in this Document
proximity to water resources and how materials will be stored to avoid the possibility of accidental spills. • How containment of spills and leaks or discharges with potential for water or land impacts shall be manages in accordance with industry technical guidance and relevant Australian Standards in order to achieve project goals.	Section 4
• A characterisation of potential water pollutants at the site should also be undertaken including the identification of any proposed water pollution controls and their performance. This should include details of the design and location of overburden disposal sites and any other wastewater treatment ponds.	Section 3.3, Section 4, Section 6 Figure Two, Figure Three, Figure Four, Figure Five & Figure Six

Section 2. Statutory Requirements and Guidelines

2.1. Environmental Planning and Assessment Act 1979

The clay extraction activities will continue to be subject to the provisions of the EP&A Act for any subsequent changes or modifications to the operations. Additionally the operations will need to be able to demonstrate compliance against the current Conditions of Approval issued under the provisions of the EP&A Act.

2.1.1. Council Consent Conditions

In August 1983, the Albury -Wodonga Development Corporation granted a permit (number N72), which approved the mining of clay brick within the north-eastern portion of the subject land. The activity involved an area of 7.975 hectares. The permit did not include an end date to the approval.

Council consent conditions that pertain to the discharge of water offsite are reproduced below.

Condition 6

i) The permit holder shall ensure that all water discharged from the permit area first passes through settling dams to ensure that only clear water is discharged. Water discharged into any adjacent watercourse shall be done in such a manner and be of such quality as to meet any requirements of the State Water Resources Commission and Soil Conservation Service.

ii) The settling dams shall be regularly cleared of sludge which shall be disposed of in such a manner as not to pollute any drains or water courses.

ii) Additional drainage works shall be carried out as directed by, and to the satisfaction of the Corporation.

2.1.2. NSW Environment Protection Authority (EPA)

An EPL application was submitted to the EPA (with report *Discharge Protocol for the Andersons Clay Mine* ref: 4092_BA_DP_2017_F0) on the 31st of March 2017 in order to comply with the consented extraction tonnages and to include a licenced discharge point. Licence 20938 was granted on the 21st of June 2017.

The water monitoring sites are described below.

Water and land

EPA Identi-fication no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1		Water quality discharge point	Energy dissipator/level spreader at in-pit sedimentation dam
3	Monitoring prior to discharge		In-pit sedimentation dam

Concentration limits on the discharged water are shown below.

POINT 1

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
TSS	milligrams per litre				50

2.1.3. Water Access Licence

The Water Management Act 2000 identifies basic landholder rights and when access licences are required. The harvestable water right is defined in terms of and equivalent dam capacity, the Maximum Harvestable Right Dam Capacity (MHRDC). Schedule 1 of the Water Management Regulation exempts certain classes of dam including those dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by a public authority to prevent the contamination of a water source. Therefore, as the on-site dams are used solely for the capture, containment and reticulation of drainage, consistent with best management practice to prevent impacts to Humbug Gully, the dams are currently exempt from the need to obtain a licence under the WM Act.

The site is located within the Murray Unregulated and Alluvial Water Source water sharing plan. It is not planned to extract water from the natural rivers, creeks, in-river or off-river pools therefore licencing is not required.

The local aquifer is identified as the Lachlan Fold Belt Groundwater Source. The development is not expected to intercept the groundwater source at the mine due to the ridgeline setting and no licencing will be required.

2.2. Objectives

The principle objectives of this Water Management Plan are set out below:

- Assessment of potential impacts on the quality and quantity of existing surface and groundwater resources;
- Identify all potential water pollutants and the risks they pose to the environment and human health;
- Provide proposed water pollution control measures and assessment of their performance;
- To minimise erosion and sedimentation from all active and rehabilitated areas, thereby minimising sediment ingress into surrounding surface waters;
- To ensure the segregation of 'dirty' water from 'clean' water and maximise the retention of time of 'dirty' water such that any discharge from the project site meets the relevant water-quality limits, including limits contained in the relevant guidelines and any limits imposed by specific project approvals. 'Dirty' water is defined as surface runoff from disturbed catchments. 'Clean' water is defined as surface runoff from catchments that are undisturbed or rehabilitated catchments;
- To minimise the volume of water discharged from the project site but, should the discharge of water prove necessary, ensure sufficient settlement time is provided prior to discharge or employ other means such as flocculants to ensure the water meets the objectives identified in the point above;
- To monitor the effectiveness of surface water and sediment controls and to ensure all relevant surface water quality criteria are met;
- To determine a water balance for the site based on current and projected usage;
- Develop a set of performance criteria and appropriate actions based on a risk assessment of the site;
- Determine the likely final water level in the void and assess the impact to the environment and downstream water users; and
- Identify any licencing requirements or other approvals required under the Water Act 1912 and/or Water Management Act 2000.

Plan of:	Water Management Plan for Andersons Clay Mine Environmental Impact Statement 2018 - Site Location	Location:	253 Shaw Street, Springdale Heights, NSW	Source:	nearmap - Image Date 01/05/2018 & Google Maps 2018	Our Ref:	3618_BAN_WMP_DA17_C001_V2_F1.cdr
Figure:	ONE	Council:	Albury Wodonga Shire Council	Survey:	N/A	Plan By:	JD
Sheet:	1 of 1	Tenure:	Permit Number N72	Projection:	N/A	Project Manager:	TO
Version/Date:	V2 04/10/2018	Client:	PGH Bricks & Pavers Pty Ltd	Contour Interval:	N/A	Office:	Thornton

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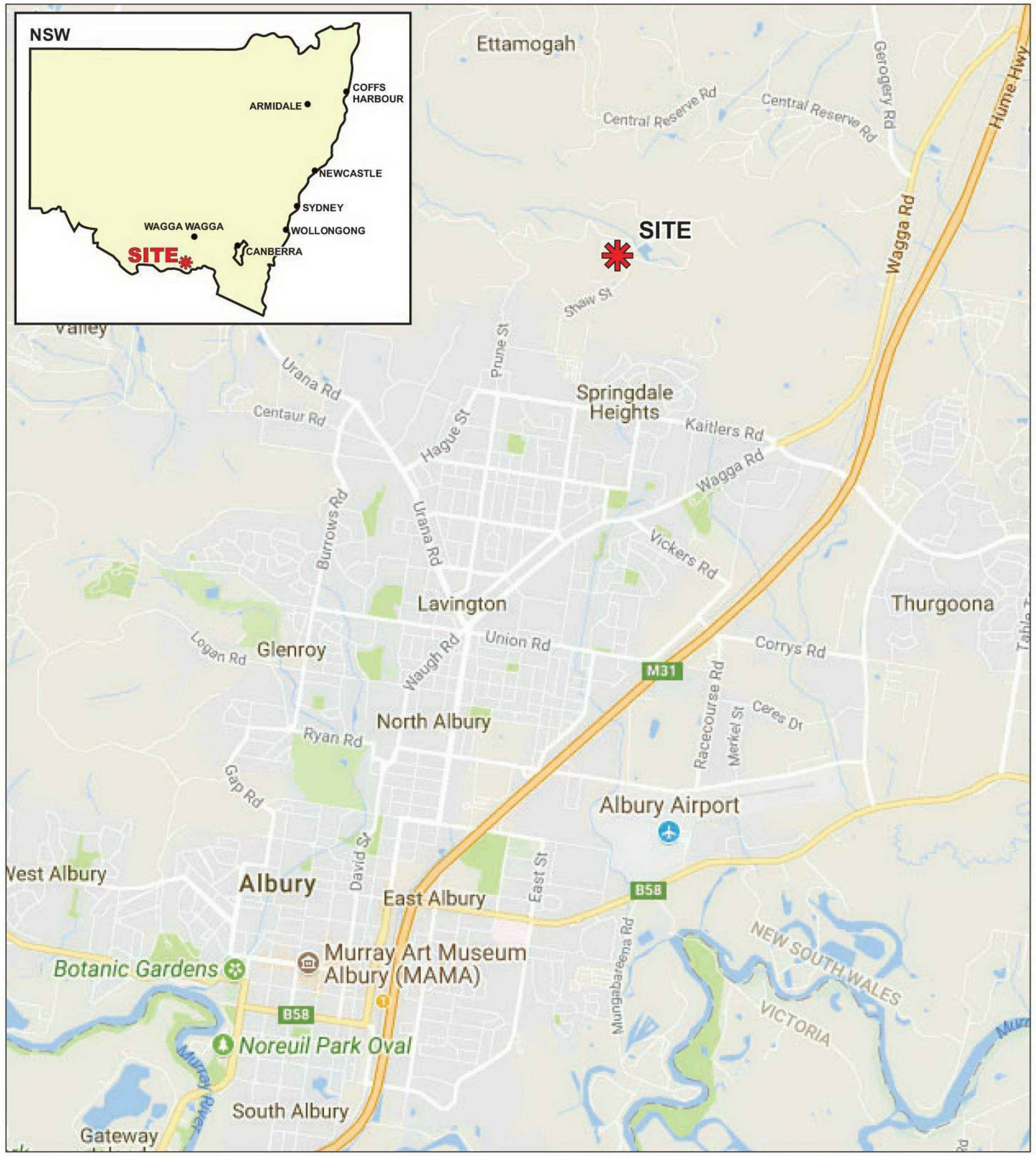

Approx Scale: 0 1 2km

Approx Scale: 0 150m

Legend

- Site (*Lot 2 DP 856969*)
- N72 Consent Boundary
- Lot Boundary

Manager/Authorisation Holder PGH Bricks & Pavers Pty Ltd: Joe Gauci

Signed:

Date: 27/11/2018

Project Manager VGT: Tara O'Brien

Signed:

Date: 27/11/2018

Plan of:	Water Management Plan for Andersons Clay Mine Environmental Impact Statement 2018 - Site Layout	**Location:**	253 Shaw Street, Springdale Heights, NSW	**Source:**	nearmap - Image Date 01/05/2018 & Landair Surveys	**Our Ref:**	3618_BAN_WMP_DA17_C002_V2_F2.cdr
Figure:	TWO	**Council:**	Albury - Wodonga Shire Council	**Survey:**	Landair Surveys - Image Flown 08/02/2017	**Plan By:**	SK/JD
Sheet:	1 of 1	**Tenure:**	Permit Number N72	**Projection:**	MGA	**Project Manager:**	TO
Version/Date:	V2 04/10/2018	**Client:**	PGH Bricks & Pavers Pty Ltd	**Contour Interval:**	1m	**Office:**	Thornton

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Section 3.Existing Water Environment

3.1. Geology and Soils

The resource in Andersons Clay Mine consists of two types of clay, a weathered granite from the Silurian period and a weathered Phyllite from the upper Ordovician. The contact between these two rock types runs diagonally through the north-west corner of the property boundary. The Phyllite (in the north west) has a high percentage of mica, which provides PGH with a very unique type of brick product.

The site is located within two different soil landscapes, the Livingstone Soil Landscape to the north and the Dora Dora Soil Landscape to the south.

3.1.1. Livingstone Soil Landscape

According to the Environment NSW eSpade online data the Livingstone Soil Landscape is characterised by rolling to steep low hills to hills on Ordovician metasedimentary rocks. It also contains narrow crests, ridges and upper slopes, moderately long, straight to waning mid to lower slopes and narrow drainage lines. Slopes are in the order of 20-33% with local relief from 50-150m. Elevations range from 260m to 480m with the project site averaging approximately 300m.

The soils are described as shallow (<50cm) Mesotrophic Paralithic Leptic Rudodols (Lithosols) on crests, ridges and upper slopes, moderately deep (50-100cm) mesotrophic Red Chomosols and Eutrophic brown Kurosols (Red and Brown Podzolic Soils) on mid – lower slopes and moderately deep (50-100cm) Mesotrophic Brown Kandosols (Brown Earths) on lower slopes and in drainage lines.

The soil is considered as erosional with greater than 15cm of soil has been lost through sheet erosion on most cleared pasture land and burnt areas. Minor to moderate gully erosion is common along drainage lines. Gullies are up to 1.5m deep, most to bedrock.

3.1.2. Dora Dora Soil Landscape

According to the Environment NSW eSpade online data the Dora Dora Soil Landscape is characterised by rolling hills on granite with slopes from 10-30%, occasionally up to 40%. Local relief ranges from 30-90m with elevations from 200-480m. It includes broad crests and ridges, steep straight slopes and narrow drainage lines.

The crests and flatter slopes are composed of deep (1.0-1.5m), moderately well-drained Brown and Red Kandosols and Dermosols (Red Earths). Other slopes are made up of moderately deep (0.5-1.0m), very well-drained Bleached (sporadically) Leptic Tenosols and Rudosols (Lithosols).

There are localised moderately discontinuous, shallow gully erosion in some drainage depressions and localised mass movement of steeper slopes.

3.2. Topography

The site is located in a ridge on the northern outskirts of Albury with the highest elevations at approximately 320m RL in the south sloping to 300mRL to the north.

Slopes on the site range from 5 to 45 % with the steeper slopes within the excavation itself.

3.3. Site Features

The site has a number of features listed below:

- Light vehicle parking is available at the end of Shaw St and outside the property boundary, if required. Generally heavy vehicles are parked and loaded on the pit floor;
- Bundwalls are located around the perimeter of the site;
- The site surface, excluding the pit is includes dams, overburden and topsoil stockpiles, grass and vegetation. Roads are constructed of gravel;
- Humbug Gull creek runs to the north of the site outside the property bounds; and
- There are a number of remnant vegetation areas as well as revegetated tree stands.

3.3.1. Chemical Storage

No chemicals are stored on site. Contractors may refuel plant and equipment on site and have spill kits available at all times.

3.3.2. Contaminated Sites Register/ Dangerous Goods

A search of the NSW EPA Contaminated Land Register shows that the site has not been notified to the EPA. The proponent advises that there are no dangerous goods held on site.

3.3.3. Potential Contaminants

These items have been used on the site in small quantities and whilst unlikely to have caused contamination impacts, have been listed for reference below.

Table 5. Site Use Summary and Associate Potential Contaminants

Site Use/ Contaminant Source	Potential Contaminants	Volumes Held/ Control Methods
Weed and pest spraying	Herbicides and Pesticides (OCP's and OPP's)	Weed and Pest control is undertaken by licenced contractors. Chemicals are not stored on site and only minor amounts are used.
Fuel Storage	Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl benzene, Xylene (BTEX), Polycyclic Aromatic Hydrocarbons (PAHs)	Diesel on site is limited to that within the plant and equipment with the exception of refuelling tanks. No fuel is stored on site. Refuelling is conducted in bunded/hardstand areas.
Oils/Solvents/Lubricants in production and maintenance	Hydrocarbons	Oils on site are limited to that within the plant and equipment. All vehicle and machine maintenance is conducted offsite.

Plan of:	Water Management Plan for Andersons Clay Mine Environmental Impact Statement 2018 - Regional Setting	*Location:*	253 Shaw Street, Springdale Heights, NSW	*Source:*	nearmap - Image Date 1/05/2018	*Our Ref:*	3618_BAN_WMP_DA17_C003_V2_F3.cdr
Figure:	THREE	*Council:*	Albury - Wodonga Shire Council	*Survey:*	N/A	*Plan By:*	TO/JD
Sheet:	1 of 1	*Tenures:*	Permit Number N72	*Projection:*	N/A	*Project Manager:*	TO
Version/Date:	V2 04/10/2018	*Client:*	PGH Bricks & Pavers Pty Ltd	*Contour Interval:*	N/A	*Office:*	Thornton

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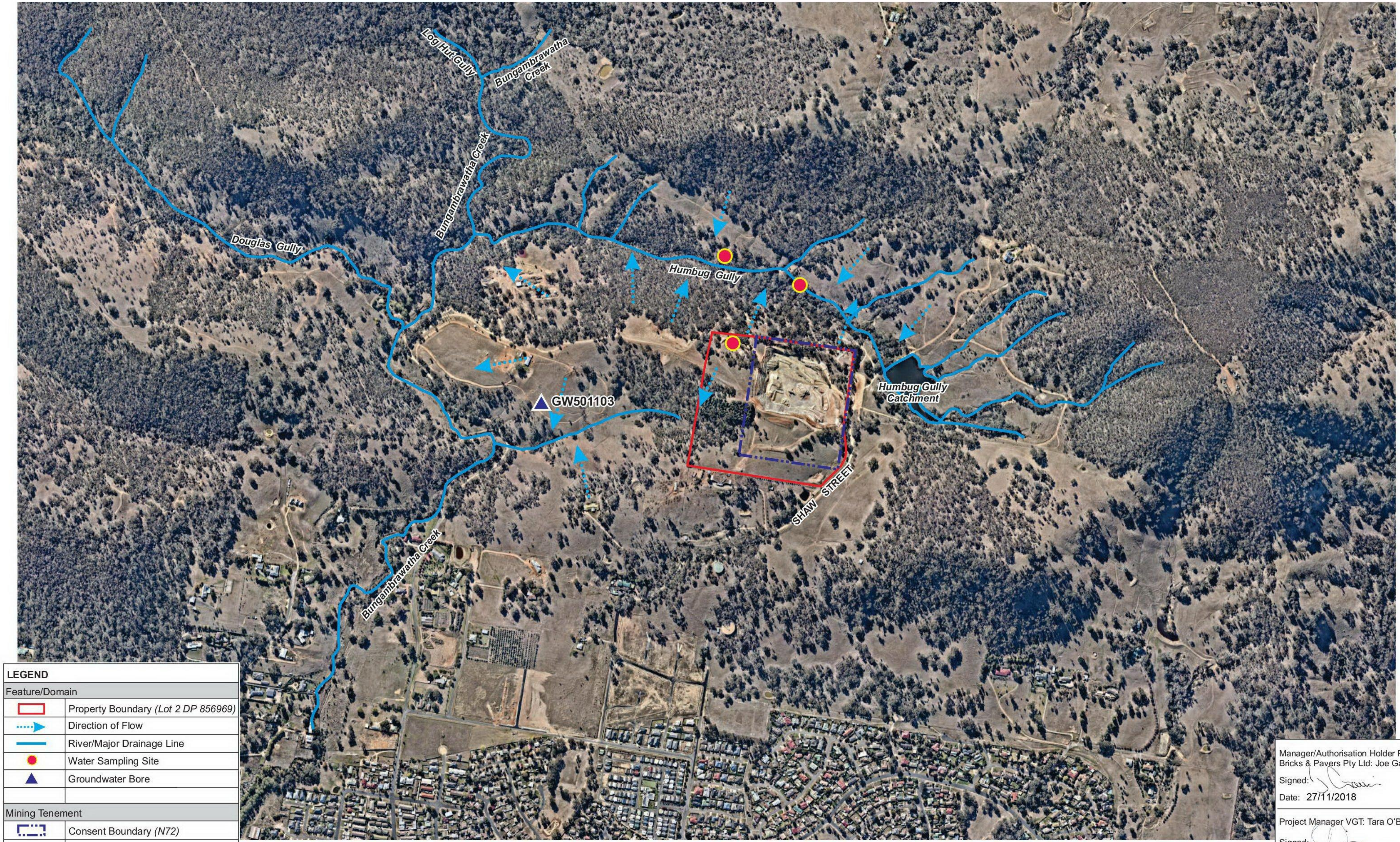

LEGEND

Feature/Domain	
	Property Boundary *(Lot 2 DP 856969)*
	Direction of Flow
	River/Major Drainage Line
	Water Sampling Site
	Groundwater Bore
Mining Tenement	
	Consent Boundary *(N72)*

Manager/Authorisation Holder PGH Bricks & Pavers Pty Ltd: Joe Gauci
Signed:
Date: 27/11/2018

Project Manager VGT: Tara O'Brien
Signed:
Date: 27/11/2018

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Plan of:	Water Management Plan for Andersons Clay Mine Environmental Impact Statement 2018 - Existing & Proposed Traffic Management Plan
Figure:	FOUR
Sheet:	1 of 1
Version/Date:	V2 04/10/2018

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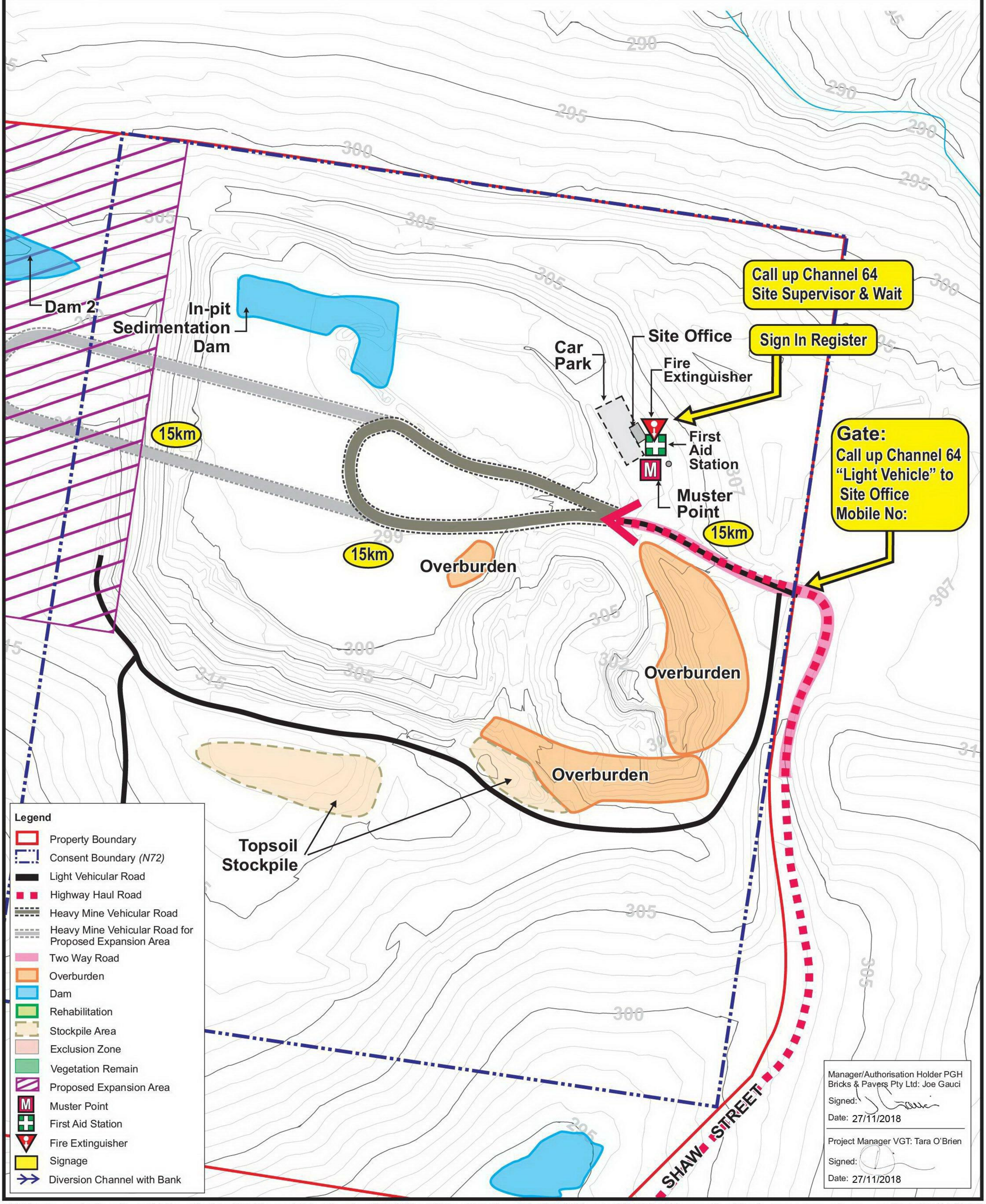
Location:	253 Shaw Street, Springdale Heights, NSW	***Source:***	nearmap - Image Date 10/10/2017	***Our Ref:***	3618_BAN_WMP_DA17_C004_V2_F4.cdr
Council:	Albury - Wodonga Shire Council	***Survey:***	Landair Survey Flown 08/02/2017	***Plan By:***	JD
Tenures:	Permit Number N72	***Projection:***	MGA	***Project Manager:***	TO
Client:	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	1m	***Office:***	Thornton



Manager/Authorisation Holder PGH Bricks & Pavers Pty Ltd: Joe Gauci
Signed:
Date: 27/11/2018

Project Manager VGT: Tara O'Brien
Signed:
Date: 27/11/2018

3.4. Catchments and Watercourses

Prior to development, surface water captured on the northern portion of the ridge transecting the site would drain into Humbug Gully creek and thence to Bungambrawatha Creek which reaches the Murray River at Albury some 8km from the site. Surface water captured on the south western portion of the ridge drains to an unnamed creek to the west which joins Bungambrawatha Creek. In the south east surface water drains to a number of farm dams located off the site and any overflows are directed alongside Shaw Street until it disperses into rural pastures in the south west.

With the development of the mine, surface water captured to the north of the ridge line is directed to the pit sump. A small clean water catchment is located to the west of the current pit along the ridgeline and drains into a farm dam. Outside of these catchments, clean surface water continues to flow the natural drainage lines outlined above. Thus, the site currently has one dirty water catchment that requires management.

3.4.1. Catchment One

This comprises the current pit area and the pit sump. The sediment dam capacity within the void is shown in *Table 6* below. The volume of the sediment dam required to catch the design storm event within the disturbed area as recommended by the Managing Urban Stormwater Soils and Construction –Volume 2E Mines and Quarries guideline is shown in *Table 7* below.

Table 6. Catchment Volumes

Dam Identification/ Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 90th percentile, 5-day rainfall event for a 5-day management period (m^3)	Dam Volume Required for 90th percentile, 5-day rainfall event for a 20-day management period (170%) (m^3)
Disturbed Mine Area	4.7	86	1,059	1,145	1,947

Assumptions for soil characteristics for the calculations in the table above are discussed in *Section 6.4*.

Table 7. Total Sediment Dam Volumes

Dam Identification/ Catchment	Dam Area (m^2)	Estimated Depth (m)	Estimated Volume (m^3)
In-Pit Sedimentation Dam	1,928*	4	7,712

*Note: Area estimated from Nearmaps 2017 photo data

As can be seen from the calculations above the current sediment dam is sufficient to contain the design storm event. It should be noted however that the total void has a vastly greater volume, at approximately 1,447,000m^3 before it would overtop.

3.4.2. Catchment Two

This comprises the clean water catchment of approximately 1.3Ha to the west of the pit which contains a farm dam. The dam overtops via a spillway once sufficient rainfall is received and eventually drains into Humbug Gully.

Plan of:	Water Management Plan for Andersons Clay Mine Environmental Impact Statement 2018 - Existing Catchments	Location:	253 Shaw Street, Springdale Heights, NSW	Source:	nearmap - Image Date 01/05/2018	Our Ref:	3618_BAN_WMP_DA17_C005_V2_F5. cdr
Figure:	FIVE	Council:	Albury - Wodonga Shire Council	Survey:	Landair Surveys - Image Flown 08/02/2017	Plan By:	TO/JD
Sheet:	1 of 1	Tenures:	Permit Number N72	Projection:	MGA	Project Manager:	TO
Version/Date:	V2 04/10/2018	Client:	PGH Bricks & Pavers Pty Ltd	Contour Interval:	1m	Office:	Thornton

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3.5. Surface Water

3.5.1. Surface Water Quality

3.5.1.1. Project Site

Although the site does not have specific limits on discharged water quality stated in the consent conditions, the EPL has the following limits.

- Total Suspended Solids (TSS) will be less than 50mg/L.

Although not an EPL requirement, it is recommended that the pH of the water to be discharged is measured and should comply with the following.

- The pH will be between 6.5 to 8.5.

Testing of the site dams have been conducted on a one-off basis to date and the results are shown in the table below.

Table 8. On-Site Water Analysis

Date	Location	Temperature (ºC)	pH	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)
31/3/2017	Top of Hill Pond	21.0	6.8	112	25
31/3/2017	Main Pit Pond	21.4	7.2	56	2,550*

*Note- site not discharging.

It is deducted from the above data that the main issue for the discharge of water from the site will be in reducing the sediment load.

3.5.1.2. Receiving Environment

No extensive water testing has been conducted in the area or onsite in the past. The watercourses in the area are ephemeral and this presents some difficulty in undertaking a regular water monitoring program of the receiving environment. Sampling of the upstream and downstream environment was undertaken by VGT on the 8th of September 2017.

Table 9. Receiving Environment Water Analysis

Date	Location	Temperature (ºC)	pH	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)
8/9/2017	Upper Sediment Pond (clean water dam)	17.3	6.3	205	13
8/9/2017	Upstream (Humbug Gully)	17.3	6.3	140	7
8/9/2017	Downstream (Humbug Gully)	17.5	6.4	73	9

On the basis of the results above it can be said that the receiving environment is of low conductivity and low total suspended solids. A review of the data available on the DPI-Water website for the Murray River at Albury, of which the site eventually drains to, indicates the conductivity of the river is less than 100µS/cm and a pH range of 7 to 8.

The pH of the surrounding environment is somewhat low, however this is likely to be a reflection of the surrounding surface soils.

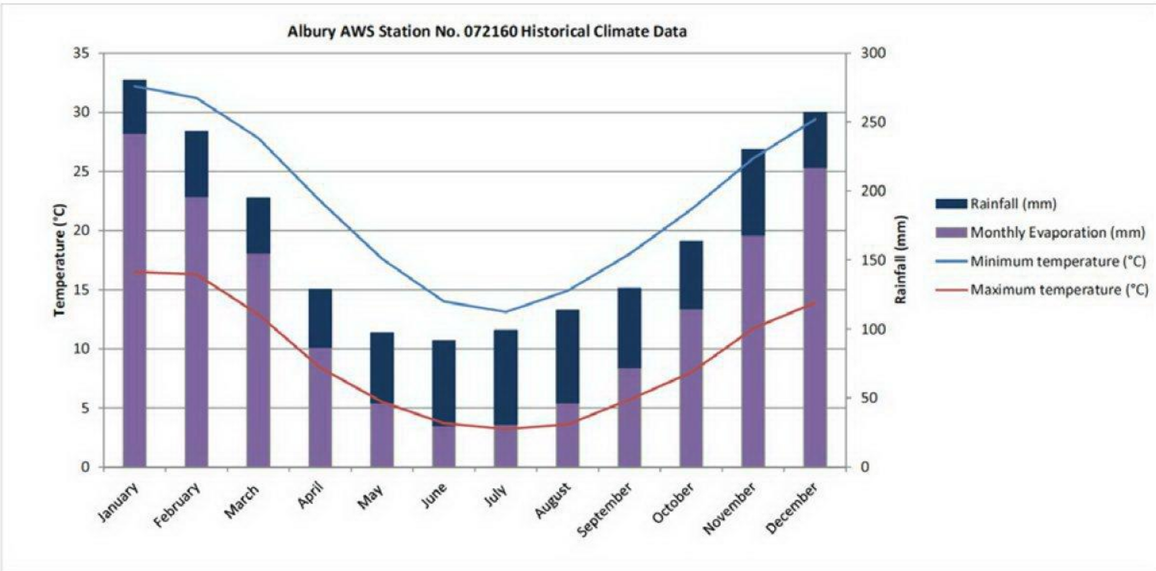
3.5.2. Surface Water Quantity

The volume of water captured over the current disturbed area has been calculated for the design storm event in *Section 3.4* as is the volume currently held in the In Pit Sedimentation Dam. The water balance in *Section 5* illustrates the expected volumes of water that will be managed on the site currently and also during the expansion of the pit.

3.5.3. Rainfall and Evaporation

The closest Bureau of Meteorology Station is Albury Airport (AWS- Station Number 072160, 36.07ºS, 146.95ºE), approximately five kilometres south from the project site. The historical climate data (1993-2017) indicate that on average, January is the hottest month of the year with a mean maximum temperature of 32.2ºC and July is the coldest month of the year with a mean minimum temperature of 3.2ºC. The historical climate data (1993-2017) indicate that on average, July is the wettest month of the year with a mean monthly total rainfall of 68mm and January is the driest month of the year with a mean monthly total rainfall of 38.5mm. Total annual rainfall recorded historically is 624mm.

The closest station with evaporation observations is the Hume Reservoir (Station Number 072023, 36.10ºS, 147.03ºE), about 12km to the northwest of the site. The lowest evaporation occurs in June July with the highest evaporation occurring in January. The mean daily evaporation recorded at the Hume Reservoir is 3.9mm/month



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3.6. Groundwater

3.6.1. Groundwater Quality

No groundwater has been encountered at the site and no groundwater is expected to be encountered during the development. The closest bore (GW501103) according to DPI-Water is located approximately 600m from the site to the west. Data indicates that water bearing zones were found between 30 to 36 m and 72 to 78m from the top of the hole in a blue shale material. The RL of the surface of the bore location is estimated to be some 50m lower than the base of the present pit. Salinity data indicates that the upper water bearing zone is saline at 3,300 mg/L of total dissolved solids whilst the lower water bearing zone is somewhat less saline at 1,500mg/L.

3.6.2. Groundwater Quantity

No data is available on the quantity of groundwater in any aquifers present on the site. Probably due to the ridgeline setting, groundwater does not appear well utilised around the site for stock, domestic or irrigation purposes compared with the much lower gullies closer to the Murray River. As the project is unlikely to use or encounter any regional groundwater tables the development is not expected to impact groundwater quantities. To date the current mine faces have not shown any seepage of groundwater.

Section 4. Proposed Water Management

4.1. Proposed Changes to the Catchments

As the mine progresses to the west, the Catchment Two will be integrated into Catchment One. All the surface water captured within the disturbed area of the pit will be diverted to the In-Pit Sedimentation Dam. The total dirty water catchment will increase in area from approximately 4.7ha to 11Ha.

The volume of the sediment dam required to catch the design storm event within the fully developed disturbed area as recommended by the *Managing Urban Stormwater Soils and Construction –Volume 2E Mines and Quarries* guideline is shown in *Table 10* below.

Table 10. Catchment Volumes of Developed Site

Dam Identification/ Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 90th percentile, 5-day rainfall event for a 5-day management period (m^3)	Dam Volume Required for 90th percentile, 5-day rainfall event for a 20-day management period (170%) (m^3)
Developed Disturbed Mine Area	11	274	2478	2,752	4,678

The current In-Pit Sedimentation Dam is estimated to have a capacity of approximately 7,700 cubic metres as shown in *Section 3.4.1*. Thus, the sediment dam is of sufficient capacity to contain the design storm event.

All clean water will be diverted around the site via earthen bunds is necessary. Due to the ridgeline setting clean water will naturally fall away from the pit.

Plan of:	Water Management Plan for Andersons Clay Mine Environmental Impact Statement 2018 - Developed Site Catchments	**Location:**	253 Shaw Street, Springdale Heights, NSW	**Source:**	nearmap - Image Date 01/05/2018 & Landair Surveys	**Our Ref:**	3618_BAN_WMP_DA17_C006_V2_F6.cdr
Figure:	SIX	**Council:**	Albury - Wodonga Shire Council	**Survey:**	Landair Surveys - Image Flown 08/02/2017	**Plan By:**	SK/JD
Sheet:	1 of 1	**Tenure:**	Permit Number N72	**Projection:**	MGA	**Project Manager:**	TO
Version/Date:	V2 04/10/2018	**Client:**	PGH Bricks & Pavers Pty Ltd	**Contour Interval:**	1m	**Office:**	Thornton

This figure may be based on third party data which has not been verified by vgt and may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and vgt does not warrant its accuracy.

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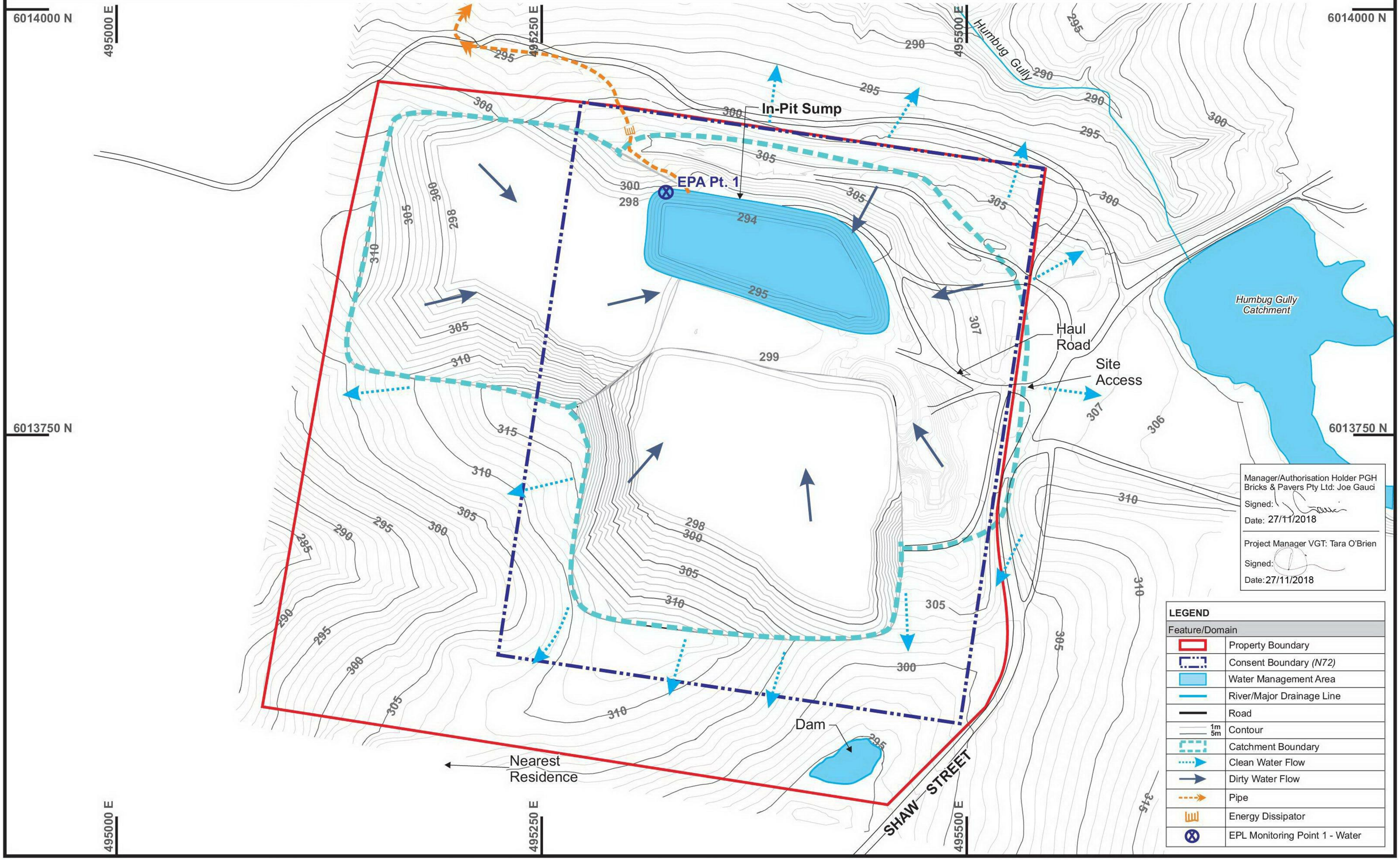

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4.2. Discharge

4.2.1. Determining Need for Discharge

Since the pit has a fairly vast storage capacity, the need to maintain capacity for the design storm event is not the driving factor from determining the need to discharge. The need to discharge will be determined on the need for extraction within the mine void, other mining related operations within the pit. Moreover, a small volume of water may be retained onsite for dust suppression.

4.2.2. Maintaining Dam Levels

The In-Pit Sedimentation Dam will be pegged to indicate the maximum sediment level that can be contained within the dam before desilting is required. A peg will also be installed to indicate when there is insufficient capacity remaining in the dam for the design storm event.

A trigger level for the de-silting of the sediment dam has been developed below. As the volume of the dam exceeds the design storm criteria by a large margin it has been determined for this dam that the need for desilting is based upon a percentage of the capacity of the sediment dam i.e. a nominal 20% of the total volume. Note, the total volume of the In-Pit Sedimentation Dam is assumed to be the 'working' maximum capacity in which pit operations can comfortably be undertaken without flooding the pit floor.

Table 11. Trigger Levels for De-silting Sediment Dams

Dam Identification/Catchment	Sediment Dam capacity (m^3)	Maximum estimated Sediment Basin Storage (soil) volume (m^3)
In-Pit Sedimentation Dam	7,700	1,500

The maximum estimated sediment storage volume for the In-Pit Sedimentation Dam is approximately 1,500 cubic metres as shown in *Table 11* above. This equates to approximately 1m of sediment in the dam before desilting should be undertaken. Pegs can be placed in the bottom edges of the dam once emptied where the top of the peg is approximately 1 metres above the floor of the dam. Once silt reached the top of the peg the dam should be de-silted.

4.2.3. Treatment of Water to be Discharged

The following outlines the procedure for preparing water for discharge from the In-Pit Sedimentation Dam:

- The water in the In-Pit Sedimentation Dam will be sampled and submitted for testing at a NATA approved laboratory;
- If the sampled water meets the criteria listed in *Section 2.1.3,* the dam is suitable for discharge and may be emptied (see below for discharge procedure);
- If the sampled water does not meet the required criteria, the dam will be treated with flocculants (gypsum) and sufficient time allowed for sediment to settle is given before additional sampling and testing is conducted;
- Ideally the gypsum is mixed with water from the pit to create a slurry which is sprayed uniformly across the surface of the dam. The pump can be used to recirculate the dam water to encourage mixing within the dam; and

- The water will then be sampled and tested again to ascertain if it meets the discharge criteria. The above steps will be repeated until the water is of a suitable quality.

4.2.4. Discharge of Water

Once the water has been determined to be of suitable quality to discharge, the water will be gravity fed through two 1 inch pipes to an energy dissipater located in the northwest corner of the Mine Lease. From the exit point it will flow westerly to a culvert under an access road on the neighbouring property. From there the discharged water will eventually reach Humbug Gully via a natural water course located to the north west of the mine lease.

No concentrated flows will be permitted to leave the site. The flow rate will be approximately 1L/sec (0.001m^3/sec). The discharge pipe will be fed into an energy dissipater to minimise erosion impacts from the discharged water. The discharge will be supervised to ensure there is no adverse impacts noted such as visible sediment in discharge water, erosion and gullying, flooding etc. If impacts are noted discharge will cease immediately and remedial action undertaken.

The controlled discharge rate downstream will be much lower than the rate expected by a 1 in 10-year ARI event expected in the watercourse leading to Humbug Gully prior to development as can be seen in the table below. Note, the soils are assumed to be hydrological group D, very high runoff potential. It should be noted that the flows will essentially be restored to the downstream environment once rehabilitation is completed.

Table 12. Flow Rates for 1 in 10-year storm event

Catchment	Flow rate (cubic metres per second)
Estimated Catchment prior to development (~5Ha)	1.251*
Controlled discharge	0.001

*Calculated using the Blue Book and IFD data.

4.3. Contaminated Water

The primary risk of contamination of the surface water, apart from sediment, is from the fuels and oils (lubricants and hydraulic fluid) used by the plant and machinery on the site. Refuelling and minor repairs and maintenance is undertaken in the hardstand areas or offsite. Fuel and oil is not stored on site. Diesel fuel is mainly contained within the plant and trucks and minor amounts held in a mobile refuelling tank which is filled off site as required. The site maintains a spill kit and all contractors are required to carry a spill kit on plant or equipment.

Due to the small volumes of hydrocarbons held on site it is unlikely that a spill would cause significant material harm to the environment. Should a spill occur it could be managed with the spill kits and localised contamination removed from the site.

4.4. Diversion Drains

Any diversion drains installed on the site will be compliant with Blue Book requirements and able to withstand a 1 in 10 year ARI storm event.

Section 5.Water Balance

5.1. Overview

The objective of the water balancing modelling was to assess the ability of the project site to provide on-site water detention and to understand potential changes in surface water drainage. Under direction from the 'Blue Book' and EPL requirements, the model investigated the following:

- Determine if the site will overtop during a 'wet' year;
- Determine if the site will overtop during the next 20 years of operation using historical rainfall data as a guide;
- Demonstrate that there is sufficient water security for the site operations over the next 20 years of operation; and
- The water balance over an average rainfall year, a wet year and a dry year.

The primary source of water on the site is from incident rainfall collected into the pit sump known as the In-Pit Sedimentation Dam. A farm dams is also located on the site to the west of the current pit. Water is consumed on the site for dust suppression purposes. It may also be utilised in the future to irrigate rehabilitated areas however, this has not occurred to date.

As mining progresses, the In-Pit sedimentation Dam will relocate to the north west corner of the pit floor to enable the fullest extraction of the resource. The pit void will correspondingly be enlarged.

5.2. Modelling Assumptions

The following assumptions and inputs were applied during the development of the water balance model:

- The water balance model has been run using the current void as the water storage area. As the extraction progresses the void available for water storage will increase. The current estimated dam volume has been used as the initial dam volume for the model;
- The current dam volumes have been estimated from survey data and depth estimates and is the starting volume for the model;
- The current catchment area (4.7Ha) for surface water includes the current void. The full expansion of the pit will have a catchment area of approximately 11Ha. The model assumes that over the next 20 years the expansion of the pit is staged so that the final disturbed area reaches its maximum in around 16 years. This is independent of whether the resource recovery has been maximised i.e. the pit has reached the full depth;
- To ensure a conservative and realistic assessment is being carried out, 10mm of rainfall will be applied prior to the expected runoff to commence. It is industry standard practice to provide wetting of the catchment and allows the dams retain some water, as in practice the dams generally have carryover of water from previous flood events .i.e. they are rarely dry;
- To understand how the system operates under both wet and dry conditions, the existing site scenarios were modelled for average rainfall years, a wet year and a dry year and also with application of a daily time step for a 20-year period, 1996 to 2016. This time period includes one of the driest and also some of the wettest years

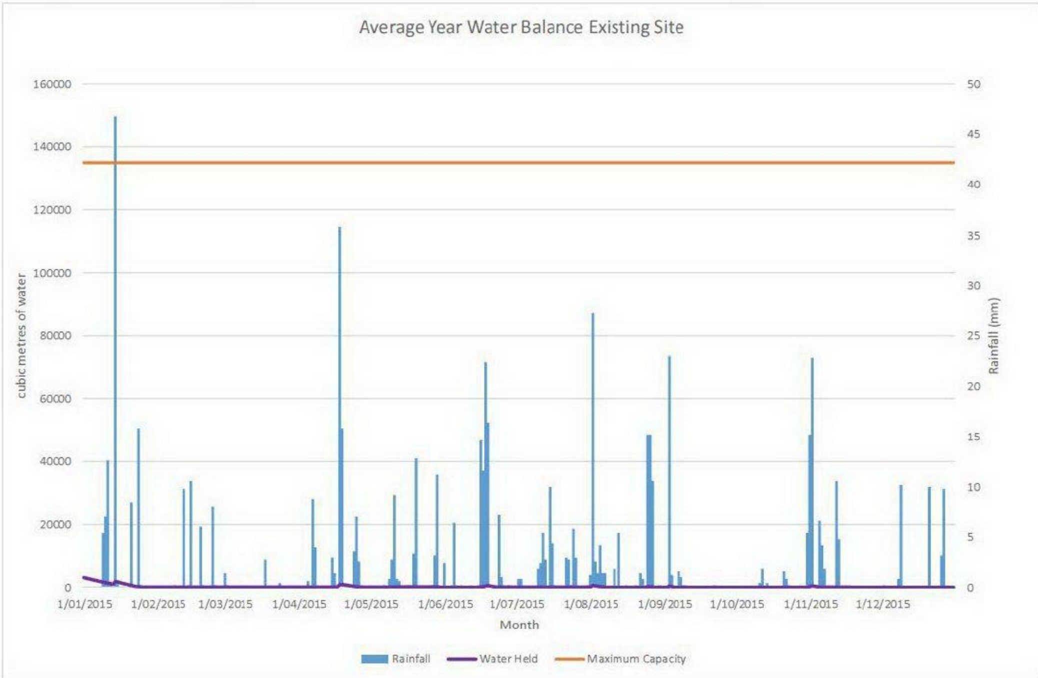
over the period of time records haven been held. The average rainfall for the period is typical of the historical average for the area;

- Historical rainfall data from the Albury Airport AWS site (BOM Station no' 72160) has been used for the years 1996 to 2016;
- The average annual rainfall is 624mm according to BOM and the year 2015 where 621mm of rainfall was received has been selected as representative of an average year;
- The wettest year and driest years were 1939 (1,187mm) and 2006 (297mm) respectively;
- A runoff coefficient of 0.64 (from the blue book) has been used assuming a Soil Hydrological Group of D;
- Maximum dam volumes before overtopping have been calculated from survey data and modelling of the final void;
- The affective area of evaporation has been assumed to be the current dam surface area. The actual area will vary according to the dam volume but for this calculation vertical dam walls are assumed for ease of calculation;
- A pan evaporation factor of 0.75 for the water storage (to convert recorded pan evaporation to pond surface evaporation);
- Groundwater seepage into the dam is assumed to be negligible;
- Dissipation from the dam is assumed to be 0.01cm/hour, a typical rate for clay;
- On average 60 cubic metres per day of mining or hauling is used for dust suppression. It has been assumed that hauling and mining activities that require the water cart occur on average for 45 days in duration, 3 times per year;
- Evaporation rates were obtained from the nearest available comparative site which was the Hume Reservoir (BOM site 072023); and
- Discharge from the pit is achieved via gravity feed from two 1-inch pipes controlled by a tap. The flow rate from the pipes averages 60L/min and are assumed to flow 24 hours a day when the EPL conditions are met. This approximates 86 cubic metres of water released per day when required.

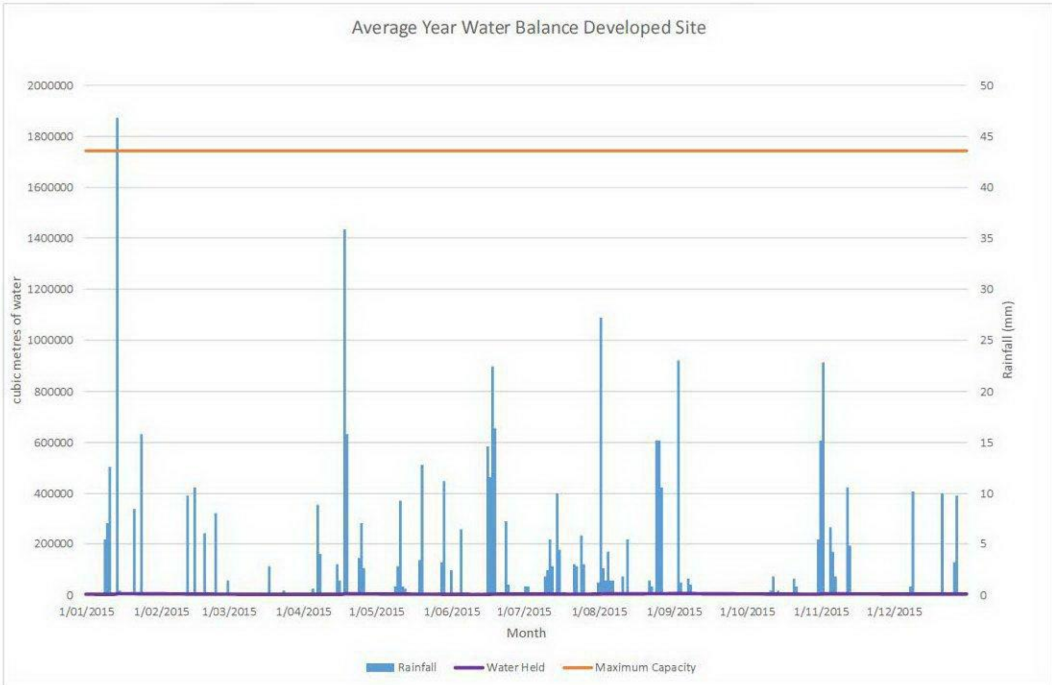
5.3. Average Year

The modelled average rainfall year was chosen by determining the annual average rainfall over the historically available data and selecting a year where the total annual rainfall recorded most closely matches the historical average. During an average rainfall year, the existing and developed site is able to contain all surface water without overtopping as shown in *Graph 1* and *Graph 2.* It suggests that there may be a deficit of water on the existing site to undertake dust suppression activities for 11 out 12 months however, mains water may be utilised to overcome this.

Graph 1: Average Year Water Balance for Existing Site



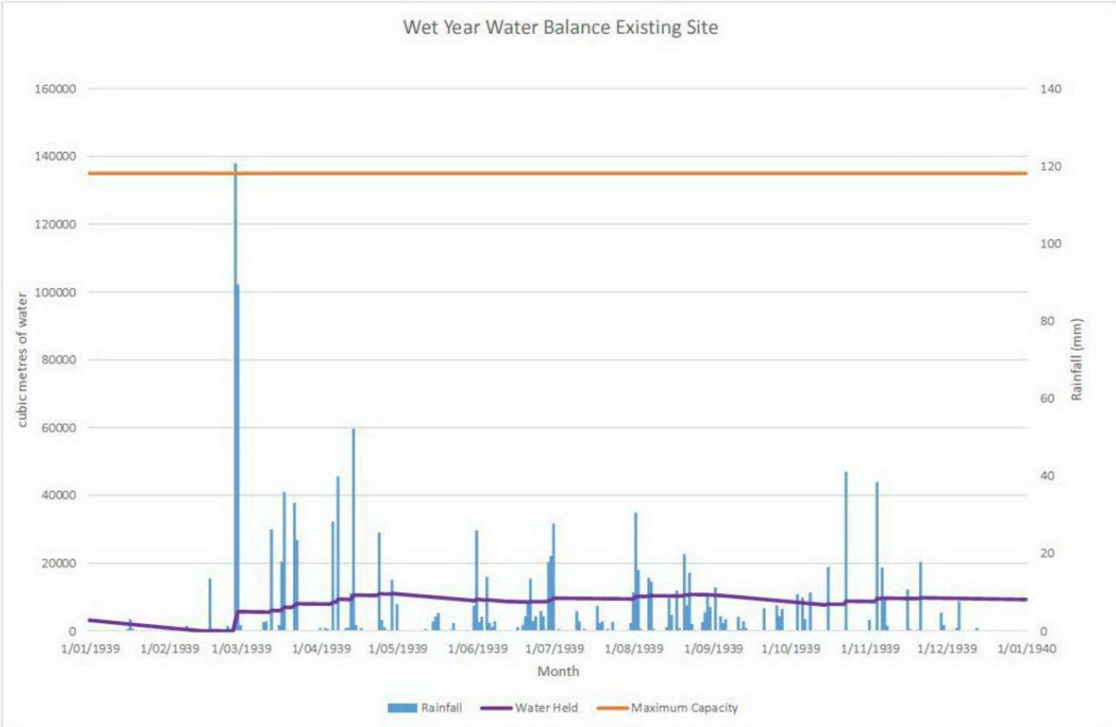
Graph 2: Average Year Water Balance for Developed Site



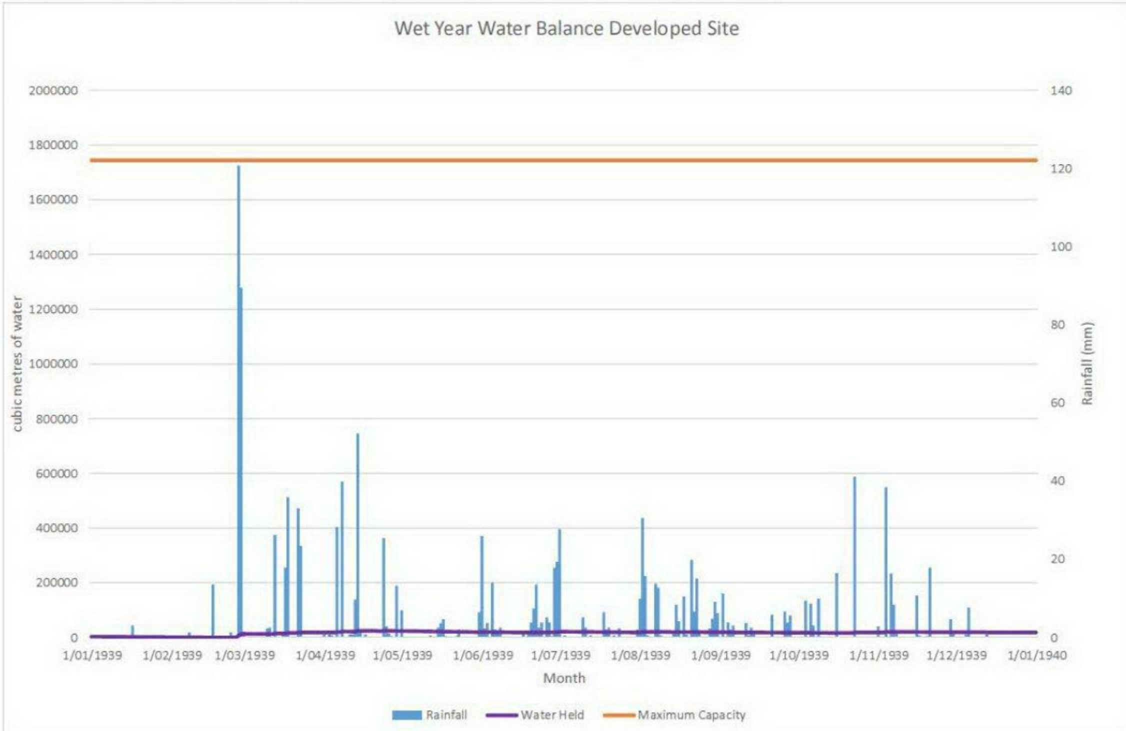
5.4. Wet Year

The modelled wet rainfall year was chosen by determining the highest recorded annual rainfall over the historically available data. During a wet rainfall year the existing and developed site is able to contain all surface water without overtopping as shown in *Graph 3* and *Graph 4.* It suggests that there may be a deficit of water on the existing site to undertake dust suppression activities for 1 month out of 12 months for both the existing site and the developed site.

Graph 3: Wet Year Water Balance for Existing Site



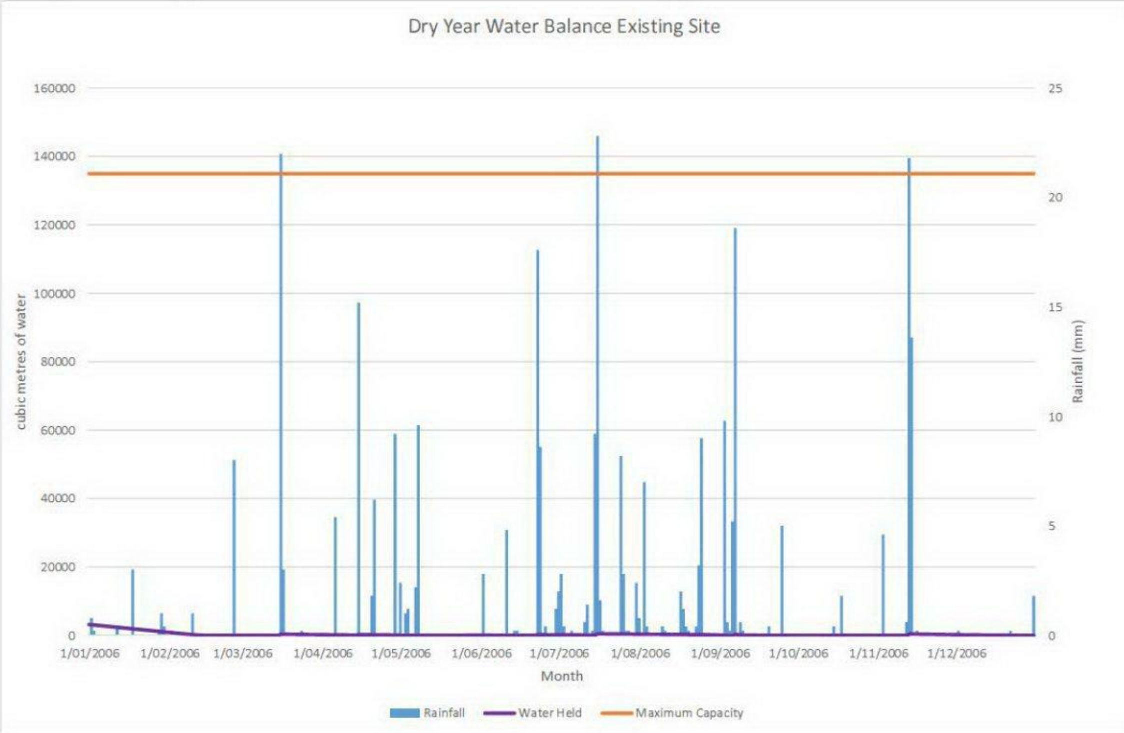
Graph 4: Wet Year Water Balance for Developed Site



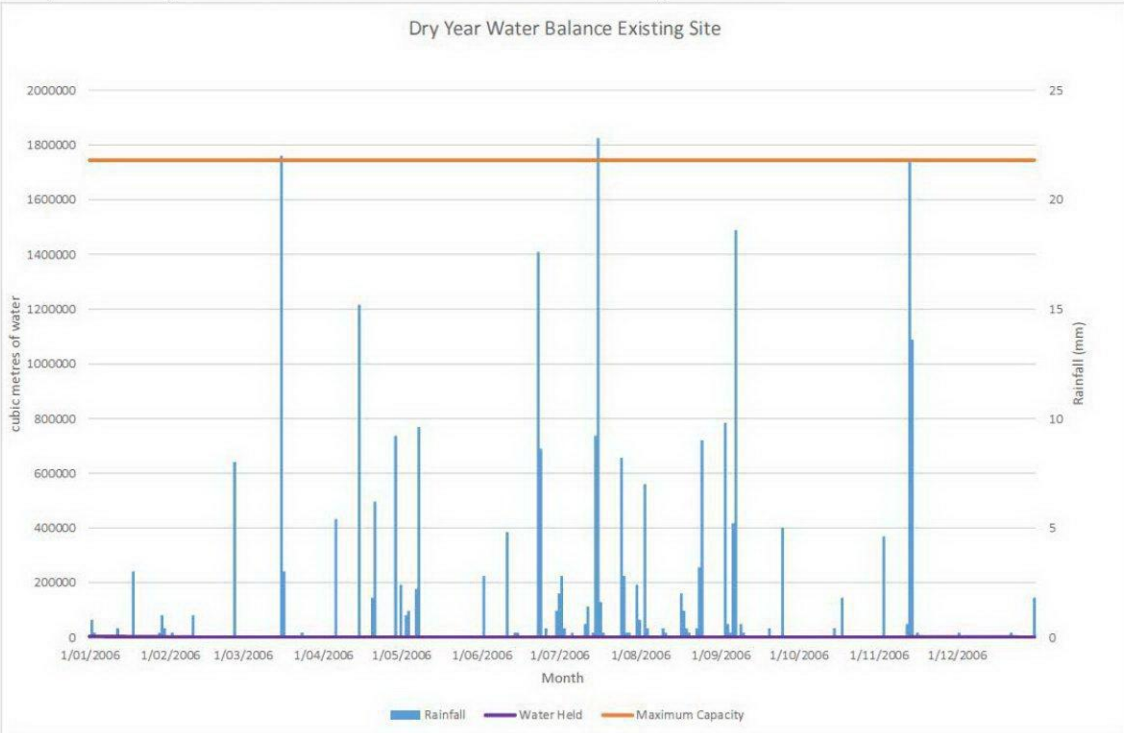
5.5. Dry Year

The modelled dry rainfall year was chosen by determining the lowest recorded annual rainfall over the historically available data. During a dry rainfall year the existing and developed site is able to contain all surface water without overtopping as shown in *Graph 5* and *Graph 6.* It suggests that there may be a deficit of water on the existing site to undertake dust suppression activities for 9 months out of for both the existing site and 5 months out of 12 for the developed site. Mains water may be utilised to overcome this.

Graph 5: Dry Year Water Balance for Existing Site



Graph 6: Dry Year Water Balance for Developed Site



5.6. 20 year Simulation

During the 20-year simulation, from 1996 to 2016, the site was modelled to gradually increase in the total disturbed area from the current 4.7Ha to the full 11Ha by approximately year 16. The actual disturbance on the site over time may vary with demand from the Jindera brick plant.

The modelling suggests that the site will commonly experience a deficit of water, particularly in the early stages of mining. As described above the demand for water for dust suppression could have been met via town water during these dry periods. As the pit disturbance increases, the model indicates that deficits of water are less likely as the volume of water captured by the site also increases. The pit would not have overtopped during the selected period.

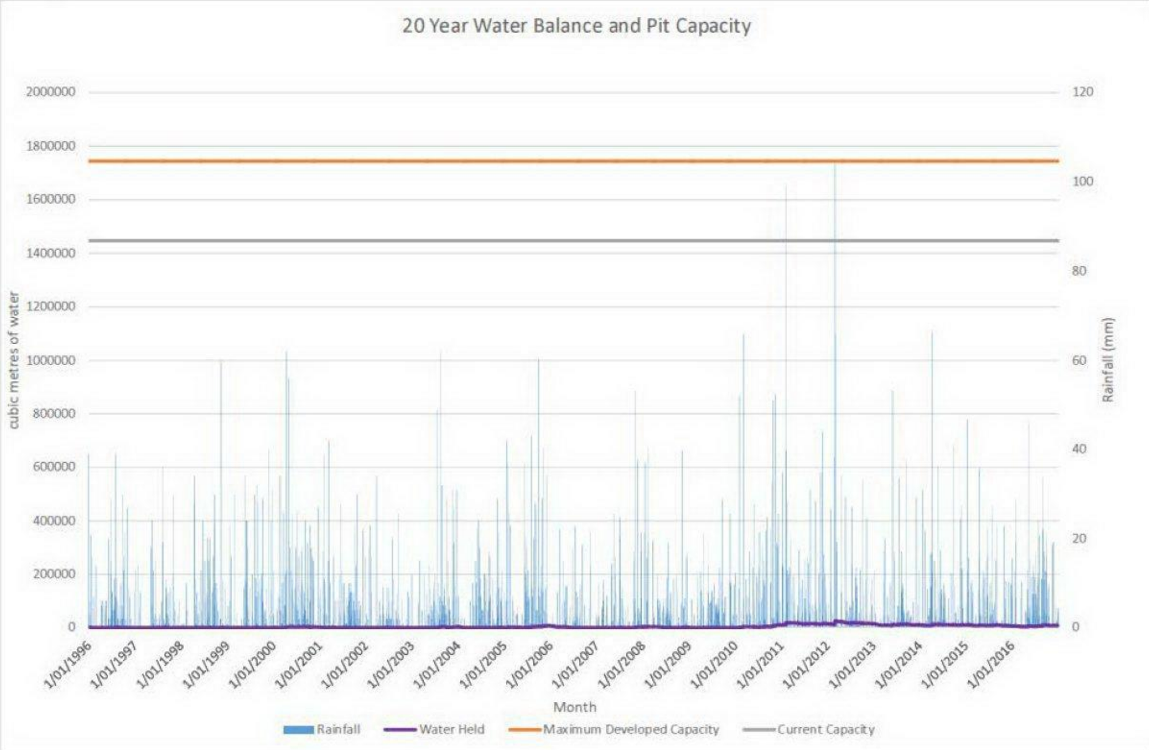
Depending on the mining requirements, the In-Pit Sedimentation Dam may require discharge (in accordance with the EPL) in order to maintain a safe and practicable pit floor. The current pit sump is estimated to contain up to 19,000 cubic metres of water before it would start to impact the pit floor itself. The model assumes that discharge would be required when the In-Pit Sedimentation Dam volume is greater than 19,000 cubic metres and that the discharge will occur on a 24-hour basis. The retention of water on the site for dust suppression during the early stages of the mining will be a priority due to the predicted deficits. With the current disturbance using rainfall data from 1996 to 1999, (annual rainfall slightly below the average) the pit is predicted, on average, to not require discharge and may be dry for 3 to 4 months each year. This correlates with the operator's experience of water management on the site.

Further, no discharge would be required as the area of disturbance increases up to approximately 7 to 8Ha. However, at the full extent of the disturbance, the site would on average require discharge on three occasions (over the 20-year period) to maintain the level of the in-Pit Sediment Dam.

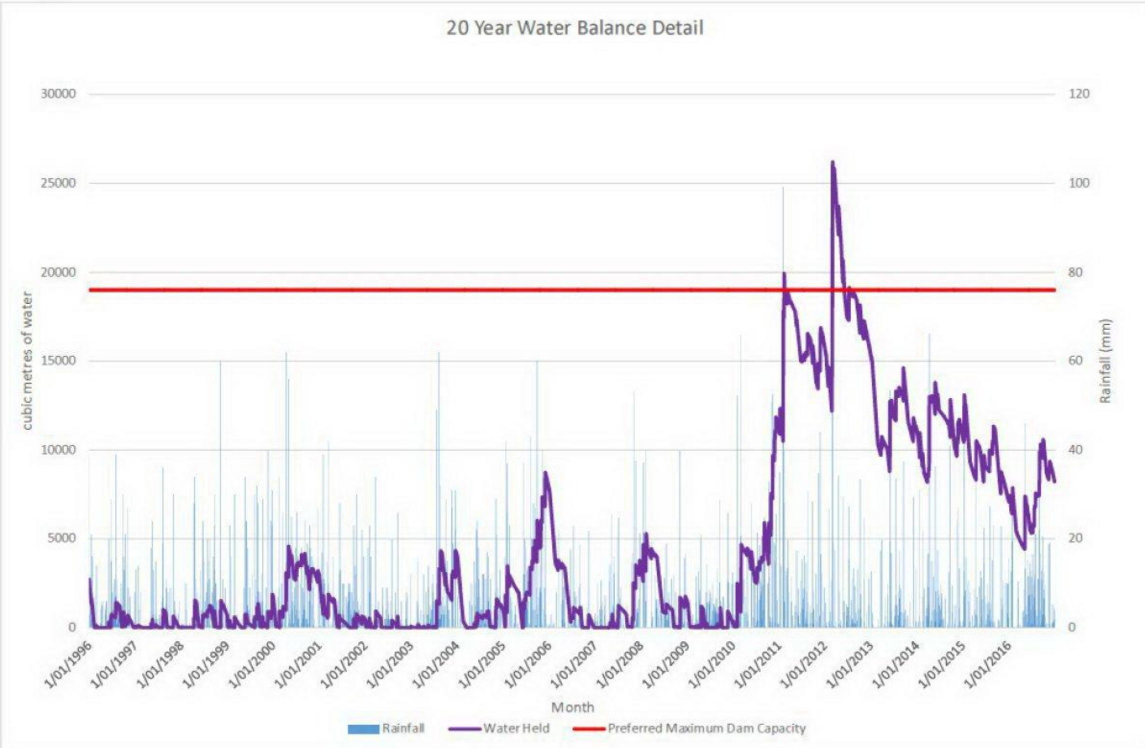
In periods of extreme rainfall i.e. >150mm over a few days, the pit may require more aggressive discharge rates to maintain access to the pit floor. This could be achieved by installing diesel pump to increase the flow rate if desired. The pit however will not overtop.

Although the actual rainfall received over the site during the life of the mine cannot be predicted, the long-term simulation gives guidance on how the mine may perform.

Graph 7: 20 Year Water Balance



Graph 8: 20 Year Water Balance Detail



5.7. Water Use

The water usage on the site is restricted to dust suppression activities at present and is currently met by the captured water from over the disturbed area. As rehabilitation progresses, water from the In-Pit Sediment Dam may be used to irrigate newly established

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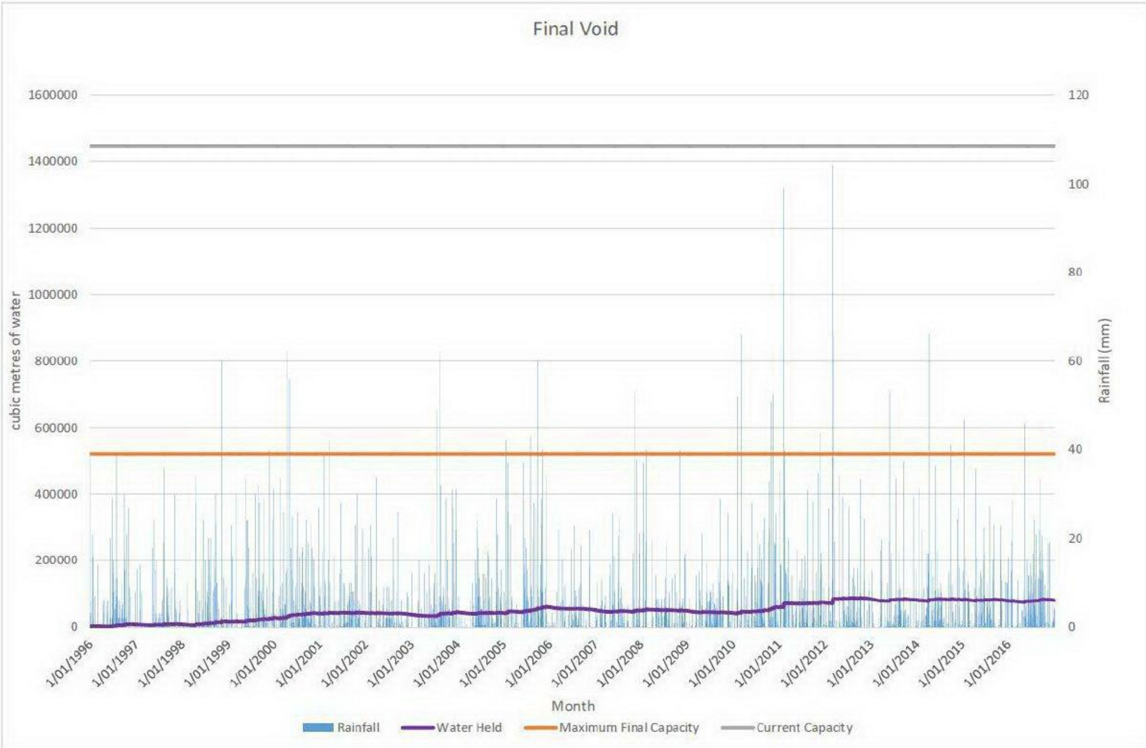
vegetation. This may assist in reducing the volume of the sediment dam, particularly when the pit extent is maximised and therefore the volume of captured water peaks. No other on-site uses for the water are planned at this stage.

5.8. Final Void Water Body

Preliminary calculations suggest that the final void is unlikely to overtop. Losses due to evaporation and dissipation will balance the rate of rainfall received well before the whole void would be filled. In any case, a spillway designed for a 1 in 100 year ARI storm event will be installed in order to safely convey dam water off the site.

A water access licence for any remaining water body will be investigated. It is likely that at WAL will be required as the void is likely to capture more than the Harvestable Rights for the site.



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Plan of:	Water Management Plan for Andersons Clay Mine Environmental Impact Statement 2018 - Conceptual Final Landform	***Location:***	253 Shaw Street, Springdale Heights, NSW	***Source:***	nearmap - Image Date 01/05/2018 & Landair Surveys	***Our Ref:***	3618_BAN_WMP_DA17_C007_V2_F7.cdr
Figure:	SEVEN	***Council:***	Albury - Wodonga Shire Council	***Survey:***	Landair Surveys - Image Flown 08/02/2017	***Plan By:***	SK/JD
Sheet:	1 of 1	***Tenure:***	Permit Number N72	***Projection:***	MGA	***Project Manager:***	TO
Version/Date:	V2 04/10/2018	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	1m	***Office:***	Thornton

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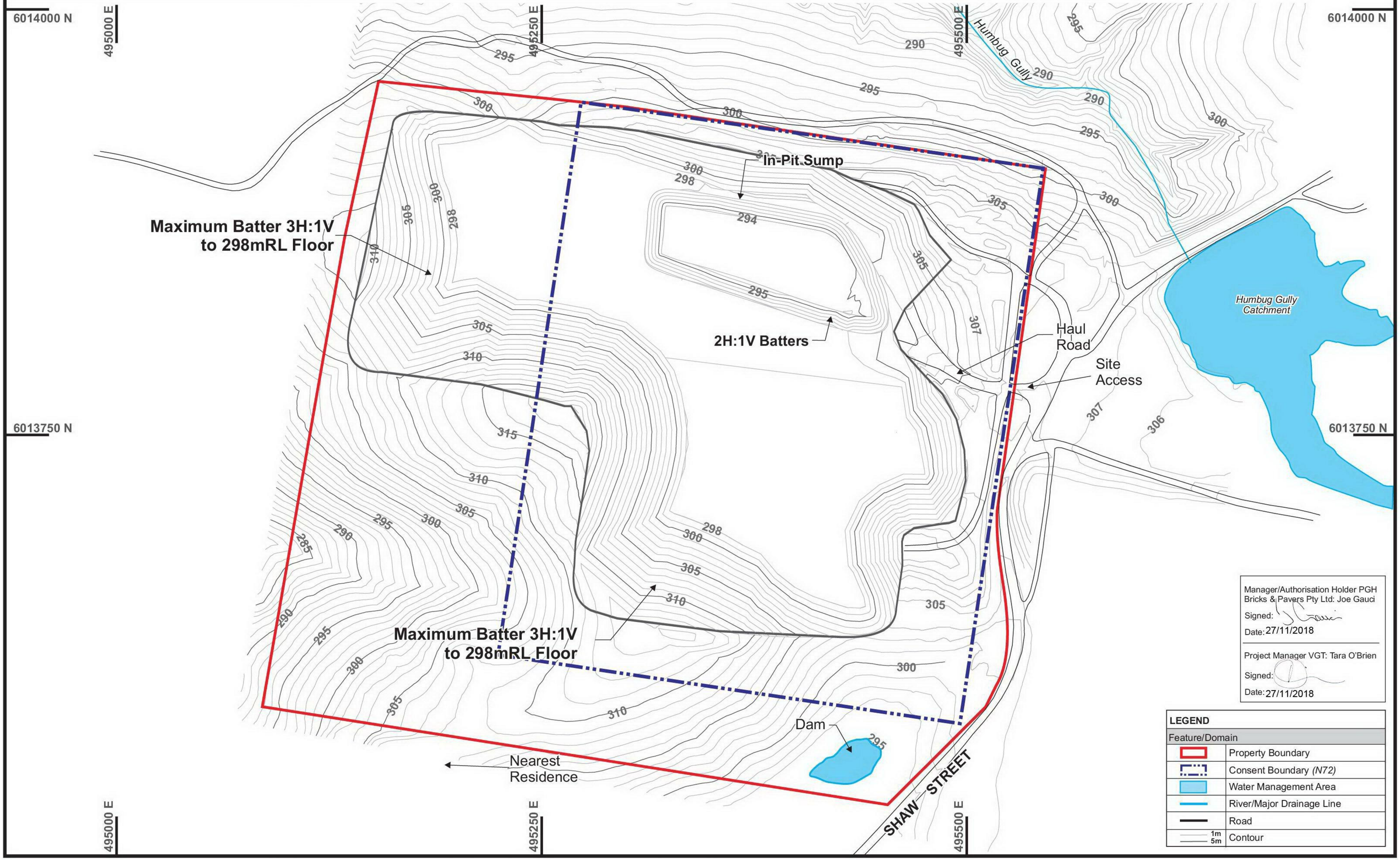

Manager/Authorisation Holder PGH Bricks & Pavers Pty Ltd: Joe Gauci

Signed:

Date: 27/11/2018

Project Manager VGT: Tara O'Brien

Signed:

Date: 27/11/2018

LEGEND

Feature/Domain	
	Property Boundary
	Consent Boundary *(N72)*
	Water Management Area
	River/Major Drainage Line
	Road
1m 5m	Contour

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Section 6.Surface Water Impacts and Mitigation

6.1. Downstream Water Users

The site is located within the Murray Unregulated and Alluvial Water Source water sharing plan. Although the site will increasingly divert surface water to the pit as the mining progresses, it will have very little impact on the total volume of water flowing into the Humbug Gully catchment and in turn the Murray River. The Humbug Gully catchment covers some 120 Hectares with the site capturing less than ten percent of that catchment. Captured water will be returned to the Murray Catchment as surface water must be discharged from the site to maintain access to the pit floor. At the completion of mining, the rehabilitated void will be permitted to fill and may overtop if it reached sufficient volume, returning all flows back to the natural drainage lines. It should be noted however, that the water balance indicates that the final void is unlikely to overtop.

Downstream land use is primarily rural residential and urban. The watercourses are generally only used for stock water or recreational purposes and not large-scale irrigation. The capture of the surface water on the site is not expected to adversely impact downstream water users.

6.2. Riparian and Ecological Values of the Watercourses

The project is not expected to have any significant impacts on the existing condition of nearby watercourses, including Humbug Gully creek and Bungambrawatha Creek. These systems are characterised by degraded environmental conditions due to agricultural pursuits and land clearing.

There will be no increase in the frequency of discharges over and above current levels in the short to medium term and therefore no additional impacts on riparian environments, including geomorphology and environmental flows. In the long-term flows are unlikely to be returned to the pre development levels as the final void is not expected to overtop. As discussed above, the volume of water captured in the final void will be very small compared to the whole of Humbug Gully catchment and impacts to the riparian and ecological value of the water course is expected to be low.

6.3. Flooding

The development will not exacerbate flood potential within the site nor downstream.

6.4. Erosion and Sediment Control

6.4.1. Soil Characterisation

The catchment area and dam volumes for the site were estimated (see *Section 3.4*) to determine the risk of sediment-laden water leaving the site. The NSW Managing Urban Stormwater handbook, also known as the Blue Book, was used to make the determinations. Several assumptions have been made as listed below. The calculations have erred on the side of caution and should be considered a 'Worst Case Scenario'.

The Soil Hydrological Group for the soil materials is assumed to be D, very high run-off potential. Water moves into and through these soils very slowly when thoroughly wetted. They regularly shed run-off from most rainfall events.

Conservatively, sediment retention basins are designed using the Type D Soils calculations. This includes the sediment storage zone calculation using the estimated soil loss for the site over two months.

The likely soil loss is calculated with the Revised Universal Soil Loss Equation (RUSLE). The values of the other RUSLE factors are: P of 1.3 and the C is assumed to be 1.0 for bare soil. Calculations can be found in *Appendix A.*

The potential soil loss of the site has been calculated using *Managing Urban Stormwater, Soil and Construction, Volume 2E Mines and* Quarries for a 90th percentile, 5-day rainfall event assuming a non-sensitive receiving environment. Important site physical characteristics are identified in the table below.

Table 13. Constraints and Characteristics

Constraint/Opportunity	Value
IFD:2 year, 6 hour storm	6.02 (from the BOM IFD data)
Slope Gradients	Low to Moderate to high (Average 6-10%)
Potential Erosion Hazard	Very Low
Soil Erodiblity	High (assumed)
Calculated Soil Loss	Up to 110 tonnes/Ha/yr depending on particular mine slopes.
Soil Loss Class	1
Soil Texture Group	Type D
Soil Hydrological Group	D
Runoff Coefficient	0.64 (Soil Hydrological Group D)
Current Disturbed Site Area	4.7 Ha approximately
Developed Disturbed Site Area	11 Ha approximately

6.4.2. Sources of Erosion and Sediment

Surfaces at most risk of erosion are exposed surfaces within the pit, particularly where slopes are steep. Incident rainfall is the primary mechanism from which erosion can occur. Sediment can be mobilised by surface water received over the exposed surfaces. The fine clay material found on the site is prone to erosion and sediment entrainment.

6.4.3. Erosion Control

Generally the site is prone to moderate erosion but these are limited to the exposed worked areas of the mine. Eroded soils and sediment are captured within the pit sump and do not leave the site. Slopes are kept moderate where possible in the pit to reduce the erosion hazard.

6.4.3.1. General Instructions

The control of erosion and sedimentation at the site will focus on source reduction measures. In general these measures will include:

- Reading the Surface Water Management Plan with any engineering plans and any other plans or written instructions issued in relation to development at the subject site;

- Ensuring contractors undertake all soil and water management works as instructed in this specification and constructed following the guidelines stated in the "Blue Book"; and
- Inform all subcontractors of their responsibilities in minimising the potential for soil erosion and pollution to downslope areas.

6.4.3.2. Works Sequence

All works are to be undertaken following the Mine Operations Plan (MOP) in the following sequence:

- Topsoil in new areas will be surveyed, mapped and the texture, thickness and quality described prior to stripping. Topsoil and overburden not for immediate use will be stockpiled in appropriate areas and limited to 2 metres in height and revegetated with temporary ground cover species, mulching or chemical stabilisers or binders if they are to remain in place for more than 30 days. A minimum of 70 percent cover is required for both mulch and vegetative covers;
- Construct earth banks (Stormwater Collection Drains) to divert as much clean water as possible and capture the dirty water in the extraction area;
- Undertake extraction activities in the new area;
- Rehabilitate lands in exhausted areas with topsoil and overburden and revegetate;
- Install barrier fencing to limit access to rehabilitated areas; and
- Ensure management practices are carried out to minimise areas being affected by wind and water erosion.

6.4.3.3. Erosion Control Instructions

The soil erosion hazard on the site will be kept as low as practicable by minimising disturbance. Some ways of doing this are outlined in *Table 14*. Extraction will take place within a defined work area. Entry to land not involved directly in the extraction process will be prohibited and will be managed as natural grassland or woodland as appropriate. Vehicular access to the site will be limited to that essential for extraction or rehabilitation.

Table 14. Limitations to Access

<table>
<tr><th>Landuse</th><th>Access Limitations</th><th>Comments</th></tr>
<tr><td>Extraction</td><td>Land disturbances beyond five (preferably two) metres from the edge of the operations are prohibited.</td><td rowspan="3">All site workers should clearly recognise these areas and they should be clearly marked — suitable materials include barrier mesh, sediment fencing, etc. The project manager will determine their actual location on site. They can vary in position to conserve existing vegetation best while being considerate of the needs of efficient works activities.</td></tr>
<tr><td>Access Roads</td><td>Roads and tracks are limited to a width that are the minimum necessary to allow safe operation of heavy equipment</td></tr>
<tr><td>Remaining Lands</td><td>Land disturbances are prohibited except for essential management works.</td></tr>
</table>

Rehabilitation means:

Achieving a C-factor (Revised Universal Soil Loss Equation) of less than 0.1 and setting in motion a program that should ensure it will drop permanently, by reducing the risk of erosion by vegetation, paving, armouring, etc. as soon as practicable after extraction activities cease.

It should be noted that the cover factor, C, is the ratio of soil loss from land under specified crop or mulch conditions to the corresponding loss from continuously tilled, bare soil. A C-factor of 1.0 corresponds to that of bare soil.

While C-factors are likely to rise to 1.0 during the work's program, they should not exceed those given in Table 15 within the specified times.

Table 15. Maximum acceptable C-factors at nominated times during works

Lands	Maximum C-Factor	Remarks
Waterways and other areas subjected to concentrated flows, post construction.	0.05	Applies after ten working days from completion of formation and before they are allowed to carry any concentrated flows. Flows are limited to those indicated in "Blue Book". Foot and vehicular traffic are prohibited in these areas.
Stockpiles, post clearance	0.1	Applies after ten working days from completion of formation.
All lands, including waterways and stockpiles during construction	0.15	Applies after 20 working days of inactivity, even though works might continue later.

Note: *working days* does not include public holidays, weekends or days when work is not possible due to wet weather.

The required C factors can be achieved in the short term (temporary protection for up to six months) with either:

- a suitable soil binder in areas of sheet flow, e.g. topsoil stockpiles; and
- a temporary vegetative cover.

Any soil binders applied should be employed following the manufacturer's instructions.

A suggested listing of suitable plant species is shown in *Table 16.* Before sowing, additional tests should be undertaken to assess the requirements of ameliorants such as lime to help plant growth.

Table 16. Plant Species for Temporary Cover

Sowing Season	Seed Mix
Autumn/Winter	Oats @ 40kg/Ha Japanese Millet @ 10kg/Ha
Spring/Summer	Oats @ 20kg/Ha Japanese Millet @ 20kg/Ha

While ever the C-factor is higher than 0.1, maintain the lands in a condition that resists removal by wind. This can be achieved by keeping the soil moist (not wet) by sprinkling with water and where practicable, leaving the surface in a cloddy state. Notwithstanding the above, schedule works so that the duration from the conclusion of land shaping to completion of final stabilisation is less than 10 days on slopes steeper than 30 per cent and 20 days on slopes less steep than 30 per cent.

Lands planted recently with grass species will be watered regularly until an effective cover has properly established and plants are growing vigorously. Follow-up seed and fertiliser will be applied as necessary in areas of minor soil erosion and/or inadequate vegetative protection. Where practicable, foot and vehicular traffic will be kept away from all recently stabilised areas.

Topsoil is to be stripped in a moist condition to avoid pulverisation and dust and topsoil stockpiles are not to exceed 2m in height with a minimum crest width of 2m. They should be seeded with a temporary vegetation cover if stockpiles are to remain longer than 30 days. Stockpiles are to be located at least five metres from areas of likely concentrated or high velocity flows, especially drainage lines and access roads. If necessary, earth banks or drains will be constructed to divert localised run-on. Soil materials are to be replaced in the same order they are removed from the ground. It is particularly important that all subsoils are buried and topsoils remain on the surface at the completion of works.

Earth batters can have maximum gradients of 2(H):1(V) during the works program but will be laid back to lower grades before the rehabilitation program starts. Final batter gradients will be between 3(H):1(V) and 4(H):1(V).

All waterways, drains, spillways and outlets will be constructed to be stable in accordance with the "Blue Book" for soils with high erodibilities.

6.5. Post Closure

The impact of the proposed final landform on surface water is not expected to be significant. The flatter profile of the area post closure compared to the existing site will potentially reduce erosion from runoff from the area. The extent to which the area is woodland, or grassland could also impact on the runoff volumes. The Surface Water Management Plan will remain in place until the water quality from the site meets the target objectives for the area. With the use of vegetation and reduced slopes it is expected that there will be limited risk of impacts on surface water post closure.

Section 7.Groundwater Water Impacts and Mitigation

7.1. Groundwater Quality

As stated previously, no groundwater has been encountered at the site and no groundwater is expected to be encountered during the development. Available data suggests that the groundwater level is well below the proposed pit floor level as discussed in *Section 3.6*. The site activities do not pose any great risk to the groundwater quality.

7.2. Groundwater Quantity

As the project is unlikely to use or encounter any regional groundwater tables the development is not expected to impact groundwater quantities. There may be some localised depression in the table surrounding the excavation area during the works however once the final rehabilitation has been completed and the void fills, it is likely that the groundwater level will be nearly restored.

7.3. Groundwater Dependant Ecosystems (GDE)

Humbug Gully is considered to have a moderate potential for Ground Water Dependant Aquatic Ecosystems with and an In Flow-dependent Ecosystem (IDE) likelihood of 7 (from the BOM GDE web portal). It flows into Bungambrawatha Creek which is considered to have a high potential for GDE and an IDE likelihood of 10.

The likelihood grid for inflow-dependent ecosystems expresses the likelihood that landscapes are accessing water in addition to rainfall. The likelihood is expressed as a range of values between 1 (low) and 10 (high), where 10 indicates landscapes that are most likely to access additional water sources. The additional water source may be soil water, surface water, or groundwater. The potential GDE in Humbug Gully are most likely accessing additional water from the Humbug Gully Dam upstream and to the east of the project site, which was a former clay mine. The dam will not be influenced by the development of the site. It is unlikely that the site will intersect groundwater and there will be minimal discharge of water and impact to the surface flows to the gully during the development. Therefore, the impact to the aquatic GDE in Humbug Gully is considered low.

There are no Terrestrial GDEs on or nearby the site.

Section 8.Monitoring and Maintenance

8.1. Surface Water

8.1.1. Quality

Samples are collected and tested by a NATA Accredited Facility.

Sampling is undertaken from the following locations as required on the EPL.

1. Quarry Pit
2. Energy Dissipater at discharge point from the In-Pit Sedimentation Dam.

PGH undertakes sampling prior to discharge as required the EPA licence. Routine analytes tested and concentration limits will be those listed in the EPA licence and are as follows:

- pH is to be between 6.5 to 8.5;
- TSS is <50mg/L; and
- Oil and Grease <10mg/L

Other analytes may be assessed at the discretion of PGH. Monitoring of the surface water outside the EPL Licence Points may be undertaken from time to time such as the other sediment dams in and out of the pit.

The results of all monitoring are recorded and assist in the compilation of the Annual Environmental Management Report to the DRE and to the EPA in the Annual Return.

8.1.2. Contaminated Water

- No waste will be stored on-site unless adequately bunded and stored;
- Contractors will remove all waste at the end of each day or ensure it is stored in the appropriate on-site bins for later removal by a licenced contractor;
- Regular visual monitoring will be undertaken to ensure no leaks, spills or other sources of contamination have entered the water management system; and
- Should a spill or leak occur, PGH and contractors will proceed as per their Spill and Leaks procedures.

8.1.3. Surface Water Flows

The following management checks on the surface water flows will be undertaken monthly and recorded:

- Visual check of stability and operation of all banks, ponds, channels and spillways to be undertaken monthly. Effecting any necessary repairs;
- Visually check the discharge point leading to Humbug Gully to ensure that the discharge does not cause erosion or scouring of the creeks. Effecting any necessary repairs;
- Drains and culverts for both clean water and dirty water will be examined for vegetation cover and blockages and maintenance will be performed to ensure they are working as designed;
- Diversion bund walls will be inspected regularly to assess the integrity and effectiveness. Maintenance will be performed when required;

- Removal of spilled materials from hazard areas, including lands closer than five metres from areas of likely concentrated or high velocity flows, especially waterways and access roads;
- Ensuring that rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate; and
- Constructing additional erosion and /or sediment control works as might become necessary to ensure the desired water quality control is achieved

8.2. Erosion and Sediment Controls

Monitoring of the soil erosion, sediment and water is undertaken monthly and recorded.

8.2.1. Erosion Controls

- Topsoil stripping to be visually monitored to check moisture content of soil and depth of stripping;
- Stockpiles to be visually assessed at time of forming to check they do not exceed two metres high;
- Removal of spilled clay or other materials from hazard areas, including lands closer than five metres from areas of likely concentrated or high velocity flows, especially waterways and access roads;
- Ensuring rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate; and
- Constructing additional erosion and/or sediment control works as might become necessary to ensure the desired water control is achieved.

8.2.2. Sediment Dam Management

Sediment dams will be managed using the following:

- Level indicators will be installed in dams with relevant marks located on the peg to indicate the amount of sediment load in the dam;
- All sediment basins will be maintained by de-silting when the capacity is diminished;
- Sediment dams and clean water dams will be visually assessed for water quality and volumes on a regular basis or as required after high rainfall events;
- If discharge is required, the visual assessment will be followed by sampling and testing of the water quality prior to discharge to ensure water quality criteria are met;
- The EPA limit of TSS of less than 50mg/L in the discharged water will be adopted (unless modified by the EPA);
- Ensuring that rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate; and
- Constructing additional erosion and /or sediment control works as might become necessary to ensure the desired water quality control is achieved.

Section 9.Performance Criteria

Table 17. Performance Criteria and Trigger Action Response Plan

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
Water discharged from the site is consistent with the baseline hydrological conditions of the surrounding environment	Flow rate of the discharged water to not exceed that expected by natural flow rates expected pre-development.	Significant changes to flow rates of water discharged erodes the creeks or otherwise harms ecological communities downstream.	Flow rates for controlled discharge exceed those in Section 4.2.4 for a 1 in 10 year ARI storm for the catchments pre-development.	Review discharge procedures and capacity of pipes and pumps used to discharge water to ensure flow rates are not exceeded.	Annual review report/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
Sediment to be contained on site	Sediment Dams are sized according to the 'Blue Book' Criteria for a 5-day 90th percentile storm event with 20-day management period (see Section 3.4*)*	Sediment is not contained within the sediment dams and is observed as uncontrolled discharge exiting the site due to incorrect dam sizing.	• Sediment dams reach capacity and are at risk of overtopping after a 5-day rainfall event of 35mm. • Uncontrolled discharge is observed leaving the site from the sediment dams after a 5-day rainfall event of 35mm.	• Dam sizes are to be verified against current catchments. • Dams are to be enlarged if required to meet the required capacity. • Review of the SWMP to be undertaken.	Annual review report/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	Sediment Dam capacity is maintained at a level sufficient for the design 5-day 90th percentile storm event with 20-day management period (see Section 3.4*)*	Sediment is not contained within the sediment dams and is observed exiting the site as uncontrolled discharge due to dams having diminished capacity as requiring desilting or dam not emptied from previous storm event.	Sediment retained in sediment dams exceeds that calculated (and pegged with markers onsite) as the maximum volume before desilting is required as listed in Table 11.	Once this level has been reached the dams will be desilted.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	All surface water received over exposed surfaces prone to sediment entrainment is flows to the dirty water management system.	Surface water received over exposed surfaces prone to sediment entrainment that egresses off site as no sediment dam or drains provided for disturbed catchments.	Expansion of the mine or changes to the mining sequence that may impact the current water management system.	• Review of site and SWMP to determine water management requirements. • No work will commence in new areas or changes to the mining sequence until the SWMP is reviewed and appropriate water management structures are constructed.	Environmental Management Report/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	Constructed drains/pipes direct sediment laden water to the sediment dams and clean water around the site.	• Sediment leaves the site due to the failure to construct suitable drains/pipes to contain the design storm event to direct dirty water to the sediment dams. • Excessive clean water is diverted onto the site and sediment dam capacity for dirty water is impacted causing overtopping of dams	• Clean or dirty water drains/pipes observed to be blocked or damaged. • Inspection during rainfall events shows dirty water egressing the site via drain overflow. • Inspection during rainfall events shows additional drains/pipes required to redirect dirty water to sediment dams. • Inspection during rainfall events shows additional drains required to redirect clean water around the site.	• Blocked or damaged drains/pipes are to be repaired. • Drains sizes are to be checked by on-site measurements to ensure compliance with Blue Book calculations i.e. All drains will be designed for the 1 in 10 year design storm event. • Install additional drains/pipes as required.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
	Sediment Dam spillways and earth embankments are vegetated and stable for the design storm event.	• Sediment leaves the site due to the failure of the dam wall or spillway due to not being designed for the design storm flows. • Sediment leaves the site due to the erosion of the dam wall or spillway.	• Inspection during a 5-day rainfall event of <35mm shows overtopping of the sediment dams. • Erosion or tunnelling on the dam walls observed. • Dam wall failure. • Inspections shows dam walls (earth embankments) are not adequately vegetated and spillways protected from erosion adequately.	• Spillways to be measured to check if complies with Blue Book calculations i.e All spillways to be designed for the 1 in 100 year design storm event. • Dam walls and batters to be measured to ensure they are not too steep i.e.>3H:1V • Replace vegetation on eroded surfaces if required. • Repair dams as required.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
Erosion is minimised	Rehabilitation slopes are designed to minimise the effects of erosion according to the Blue Book	• Excessive sediment build up in sediment dams. • Re-vegetation unable to establish. • Loss of topsoil for rehabilitation.	• Slopes in rehabilitated areas observed to be steeper than 4 horizontal to 1 vertical. • Slope lengths between catch drains exceed 80m for a 3H:1V batter. • Visual inspection shows evidence of excessive rilling or gullying on rehabilitation slopes. • Visual inspection shows established rehabilitated areas lose vegetation coverage or are unable to establish adequate vegetation coverage i.e. <70% coverage. • Visual inspection shows spread topsoil on areas awaiting revegetation is eroding.	• Install catch drains or earth banks on slopes where slope lengths exceed recommendations. • Review rehabilitation areas to determine where slopes and catch drains need maintenance or repair or reworking. • Reseeding/replant areas that require increased vegetation cover. • Replace/ rework topsoil as required.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	Revegetation whether temporary or permanent is undertaken as soon as practicable to reduce the exposed surface area.	• Excessive sediment build up in sediment dams. • Re-vegetation unable to establish. • Loss of topsoil.	A C-factor (Revised Universal Soil Loss Equation) of less than 0.1 is not achieved on rehabilitated surfaces i.e. equivalent of 70% coverage by vegetation.	Review rehabilitation areas to determine where revegetation requires maintenance or repair.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	Long term topsoil stockpiles and overburden stockpiles are protected from erosion within 10 days of formation.	• Excessive sediment build up in sediment dams. • Loss of topsoil for rehabilitation.	A C-factor (Revised Universal Soil Loss Equation) of less than 0.1 is not achieved on rehabilitated surfaces i.e. equivalent of 70% coverage by vegetation.	Review topsoil and overburden stockpiles to determine where maintenance or repair is required.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	Access to rehabilitated areas and works areas are limited to necessary vehicles and personnel	• Erosion of rehabilitation areas due to tracks by vehicles. • Disturbance and erosion of areas outside the mine extraction footprint.	Monthly visual inspections shows evidence of vehicle tracks or earthworks outside of approved works areas or within rehabilitation areas.	• Repair damage to rehabilitation areas or areas outside the mine extraction footprint. • Ensure adequate signage and/or barrier fencing is erected to limit traffic access to sensitive areas • Review staff training to ensure personnel are aware of 'no go' areas.	Monthly inspection reports & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
	Tracks suitable for access or pedestrian usage will not be subject to excessive erosion	Excessive sediment build up in sediment dams.	Visual inspection indicates excessive road erosion and deterioration.	• Slopes of major tracks <10° or have cross drains/banks installed. • Where unsuitable soils are present, tracks to be stabilised with crushed bricks, concrete, gravel or similar.	Monthly inspection reports & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
Water discharged from the site is consistent with the baseline ecological and geomorphic conditions of the surrounding environment	Water quality monitoring results show that the discharge is non-polluting.	Significant changes to quality of water discharged harms ecological communities downstream.	Water Quality does not meet the objective of Section 120 of the Protection of the Environment Operations Act 1997. In particular EPL Monitoring Points show water quality parameters outside the EPL criteria of TSS<50mg/L.	• Discharge is to cease immediately. • Sediment dams are to be treated as appropriate to ensure the water to be discharged meets the EPL criteria • Discharge will not recommence until the quality of the water is sufficient.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP
	• Fuel and oil storage is bunded and spill kits are accessible. • No spills of hydrocarbons occur.	Releases of hydrocarbons changes quality of water discharged and harms ecological communities downstream.	• Hydrocarbon spill occurs that has not been contained and contaminants observed to enter the water management system. • Water Quality does not meet the objective of Section 120 of the Protection of the Environment Operations Act 1997.	• Discharge is to cease immediately. • Sediment dams are to be treated as appropriate to ensure the water to be discharged meets the EPL and PoEOA criteria. • Discharge will not recommence until the quality of the water is sufficient. • All hydrocarbon spills are to be cleaned up. • Procedures for handling hydrocarbons to be revised and updated if required. • Staff and contractors to be re-trained in the handling of hydrocarbons.	Annual review report & photographic evidence/ Managing Urban Stormwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP

Section 10.Reporting

10.1.1. Effectiveness of Water Management System

The effectiveness of the water management system will be assessed in any annual reviews undertaken in the form of an Annual Environmental Management Report (AEMR) as required by the DPE as a Mine Lease condition. These reviews will report on the progress towards performance criteria as developed in the Mine Operation Plan. Where an action response has been implemented, details of the action and any results obtained will be included in the AEMR. The AEMR's will be submitted to the DPE until the Mining Lease have been relinquished.

As part of the measurement of the effectiveness of the water management system, PGH will assess the following:

- Water imported, water use, volumes stored and any discharges from the site and report results or changes to the balance;
- Water quality results for compliance and trends;
- Identifying non-compliances and actions taken to ensure compliance;
- Discrepancies between the predicted and actual impacts of the development; and
- Measures that may be undertaken to improve the environmental performance of the development.

Section 11. References

Ref 1. Albury City Council ((2010) *Local Environmental Plan*

Ref 2. ANZMEC and Minerals Council of Australia (2000) *Strategic Framework for Mine Closure*

Ref 3. Bureau of Meteorology (2017) *Albury Airport AWS Statistics*

Ref 4. Bureau of Meteorology (2018) *Groundwater Dependant Ecosystem Atlas*

Ref 5. DECC (2004) Managing Urban Stormwater Soils and Construction –Volume 2E Mines and Quarries

Ref 6. Environment NSW (2010) eSpade online data *Livingstone Soil Landscape*

Ref 7. Environment NSW (2010) eSpade online data *Dora Dora Soil Landscape*

Ref 8. EPA (2018) *Contaminated Sites Register*

Ref 9. NSW Coal Association (February 1995) – *Mine Rehabilitation*

Ref 10. New South Wales Department of Trade & Investment – Resources and Energy (September 2013) *ESG3: Mining Operations Plan (MOP) Guidelines*

Ref 11. NSW Government (2018) on line Portal SEED- *Land Capability Mapping of NSW*

Ref 12. NSW Office of Heritage and Environment (2018) *Hydrogeological Landscapes for the Eastern Murray Catchment- Nail Can-Bungowannah Hydrogeological Landscape*

Ref 13. NSW Office of Environment and Heritage (2018) *Hydrogeological Landscapes for the Eastern Murray Catchment- Table Top Hydrogeological Landscape*

Ref 14. NSW Office of Environment and Heritage (2012) *The Land and Soil Capability Assessment Scheme (second approximation) - A General Rural land Evaluation System for NSW* (LSCAS).

Ref 15. NSW Soil Conservation Service (1978) *Albury District Technical Manual*

Ref 16. VGT (2016) *Mine Operations Plan for: Andersons Clay Mine Springdale Heights*

Ref 17. Personal Communication Tim Fuge (Fuge Earthmoving) 06/07/2017

Appendix A: Blue Book Calculations

1. Erosion Hazard and Sediment Basins

Site Name: Andersons

Site Location:

Precinct/Stage:

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	Pit	Dam 2	Dev Pit				
Total catchment area (ha)	4.7	1	11				
Disturbed catchment area (ha)	4.7		11				

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D				From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D				Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5				See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	90	90	90				
x-day, y-percentile rainfall event (mm)	35.2	35.2	35.2				
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	6.02	6.02	6.02				

RUSLE Factors

Rainfall erosivity (*R* -factor)	1020	1020	1020				Auto-filled from above
Soil erodibility (*K* -factor)	0.05	0.05	0.05				RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	150	150	250				
Slope gradient (%)	6	6	6				
Length/gradient (*LS* -factor)	2.15	2.15	2.93				
Erosion control practice (*P* -factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C* -factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.64	0.64	0.64				See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	142	142	194				
Soil Loss Class	1	1	2				See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	110	110	149				Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	86		274				See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	1059	225	2478				See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	1145		2752				

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

DOC18/188649

1. Erosion Hazard and Sediment Basins

Site Name: Andersons

Site Location: In Pit Soil Loss

Precinct/Stage:

Other Details:

Site area	Sub-catchment or Name of Structure						Notes
	W HW	S HW	N HW	floor			
Total catchment area (ha)	0.33	0.35	0.3	2.1			
Disturbed catchment area (ha)	0.33	0.35	0.3	2.1			

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	D	D	D	D			From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	D	D	D	D			Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5	5			See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	90	90	90	90			
x-day, y-percentile rainfall event (mm)	35.2	35.2	35.2	35.2			
Rainfall R-factor (if known)							Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	6.02	6.02	6.02	6.02			

RUSLE Factors

Rainfall erosivity (*R* -factor)	1020	1020	1020	1020			Auto-filled from above
Soil erodibility (*K* -factor)	0.05	0.05	0.05	0.05			RUSLE LS factor calculated for a high rill/interrill ratio.
Slope length (m)	30	35	25	100			
Slope gradient (%)	45	45	45	1			
Length/gradient (*LS* -factor)	7.61	8.63	6.55	0.20			
Erosion control practice (*P* -factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C* -factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2	2	2	2	Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.64	0.64	0.64	0.64			See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	504	572	434	14			
Soil Loss Class	5	5	4	1			See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	388	440	334	10			Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	21	26	17	4			See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	74	79	68	473			See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	95	105	85	477			

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

VGT Environmental Compliance Solutions Pty Ltd
- Environmental & Geological Assessments
- Environmental Monitoring & Management
- Quarry/Mine Plans & Rehabilitation Plans
- CPESC Endorsed Sediment & Erosion Plans
- Annual Reports
- NATA Accredited Laboratory

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