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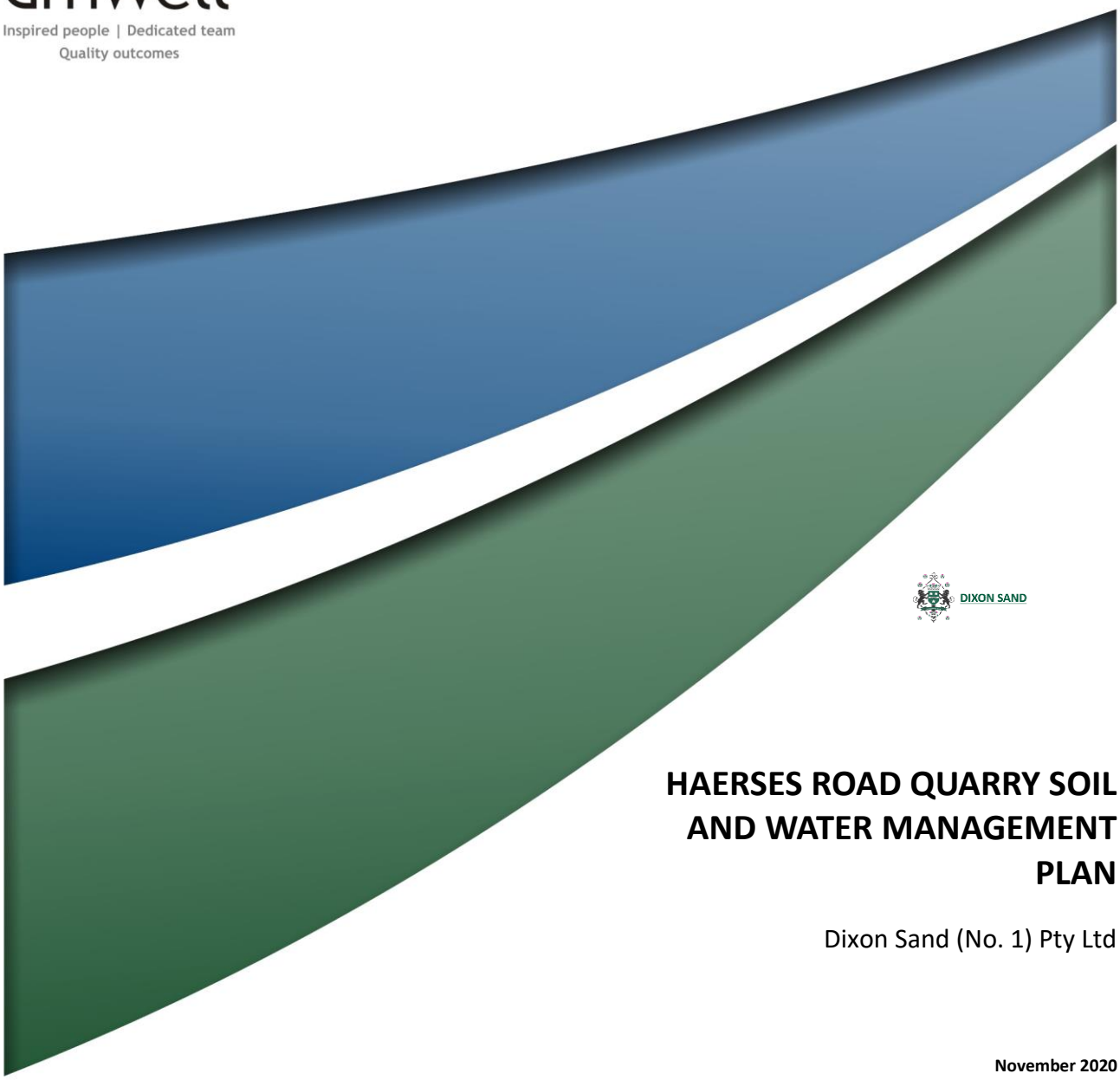

DIXON SAND

HAERSES ROAD QUARRY SOIL AND WATER MANAGEMENT PLAN

Dixon Sand (No. 1) Pty Ltd

November 2020

DIXON SAND

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Dixon Sand (No. 1) Pty Ltd

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Dixon Sand (No. 1) Pty Ltd

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	**Date**	**Name**	**Date**
1	Trish McDonald	20/4/2018	Luke Bettridge	24/4/2018
2 (Agency consultation)	Trish McDonald	24/5/2018	Luke Bettridge	24/5/2018
2a (DPE)	Trish McDonald	29/8/2018	Luke Bettridge	29/08/2018
3	Hunny Churcher	24/05/2019	David Dixon	24/05/2019
4	Hunny Churcher	23/04/2020	David Dixon	24/04/2020
5	Hunny Churcher	10/11/2020	David Dixon	10/11/2020
6	Hunny Churcher	12/11/2020	David Dixon	12/11/2020

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1.0 Introduction

1.1 Background

Dixon Sand (No. 1) Pty Limited (Dixon Sand) operates the Haerses Road Quarry (the Quarry) located on Haerses Road at Maroota, NSW (refer to **Figure 1.1**), a sand extraction and processing operation. The Quarry has been in operation since 2006. The site is approximately 71 hectares (ha) and includes Lot 170 DP 664766, Lot 170 DP 664767, Lots A and B DP 407341, Lots 176 and 177 DP 752039 and Lot 216 DP 752039 (refer to **Figure 1.2**). The Quarry is located in the small rural community of Maroota which supports a number of other sand extraction operations, including the Old Northern Road Quarry which is also operated by Dixon Sand. The Quarry supplies concrete sand and specialty sands to the Sydney metropolitan market.

The Quarry operates in accordance with Development Consent (DA 165-7-2005) by the Minister for Planning on 14 February 2006. DA 165-7-2005 was modified under Section 75W of the *Environmental Planning and Assessment Act 1979 (EP&A Act)* on 22 January 2018 (Modification 1). The Development Consent was subsequently modified under Section 4.55(1) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 29 January 2019 (Modification 2).

The Development Consent permits the extraction and processing of 250,000 tonnes per annum (tpa). Transport of up to 190,000 tpa of quarry product to the Old Northern Road Quarry for processing, located approximately 2 kilometres (km) to the north, is also permitted.

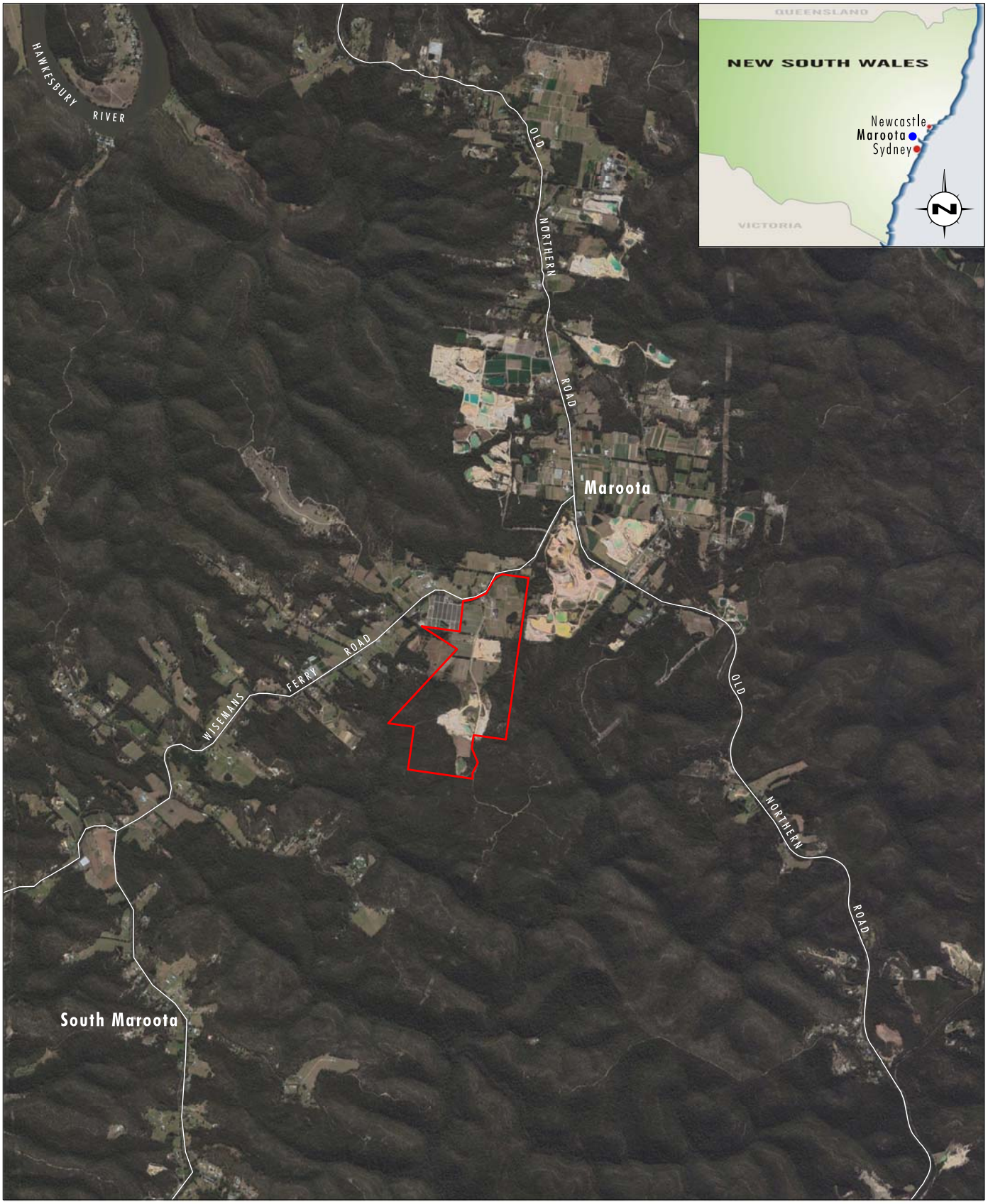
The Development Consent permits quarrying operations to be carried out on site until 14 February 2046.

1.2 Purpose and Scope

The purpose of this Soil and Water Management Plan (SWMP) is to describe the soil and water management strategies, procedures, controls and monitoring programs to be implemented for the management of potential soil and water impacts arising from the operation of Haerses Road Quarry. This SWMP applies to Lot 170 DP 664766, Lot 170 DP 664767, Lots A and B DP 407341, Lots 176 and 177 DP 752039 and Lot 216 DP 752039 as shown on **Figure 1.1**.

This SWMP addresses the relevant requirements of DA 165-7-2005. The Development Consent conditions and Environmental Assessment (EA) management commitments relevant to this plan are provided in **Section 1.4.** A checklist of where each condition has been addressed within this document is provided in **Table 1.2**. This plan also outlines the control measures to be implemented as part of the continued operations at the Quarry to minimise the potential impacts on soil and water quality.

This SWMP has also been developed in accordance with the requirements of the Department of Planning and Environment's (DPE) *Environment Management Plan Guidelines* (the guidelines). A checklist of where each condition has been addressed within this document is shown in **Appendix 1**.



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Haerses Road Quarry Site

FIGURE 1.1

Locality Map

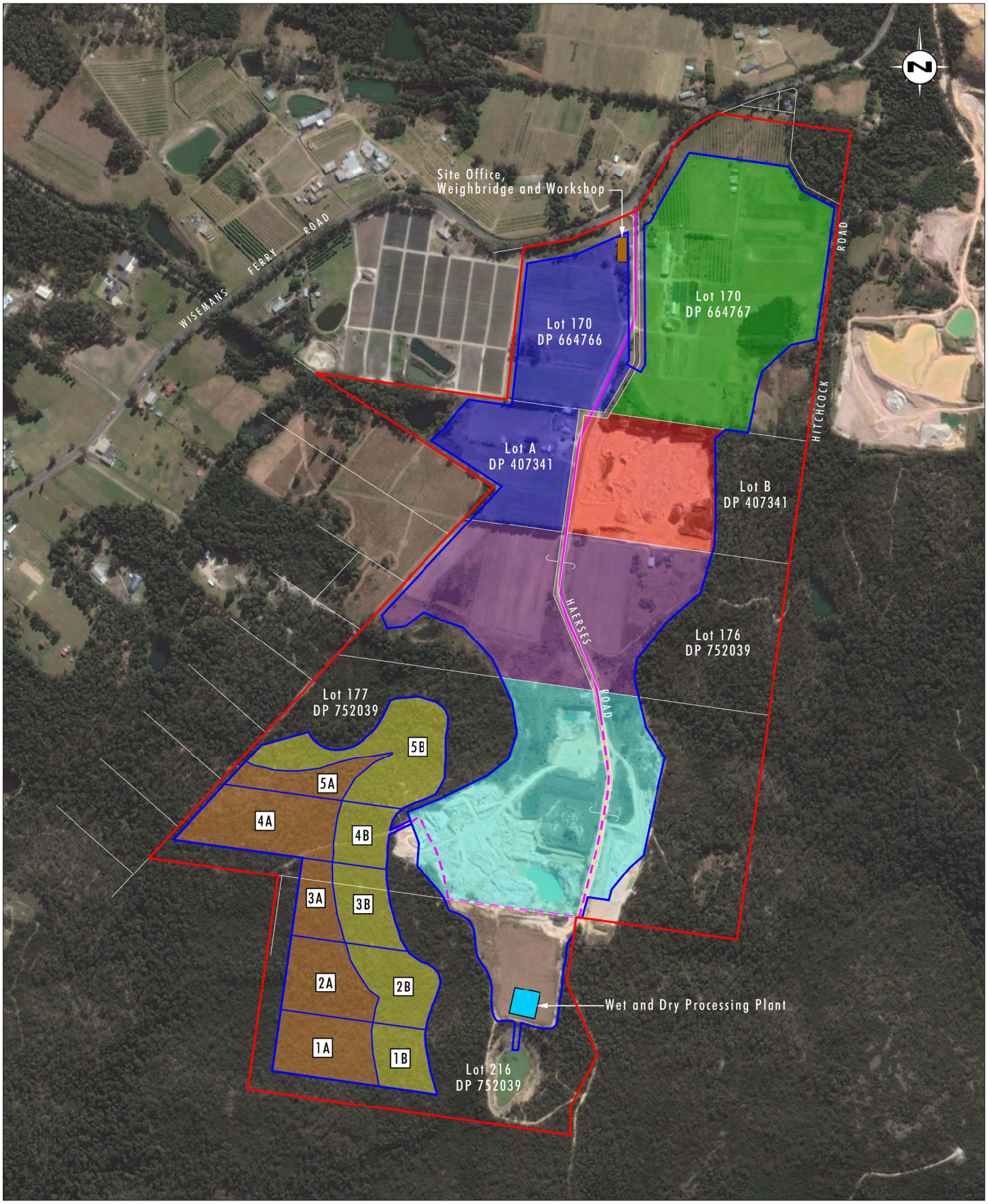

Image Source: Google Earth (Sep 2017)
Data Source: Mc Kinlay Morgan & Associates Pty Ltd (2014)

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Legend

- Haerses Road Quarry Site
- Approved Extraction Area
- Extraction Area Stage 1
- Extraction Area Stage 2
- Extraction Area Stage 3
- Extraction Area Stage 4
- Extraction Area Stage 5
- Extraction Area A
- Extraction Area B
- [1] Extraction Cell Number
- Site Office, Weighbridge and Workshop
- Wet Processing Plant
- Indicative Unsealed Haul Road
- Sealed Haul Road

FIGURE 1.2

Haerses Road Quarry

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1.3 Plan Implementation

1.3.1 Responsibilities

Environmental management at the Quarry is the responsibility of all employees and contractors, with the Quarry Manager having overall responsibility for environmental management of the operations.

Roles and responsibilities for implementation of this SWMP for key personnel at the Quarry are outlined in **Table 1.1**.

Table 1.1 Roles and Responsibilities

Role	Accountabilities for this document
Quarry Manager	• Provide sufficient resources for the implementation of this plan • Oversee the implementation of this plan • Have working knowledge of this plan • Coordinate the implementation of water management measures and strategies in accordance with this plan • Ensure that the Quarry has sufficient water for all stages of the development, and if necessary, adjust the operations to match available water supply • Ensure the Quarry is managed within the capacity of the Quarry Water Management System • Be aware of the environmental legislative requirements associated with the Quarry and take measures to ensure compliance • Ensure employees are competent through training and awareness programs
Environmental Officer	• Coordinate the review of this plan in accordance with the requirements of the Development Consent • Coordinate the water monitoring program described in this plan • Evaluate and report monitoring results as required by the Development Consent and Environment Protection Licence (EPL) • Coordinate water related incident investigations and reporting as required by legislation and internal standards and guidelines • Initiate investigations of complaints as received from the public or government agency • Provide primary contact for complaints and supply follow-up information to any complainant • Prepare a report to government agencies or neighbours following incidents/non-compliances
All employees and contractors	• Comply with all requirements in this plan • Report all potential environmental incidents to the Quarry Manager immediately • Operate in a manner that minimises risks of incidents to themselves, fellow workers or the surrounding environment • Follow any instructions provided by the Quarry Manager

1.3.2 Further Studies

Dixon Sand has no requirements under their Conditions of Consent to undertake any further studies for the SWMP.

1.3.3 Hold Points

Dixon Sand has five hold point requirements under the Conditions of Consent:

Hold Point 1 – Schedule 2 Clause 18: Buffer Zones

Within 6 months of the determination of Modification 1, the Applicant must

a) Engage a registered surveyor to mark out the boundaries of the:

- approved limits of extraction;
- buffer zones shown in Appendix 2; and
- MTSGS buffer zone

b) submit a survey plan of these boundaries to the Secretary; and

c) ensure that the boundaries of each operational extraction area are clearly marked on site in a permanent manner that allows operating staff and inspecting officers to clearly identify these limits,

to the satisfaction of the Secretary.

The Applicant must not undertake any quarrying operations within the buffer zones shown in **Appendix 2**.

*Note: This condition does not prevent construction or maintenance of acoustic bunds shown in **Appendix 3***.

Hold Point 2 – Schedule 2 Clause 20: Maximum Extraction Depth

Within 6 months of the determination of Modification 1, the applicant must:

a) establish the highest recorded wet weather groundwater levels for the site based on all available local and site-specific groundwater monitoring data; and

b) engage a suitably qualified and experienced person to prepare a Maximum Extraction Depth Map (contour map or similar) for the development to ensure compliance with condition 19 above and submit this map to the Secretary for approval.

Within 14 days of the approval of the Maximum Extraction Depth Map, the Applicant must submit a copy of the approved map and the supporting groundwater monitoring data to CLWD.

Hold Point 3 – Schedule 3: Soil and Water

The Development Consent requires Dixon Sand to obtain all necessary approvals and/or water licences for the development under the *Water Act 1912* and/or the *Water Management Act 2000*.

A Controlled Activity Approval (CAA) is required to authorise its holder to carry out a controlled activity in, on or under waterfront land. Waterfront land includes the bed of any river, lake or estuary, and any land lying within 40 metres (m) inland of the highest bank of the river; or the shore of the lake; or the mean high water mark of the estuary.

There are two first order streams which are tributaries of Stone Chimney Arm (a tributary of Little Cattai Creek) which will be intercepted by the now approved Mod 1 extraction area. Dixon Sand will obtain a CAA prior to undertaking any works within 40 m from top of bank of the streams to be impacted.

Hold Point 4 – Condition 16 Schedule 3

Prior to commencing works associated with Modification 1 (Mod 1) extraction area, the Dixon Sand must:

- Install additional monitoring bores in accordance with EA (Mod 1);
- Install one additional monitoring bore in the south-western corner of the Mod 1 extraction area;
- Install loggers in each on-site bore to enable continuous groundwater level monitoring;
- Install water level loggers in all existing on-site quarry dams and in new quarry dams when constructed; and
- Carry out an aquifer pumping test within the Sydney Basin Central Groundwater Source (SBCGS)

to the satisfaction of Crown Lands and Water Division (CLWD) within the Department of Industry.

Hold Point 5 – Condition 17 Schedule 3

Monthly groundwater monitoring (levels and quality) must be undertaken for a period of not less than 2 years demonstrating that quarry operations in the Mod 1 extraction area are not impacting the Maroota Tertiary Sands Groundwater Source (MTSGS) buffer zone prior to sand extraction in the buffer zone (refer to **Sections 2.2.1** and **5.2.2**). The approval of the Secretary must be obtained before quarrying operations commence within the MTSGS buffer zone.

1.4 Compliance Requirements

1.4.1 Development Consent Conditions

Table 1.2 presents the consolidated consent conditions relating to soil and water management at the quarry.

Table 1.2 Conditions of Consent – Soil and Water

Condition	Requirement	Section/s Addressed
Schedule 2 – Administrative Conditions		
Limits of Extraction		
18	**Buffer Zones** Within 6 months of the determination of Modification 2, the Applicant must a) Engage a registered surveyor to mark out the boundaries of the: • approved limits of extraction; • buffer zones shown in **Appendix 2**; and • MTSGS buffer zone b) submit a survey plan of these boundaries to the Secretary; and c) ensure that the boundaries of each operational extraction area are clearly marked on site in a permanent manner that allows operating staff and inspecting officers to clearly identify these limits, to the satisfaction of the Secretary. The Applicant must not undertake any quarrying operations within the buffer zones shown in **Appendix 2**. *Note: This condition does not prevent construction or maintenance of acoustic bunds shown in **Appendix 3.***	Section 2.2.2
19	**Maximum Extraction Depth**	Sections 2.2.2.1,

Condition	Requirement	Section/s Addressed
	The Applicant must not undertake any extraction within 2 m of the highest recorded wet weather groundwater level of both the MTSGS and the SBCGS	5.2.2 and 5.2.3.2
20	Within 6 months of the determination of Modification 1, the applicant must: a) establish the highest recorded wet weather groundwater levels for the site based on all available local and site-specific groundwater monitoring data; and b) engage a suitably qualified and experienced person to prepare a Maximum Extraction Depth Map (contour map or similar) for the development to ensure compliance with condition 19 above and submit this map to the Secretary for approval. Within 14 days of the approval of the Maximum Extraction Depth Map, the Applicant must submit a copy of the approved map and the supporting groundwater monitoring data to DoI.	Section 2.2.2 Appendix 3
21	The Applicant must comply with the extraction depths specified in the approved Maximum Extraction Depth Map, to the satisfaction of the Secretary.	Sections 5.2.2
22	The Applicant must review and update the Maximum Extraction Depth Map: a) annually, for the duration of the baseline groundwater monitoring program (see condition 17 of Schedule 3); and b) within 3 months of the completion of each Independent Environmental Audit (see condition 13 of Schedule 15), to the satisfaction of the Secretary.	Section 5.2.3.2
Schedule 3 – Specific Environmental Conditions		
Water Supply		
14	The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of operations under the consent to match its available water supply, to the satisfaction of the Secretary. *Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Applicant is required to obtain all necessary water licences for the development.*	Section 4.0
Water Discharges		
15	The Applicant must comply with the discharge limits in any EPL, or with section 120 of the POEO Act.	Section 5.1.1
Groundwater Management		
16	Prior to commencement of quarrying operations within the Mod 1 extraction area, the Applicant must: a) install additional monitoring bores in accordance with EA (Mod 1); b) install one additional monitoring bore in the south-western corner of the Mod 1 extraction area; c) install loggers in each on-site bore to enable continuous groundwater level monitoring; d) install water level loggers in all existing on-site quarry dams and in new quarry dams when constructed; and e) carry out any aquifer pumping test within the SBCGS to the satisfaction of DoI.	Sections 2.2 and 5.2.2.2

Condition	Requirement	Section/s Addressed
17	Prior to commencing quarrying operations within the MTSGS buffer zone, the Applicant must complete a baseline groundwater monitoring program, in consultation with CLWD and to the satisfaction of the Secretary. The program must include monthly monitoring of groundwater levels and quality within the MTSGS buffer zone for a period of not less than 2 years. The Applicant must not commence quarrying operations within the MTSGS buffer zone without the prior approval of the Secretary.	Sections 2.2 and 5.2.2.2
18	The Applicant must ensure that groundwater in the regional groundwater source managed under the *Water Sharing Plan for the Greater Metropolitan Groundwater Sources 2011* is not intercepted or contaminated by its operations. In the event of this groundwater being intercepted or contaminated, operations are to cease within the vicinity of the affected area and the Applicant must consult with the Secretary and DoI to determine the basis upon which extraction may recommence. *Note: Perched groundwater lenses that are above the regional groundwater source may be intercepted, however Water Access Licences must be held to account for all groundwater taken.*	Sections 2.2, 5.2.2.2 and 6.2
Soil and Water Management		
19	The Applicant must prepare a Soil and Water Management Plan for the development to the satisfaction of the Secretary. This plan must: (a) be prepared by a suitably qualified and experienced person/s approved by the Secretary; (b) be prepared in consultation with the EPA and DoI; (c) be submitted to the Secretary for approval prior to the commencement of quarrying operations within the Mod 1 extraction area, unless otherwise agreed by the Secretary; and (d) include a: (i) Site Water Balance that includes: • details of: ○ sources and security of water supply; ○ water use and management on site; ○ any off-site water transfers; and ○ reporting procedures; and • measures to be implemented to minimise clean water use on site; (ii) Surface Water Management Plan, that includes: • a program for obtaining detailed baseline data on surface water flows and quality in water bodies that could potentially be affected by the development; • a detailed description of the surface water management system on site including the: ○ clean water diversion system; ○ erosion and sediment controls; ○ dirty water management system; and ○ water storages, including the area, depth and capacity of any in-pit sumps; and	This plan Appendix 2 Appendix 2 Section 4.0 Section 5.1.2 Section 2.1

Condition	Requirement	Section/s Addressed
	• a program to monitor and report on: ○ any surface water discharges; ○ the effectiveness of the water management system; ○ the quality of water discharged from the site to the environment; and ○ surface water flows and quality in local watercourses; and (iii) Groundwater Management Plan that includes: • detailed management measures to ensure that quarrying operations do not intercept the highest recorded wet weather groundwater level within the MTSGS and/or the SBCGS; • a protocol to obtain appropriate water licence(s) to cover the volume of any unforeseen groundwater inflows into the quarry from the quarry face or floor; and • a monitoring program to manage potential impacts, if any, on any alluvium and associated surface water source near the proposed extraction area that includes: ○ monitoring of groundwater inflows into the quarry from the quarry face or floor, or into any in-pit sumps; ○ identification of a methodology for determining threshold water level criteria; ○ contingency measures in the event of a breach of thresholds; and ○ a program to regularly report on monitoring. The Applicant must implement the Soil and Water Management Plan as approved by the Secretary.	Section 5.1.2 Section 5.1.3.2 Sections 2.2 and 5.2.2 Section 5.2.1 and 6.2 Sections 2.1.1 and 5.2.2

1.4.2 Environmental Management Commitments

In accordance with Condition 2 Schedule 2 of the Development Consent, the quarry must be developed and operated generally in accordance with the environmental assessment reports prepared for the development. **Table 1.3** summarises the safeguards and management controls relating to soil and water quality management that have been identified in the EIS (ERM 2005b) and EA (Umwelt 2016).

Table 1.3 EA Soil and Water Quality Management Commitments

Source	Description	Section/s Addressed
EIS (ERM, 2005b)	In Stage 2, a sedimentation basin will be constructed within initial extraction and rehabilitation areas and will be maintained for the life of the Quarry.	Section 3 Figure 3.1
EIS (ERM, 2005b)	As the soils on site are highly erodible under concentrated flows, erosion and sediment controls are proposed to control drainage on site, maximise infiltration and to minimise the area of soil exposed to surface water flows. Controls will include the following: • maintain buffers and boundary setbacks and install silt fences where appropriate to prevent sediment transport and impact on adjoining land; • minimise the area of disturbance by only clearing areas immediately prior to extraction within each stage or strip and undertake progressive rehabilitation of completed strips;	Section 3.2
	• direct stormwater runoff from disturbed areas to appropriate areas and	

Source	Description	Section/s Addressed
	sedimentation ponds for infiltration or treatment prior to discharge off-site; • maintain the rim around the perimeter of the Quarry area until rehabilitation is complete; and • regular inspection and maintenance of sediment controls.	
EA (Umwelt 2016)	• Monitoring will be continued for the life of the Quarry operations to continue to refine the mapping of the extent of the MTSGS and the wet weather groundwater level in both the MTSGS and the SBCGS to allow appropriate buffers to be maintained throughout the life of the Quarry. • No extraction would be undertaken within the 100 m buffer of the MTSGS until two additional monitoring bores within the western margin of the MTSGS have been established and monitoring shows that quarrying can be undertaken in this area without impacting on the MTSGS. The decision to commence quarrying in this area will be undertaken in consultation with DPI Water and with the approval of DPE. • The depth of quarrying will maintain an elevation which is at least 2 m above the 'wet weather' groundwater elevation for the SBCGS. • A TARP for groundwater will be developed as part of the ongoing groundwater monitoring program to focus upon appropriate trigger and response actions for the management or mitigation of any unpredicted impacts that occur. The monitoring program that is in place will be used to establish the triggers, which will be designed to identify any potential impacts and trigger an appropriate response.	Section 5.2.2 Section 5.2.2.2 Section 5.2.2.1 Section 6.2
EA (Umwelt 2016)	• During the construction of infrastructure for the Modification all works and associated erosion and sediment controls will be inspected monthly and maintained as required to ensure that all required controls are in place and effective. • All erosion and sediment controls will be designed, constructed and managed in accordance with the Blue Book Volumes 1 and 2. • Following the completion of construction works, the work areas will be inspected monthly and after any rainfall events generating runoff until revegetation and stabilisation of drainage structures are complete. • During the operational phase of the Modification, inspections of the water management controls will be undertaken on a monthly basis and after storm events (i.e. greater than 50 mm rainfall in 24 hours). • The walls of all water management dams will be inspected biennially (every two years) for their structural integrity and for any maintenance requirements. The walls of the water management dams will be grassed and kept free of any trees and shrubs. • Visual inspections of water quality will be undertaken after storm events and a comment on visual water quality will be included on any erosion and sediment control inspections that are undertaken. • Monthly surface water monitoring of the in-pit sump is proposed to provide for ongoing monitoring of site water quality. • Dixon Sand will monitor the site water balance through monthly monitoring of site water usage and changes in dam water volumes, to determine an annual site water balance.	Section 3.2.3.6 Section 3.2 Section 3.2.3.6 Section 3.2.3.6 Sections 3.2.3.2 and 5.1.2.4 Section 3.2.3.6 Section 5.1.2.1 Section 5.1.2.3

1.4.3 Environment Protection Licence

The quarry operates under EPL 12513, issued under the NSW *Protection of the Environment Operations (POEO) Act 1997* (**Section 5.2.1**).

1.4.4 Water Licences

Dixon Sand currently holds two surface water access licences (WALs) and associated works approvals for lands within the Haerses Road Quarry Project area. These WALs will be modified to include extractive industry operations and amend the expiry date to 2046 in line with the Development Consent. **Table 1.4** presents the WAL details and **Figure 1.3** presents the approved water supply works.

Table 1.4 Water Access Licences

WAL Number	Associated Works Approval	Land Holding	Works	Extraction Limit (ML/year)[1]
25956	10CA105044	Lot 170 DP664767	**Work 1** Bywash Dam **Work 2** 80 mm pump centrifugal pump **Work 3** 80 mm centrifugal pump **Work 4** Bywash Dam **Work 5** 32 mm centrifugal pump	132
25941	10CA104191	Lot B DP 407341	**Work 1** Bywash Dam x 2 **Work 2** 65 mm centrifugal pump	50

Note: [1] Extraction limit assuming a full allocation of 1 ML for each unit share

As all extraction activities will be maintained above the wet weather groundwater table of the two regional aquifers, there will be no intentional interception of groundwater and therefore no water access licences for groundwater extraction are required.

1.4.5 Stakeholder Consultation

In accordance with Condition 19 Schedule 3(a) of the Development Consent, this SWMP has been prepared by a suitably qualified and experience person/s approved by the Secretary. A copy of correspondence provided by DPE approving the specialists is provided in **Appendix 2**.

In accordance with Condition 19 Schedule 3 of the Development Consent, this SWMP has been prepared in consultation with the Environment Protection Authority (EPA) and Crown Lands and Water Division within the Department of Industries (DoI, formerly CLWD). A copy of correspondence provided by the EPA and a summary of how these issues have been addressed is provided in **Appendix 2**.

As noted in **Appendix 2**, the SWMP was provided to DoI on 25 May 2018. No response has been received to date. A copy of correspondence has been provided in Appendix 2. The SWMP will be revised, as appropriate, should comments be received from DoI.

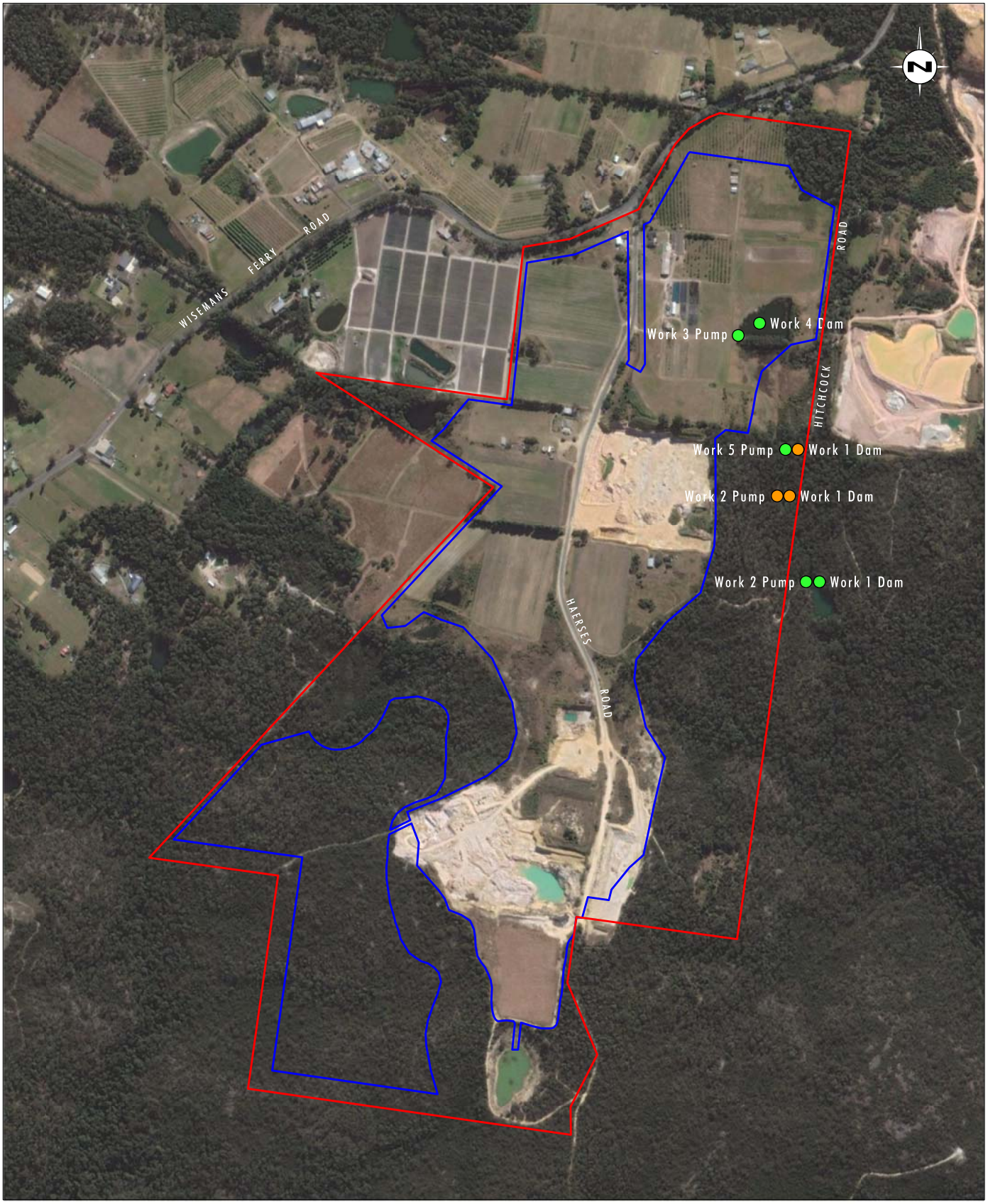

Image Source: Google Earth (Sep 2017)
Data Source: Mc Kinlay Morgan & Associates Pty Ltd (2014)

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Legend

- Haerses Road Quarry Site
- Approved Extraction Area
- WAL 25956 Works
- WAL 25941 Works

FIGURE 1.3

Approved Water Supply Works

1.5 Guidelines and Policies

Receiving water quality standards and trigger values have been developed in general accordance with *The Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Environment and Conservation Council, 2000).

The following guidelines are relevant to the management of sediment and erosion control on site:

- *Managing Urban Stormwater – Soils and Construction, Volume 1* (the Blue Book) (Landcom, 2004); and
- *Managing Urban Stormwater – Soils and Construction, Volume 2E*: Mines and Quarries (DECC, 2008).

The *NSW Aquifer Interference Policy* (DPI Office of Water 2012) applies to aquifer interference activities. Haerses Road Quarry is not permitted to extract within 2 metres of the wet weather groundwater level of the local regional groundwater table (Sydney Basin Central Groundwater Source). Extraction within the Maroota Tertiary Sands Groundwater Source (MTSGS) buffer zone (refer to **Figure 2.2**) cannot be undertaken until additional groundwater monitoring (refer to **Sections 2.2.2** and **5.2.2.2**) can demonstrate that interception of perched groundwater lenses overlaying the regional groundwater source will not impact the MTSGS. Groundwater risks associated with aquifer interference are managed by way of the Trigger Action Response Plan (TARP) process outlined in **Section 6.2**.

2.0 Soil and Water Context

The soil and water context of the site is discussed in detail in **Section 6.3** and **6.4** of the Environmental Assessment (EA) (Umwelt, 2016) and the *Haerses Road Quarry Groundwater Assessment* (Australian Groundwater Technologies, 2016).

A summary of the soil and water environment and recent baseline monitoring data is provided in the following sections.

2.1 Surface Water

2.1.1 Catchment and Hydrology

The Haerses Road Quarry site is located within the Little Cattai Creek Catchment, a sub-catchment of the Hawkesbury-Nepean catchment. The Little Cattai Creek catchment covers an area of 9,980 ha with the Haerses Road Quarry site comprising 71 ha or 1% of this catchment area. Water use within the catchment is regulated under the *Water Sharing Plan (WSP) for the Greater Metropolitan Region Unregulated River Water Sources* which commenced on 1 July 2011.The WSP covers an area of approximately 32,500 km^2, from Shoalhaven Heads in the south, Broken Bay in the north, Lithgow to the west and Goulburn to the south west. The WSP encompasses 87 management zones that are grouped into 6 water sources.

The Quarry site straddles a flat ridgeline, followed by Haerses Road, which takes an approximately north-south orientation through the site. The western extent of the approved Mod 1 extraction area is approximately 126 m AHD, with the low point of 176 m AHD to the east of Haerses Road near the boundary of the Stage 2 extraction area, rising to approximately (202 m AHD) at the north eastern extent of the approved Stage 5 extraction area. Runoff from the presently undisturbed project area catchments either side of the road flows to tributaries of Stone Chimney Arm (a tributary to Little Cattai Creek) to the west and Little Cattai Creek to the east. The confluence of Stone Chimney Arm is approximately 1.5 km south of the Quarry. Little Cattai Creek continues in a southerly and then westerly direction into the Hawkesbury approximately 10 km south-west of the site.

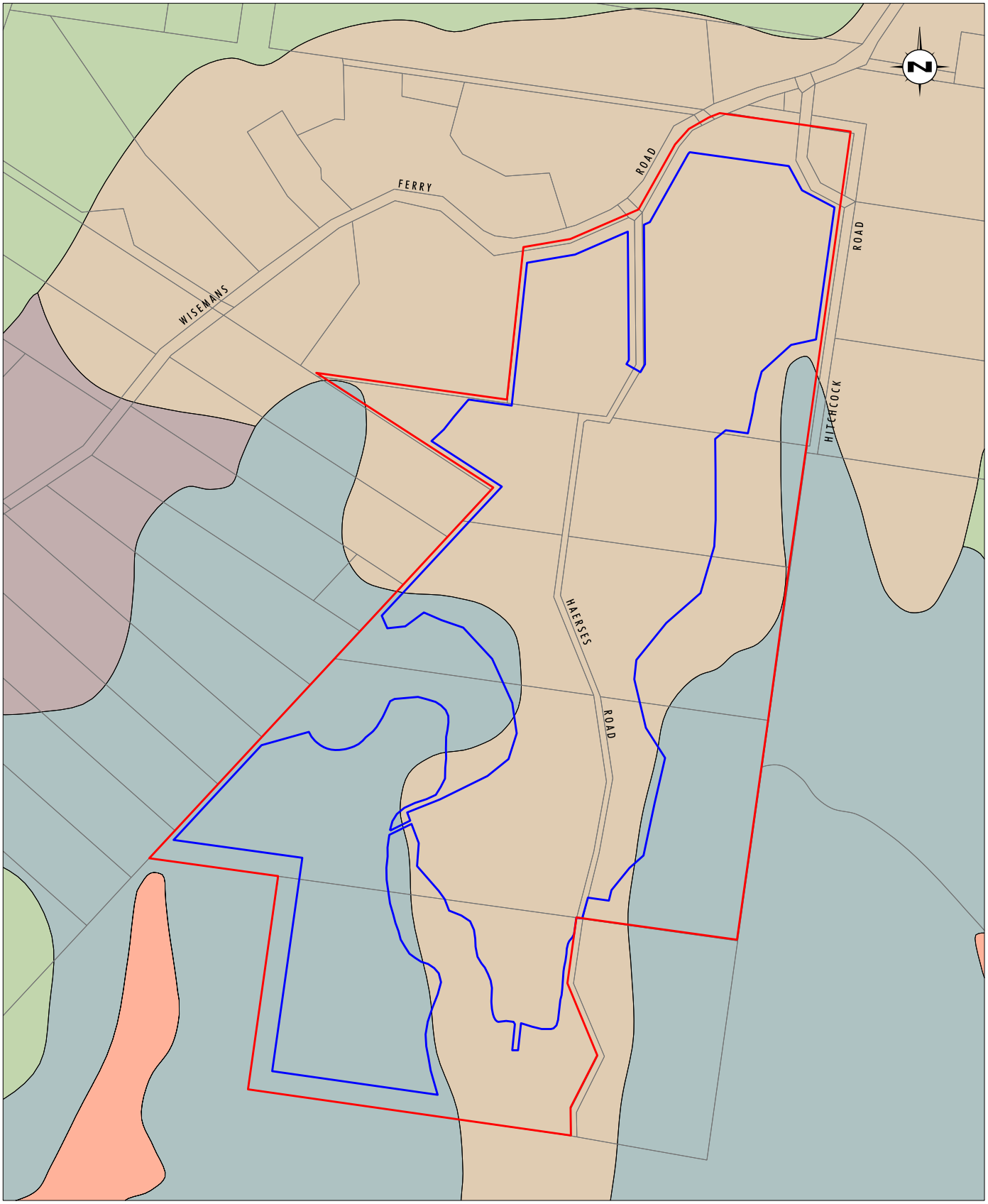
Two first order ephemeral streams which are tributaries of Stone Chimney Arm (a tributary of Little Cattai Creek) will be intercepted by the Mod 1 extraction area. Runoff from undisturbed catchments upslope of the Mod 1 extraction area will be directed around the Quarry using clean water catch drains. As such, there will be no surface water flows from the ephemeral streams, the stream catchments or from alluvial waters associated with the streams into the Mod 1 extraction area.

Runoff from the disturbed areas within the Quarry is contained within the Quarry Water Management system (WMS). Further detail on how runoff from dirty water catchments is managed at the Quarry is presented in **Section 3.0**. As a consequence of the highly porous nature of the disturbed quarry catchments, a significant proportion of runoff rapidly infiltrates exposed surfaces as groundwater recharge.

2.1.2 Soils

2.1.2.1 Soil Landscapes

The Haerses Road Quarry is underlain by two separate soil landscapes - the Maroota (ma) and Gymea (gy) soil landscapes as per mapping undertaken by McInnes (1997). Both soil landscapes have a high to extreme erosion hazard under concentrated flows and are also highly permeable. Therefore, particular care must be taken with erosion and sediment control measures to prevent erosion of soils.



Data Source: Mc Kinlay Morgan & Associates Pty Ltd (2014), OEH (2010)

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Legend

- Haerses Road Quarry Project Aite
- Approved Extraction Area
- Gymea Soil Lansdcape
- Colo Heights Soil Landscape
- Watagan Soil Landscape
- Maroota Soil Landscape
- Sydney Town Soil Landscape

FIGURE 2.1

Soils Lanscapes

2.1.3 Climate

For water balance considerations it is important to have data that contains the long term climate records for a site (i.e. typically greater than 100 years). There are numerous Bureau of Meteorology (BoM) stations located in the region surrounding the Quarry that record daily rainfall. Long term daily rainfall data is available for Old Telegraph Road, Maroota (Station 067014) located approximately 2 km north-east of the Quarry with daily rainfall records from 1925 to date. Although the data available is missing some periods of data (i.e. 1954 - 1965), and has patchy data during some periods (i.e. 1986 - 2013), a comparison of long term climate records indicates that the available good quality data captures the long term rainfall variation (i.e. long term wet and dry periods).

The daily rainfall data for the Old Telegraph Road BoM station is summarised in **Table 2.1**. The rainfall analysis undertaken excludes rainfall years with excessive numbers of missing records.

Table 2.1 Annual Rainfall

Statistic	Annual Rainfall (mm)
10th percentile	577
50th percentile	899
90th percentile	1185

In the region surrounding the Quarry, there is only one BoM station which currently records daily evaporation data, the University of Western Sydney (UWS) Hawkesbury Campus (Station 067021). The UWS BoM Station is located approximately 26 km south-west of the Quarry.

Annual pan evaporation recorded at the UWS Hawkesbury Campus (Station 067021) has been analysed for years 1973 - 2016. Analysis of the historical record shows an expected trend of evaporation increasing during the summer months and decreasing during the winter months. Average daily evaporation data for each month of the year is shown in **Table 2.2**.

Table 2.2 Average Daily Pan Evaporation

Month	Average Daily Pan Evaporation (mm/day)
January	5.9
February	5.0
March	3.9
April	3.0
May	2.1
June	1.7
July	1.9
August	2.6
September	3.8
October	4.7
November	5.1
December	5.7

2.1.4 Baseline Surface Water Quality

No receiving water surface water quality monitoring has previously been undertaken by Dixon Sand in streams adjacent to the Quarry. Dixon Sand have established two receiving water quality monitoring points in a tributary to Stone Chimney Arm to the west of the Quarry and a tributary to Little Cattai Creek to the east of the Quarry (refer to **Figure 2.3** and **Section 5.1.2.1**). Water quality data from these two monitoring locations commenced in September 2018 and will be used to develop site specific receiving water quality trigger values. It is important to note that the monitoring points are located in ephemeral tributaries and water samples can only be collected when there has been sufficient rainfall to generate flows in the tributaries. These ephemeral tributaries experienced dry conditions due to prolonged drought in 2018 and 2019. Since September 2018, three samples have been obtained in 2020 after rain events generating sufficient flow for water sampling. A procedure for inspecting and sampling at SW1 and SW2 following rain events has been adopted.

Dixon Sand has historic monitoring data for a stream to the west of the Dixon Sand Old Northern Road Quarry, approximately 2 km north of Haerses Road (refer to SW19 on **Figure 2.2**), which is expected to exhibit similar water quality to the streams adjacent to Haerses Road Quarry. **Table 2.3** presents the statistics for the receiving water quality data collected in the stream to the west of the Old Northern Road Quarry. The 20th percentile and 80th percentile results in **Table 2.3** will be adopted as interim site specific trigger values for pH and the 80th percentile results being the adopted trigger values for Total Suspended Solids (TSS) and turbidity. The EPA licensed discharge point at the Old Northern Road Quarry is located upstream of SW19. The discharge concentration limits and discharge monitoring requirements for the Old Northern Road Quarry criteria are listed in Table 5.1 of the Old Northern Road Quarry Soil and Water Management Plan.

It is important to note that the water quality statistics presented in **Table 2.3** are indicative of the expected receiving water quality in the streams adjacent to the Haerses Road Quarry. Given that the data is not specific to the Haerses Road Quarry receiving water monitoring locations, any water quality result obtained at Haerses Road Quarry which sit outside of the *interim trigger values* does not necessarily indicate that the result is outside the range of natural variation for the particular stream downstream of Haerses Road Quarry or that the Quarry has had an impact.

Table 2.3 Interim Baseline Surface Water Quality and Trigger Values (July 2003 to July 2005)

Parameter	Minimum	20th Percentile	50th Percentile	80th Percentile	Maximum
pH	<2.0	4.0	4.2	4.8	7.1
TSS (mg/L)	<2.0	2.0	2.0	8.0	17
Turbidity (NTU)	0.1	0.1	0.3	3.8	21

Note: Where water quality results were recorded below the limit of detection, the limit of detection was taken to be the result.

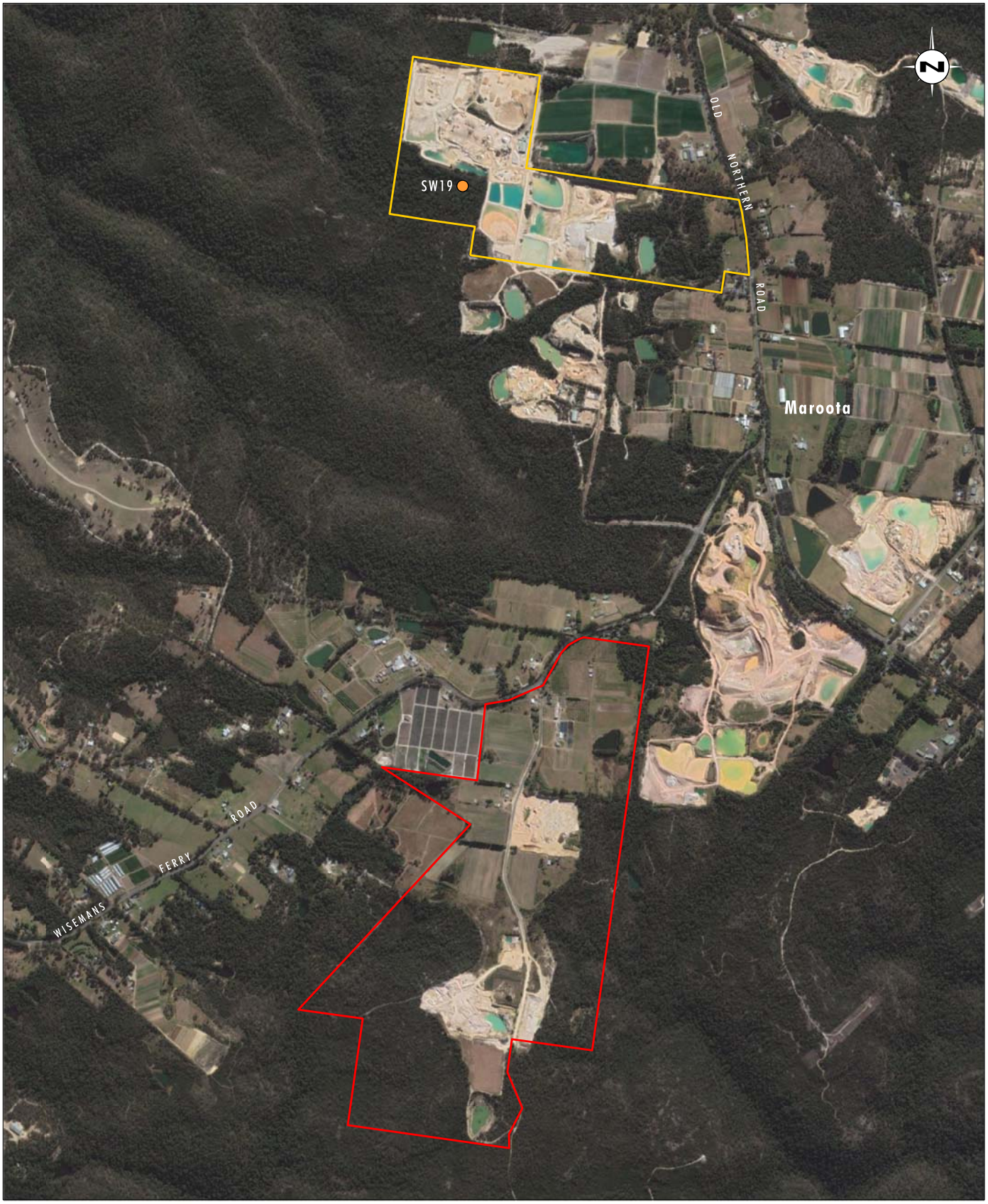

Image Source: Google Earth (2017)
Data Source: McKilay Morgan & Associates Pty Ltd (2014)

0 0.25 0.5 1.0km
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Legend

- Haerses Road Quarry Site
- Old Northern Road Quarry
- Baseline Receiving Water Monitoring Location

FIGURE 2.2

Old Northern Road Quarry Receiving Water Quality Monitoring

2.2 Groundwater

2.2.1 Groundwater Sources

There are two aquifers in the Maroota area that were considered as part of the Groundwater Assessment, being:

- the Maroota Tertiary Sands Groundwater Source (MTSGS). The MTSGS occurs in the Maroota Sands deposit and in the upper part of the Hawkesbury Sandstone (eluvial sands)

- the Hawkesbury Sandstone, a regional fractured rock aquifer. The Hawkesbury Sandstone forms part of the Sydney Central Basin Groundwater Source (SBCGS).

Both of these aquifers occur at the Haerses Road Quarry site. The MTSGS occurs along the central portion of the site, to the east of and upslope of the Mod 1 extraction area (refer to **Figure 2.2**). The SBCGS occurs within the Hawkesbury Sandstone deposit that is the target of the Mod 1 extraction area. However, the aquifer is below the proposed extraction area which will remain a minimum of 2 m above the SBCGS wet weather groundwater level (refer to **Section 5.2.2**). However, perched groundwater lenses have been mapped in areas near the quarry and may be intercepted by extraction activities. The perched groundwater lenses are believed to have limited connectivity with the regional groundwater sources (i.e. the SBCGS and MTSGS). Additional groundwater level monitoring will be undertaken to further understand the degree of connectivity between the perched groundwater and regional groundwater sources (refer to **Section 5.2.2.2**)

The MTSGS is recharged by direct rainfall infiltration and is subject to seasonal rainfall variations and longer term climatic cycles. At the Haerses Road site, water bore drilling has identified the MTSGS comprises of thin layers of gravel, thick sequences of clay, and interbedded clays and sands. These profiles are typical of palaeochannel sequences and represent the meandering nature of old river systems (Woodward and Clyde, 1999).

In the weathered profile of the Hawkesbury Sandstone small aquifer zones have developed in the eluvial sand (such as the deposit which is the Quarry resource for the approved Haerses Road Quarry), which comprises the leached and weathered profile of the Hawkesbury Sandstone. These zones often form perched aquifer systems above the deeper regional water level of the Hawkesbury Sandstone. In the majority of cases, these perched aquifer systems have limited resource value because, like the Maroota Sand, they have small aerial extent and storage. They act as temporary storage of groundwater prior to leakage to underlying aquifers.

The Hawkesbury Sandstone is generally an impermeable rock and although the rock has very little primary permeability, fracturing and jointing, where open and interconnected, provides secondary permeability and storativity.

2.2.2 Groundwater Baseline Conditions

2.2.2.1 Wet Weather Groundwater Levels and Extraction Limits

The water level of the MTSGS has been monitored and recorded at the Haerses Road Quarry since 2005 while the regional water table of the SBCGS has been monitored and recorded since 2011 (refer **Section 2.2.2**).

Within the approved extraction area, the SBCGS wet weather level ranges from 140.5 mAHD at BH4 (refer to **Figure 2.3**) in the east to 122.5 mAHD at BH5 (refer to **Figure 2.3**) in the west, therefore the maximum quarry floor level has been set at 142.5 mAHD in the east and 124.5 mAHD in the west which is 2 m above the wet weather level (Umwelt 2016). These levels will be reviewed and updated based on the work undertaken to determine the highest recorded wet weather groundwater levels for the site based on all available local and site-specific groundwater monitoring data in accordance with Schedule 2 Clause 20(a) of the Development Consent.

Localised perched aquifers could be present in the approved Mod 1 extraction area overlaying the SBCGS. While the available groundwater level monitoring data suggests that there is a very low or no potential hydraulic connection to the MTSGS, the Development Consent requires additional monitoring bores to provide a more detailed understanding of groundwater system interactions prior to extraction in Stage B of each extraction cell (refer to **Figure 2.2**). Thirteen new monitoring bores will be installed to provide the required data to assess any connectivity between the perched aquifers and the MTSGS.

Extraction in the Mod 1 area is limited to at least 100 m from the mapped extent of the MTSGS (refer to **Figure 2.2**) until it can be demonstrated that quarry activities will not impact the groundwater levels and quality of the MTSGS. Monthly groundwater monitoring (levels and quality) will be undertaken for a period of not less than 2 years to assess whether there are any impacts on the MTSGS associated with Quarry operations in the Mod 1 extraction area. Details of the new bores and groundwater monitoring program are presented in **Section 5.2.2**.

A registered surveyor has marked out boundaries of the:

- approved limits of extraction; and
- the MTSGS buffer zone.

Extraction area boundaries are all to be clearly marked in a permanent manner that allows operating staff and inspecting officers to clearly identify these limits.

Dundon Consulting Pty Ltd was engaged by Dixon Sand to analyse groundwater level monitoring data, establish the highest recorded wet weather groundwater level within the MTSGS buffer zone and prepare a maximum extraction depth map. The maximum extraction depth map was approved by DPE on 18 May 2018 and is included as **Appendix 3**.

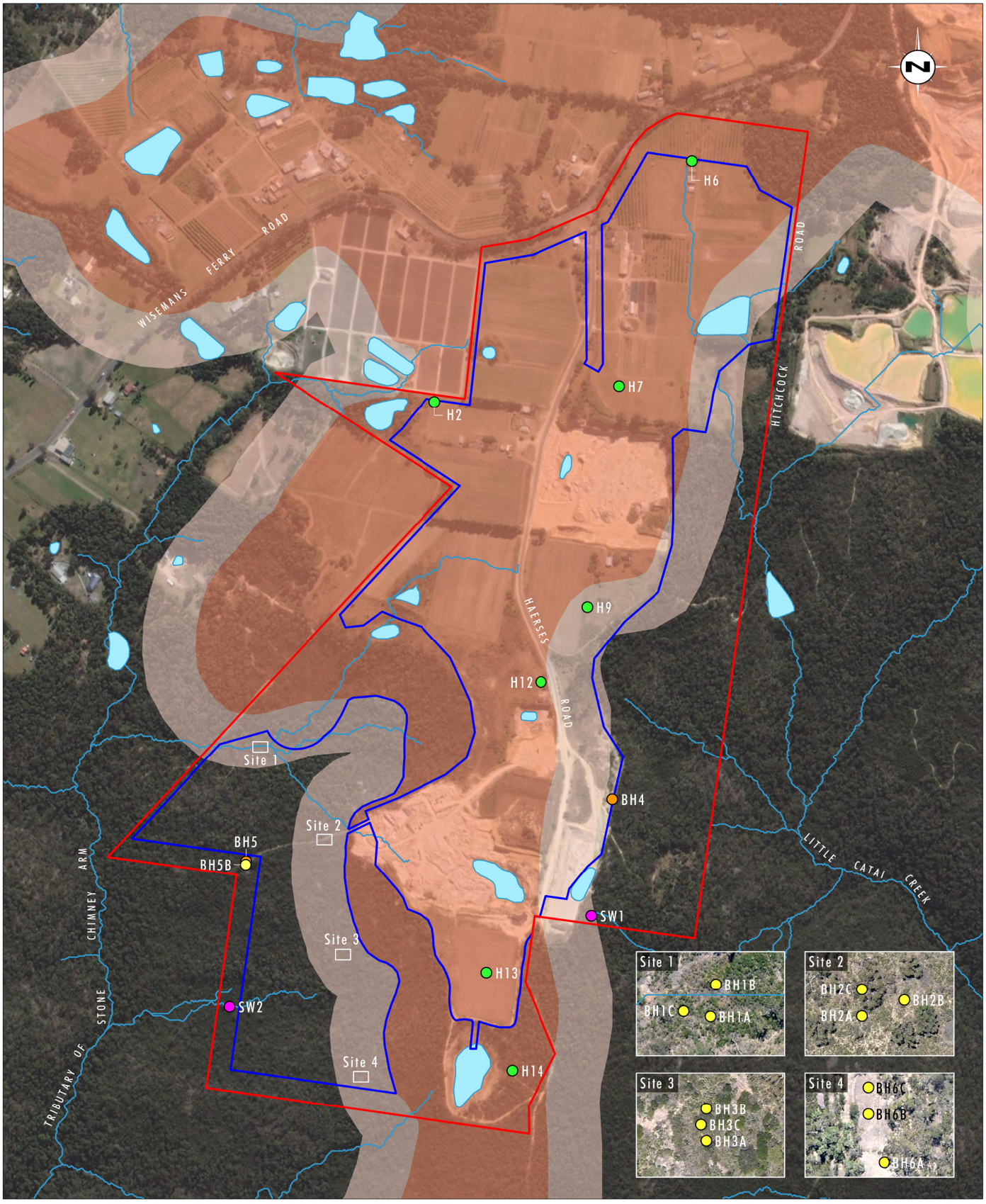

Image Source: Google Earth (Sep 2017), Nearmap (Jan 2010)
Data Source: Mc Kinlay Morgan & Associates Pty Ltd (2014), AGT (2016)

0 100 250 500m
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Legend

- Haerses Road Quarry Site
- Approved Extraction Area
- SBCGS Monitoring Bores
- MTSGS Monitoring Bores
- New Groundwater Monitoring Bores
- Surface Water Monitoring Location
- Maroota Tertiary Sands
- 100m Buffer around Maroota Tertiary Sands
- Drainage Line
- Dam

FIGURE 2.3

Surface Water and Groundwater Monitoring Locations

File Name (A4): R04/4272_022.dgn
20180817 10.51

2.2.2.2 Historical Groundwater Levels

Table 2.4 presents the baseline groundwater level statistics with the 20th percentile and 80th percentile results being the adopted site specific trigger values with respect to groundwater levels. Long term historical groundwater levels are presented in **Chart 2.1.** Groundwater level monitoring data for the 2019 monitoring period are presented in **Chart 2.2**. Groundwater monitoring locations are presented on **Figure 2.2** and detailed groundwater bore information is presented in **Table 5.2**.

Table 2.4 Baseline Groundwater Level Statistics and Trigger Values

Monitoring Location	Minimum	20th Percentile	50th Percentile	80th Percentile	Maximum
H1	173.6	173.9	174.2	175.7	176.9
H2	178.1	179.4	180.0	180.9	182.4
H4	182.1	182.8	183.1	183.2	183.4
H5	178.5	178.5	178.6	178.6	178.7
H6	179.4	181.2	181.4	182.4	184.7
H7	178.2	180.2	180.4	180.5	182.6
H8	183.3	184.2	185.2	187.5	187.8
H9	182.6	184.9	185.0	185.3	186.9
H10	175.7	175.8	176.0	176.6	176.7
H11	183.0	183.5	184.7	185.0	185.4
H12	178.2	181.0	181.1	181.2	184.0
H13	168.8	169.7	170.0	170.7	171.6
H14	171.9	174.7	174.9	175.1	177.2
BH4	139.3	140.5	140.6	140.7	141.2
BH5	121.4	123.2	123.2	123.3	123.4

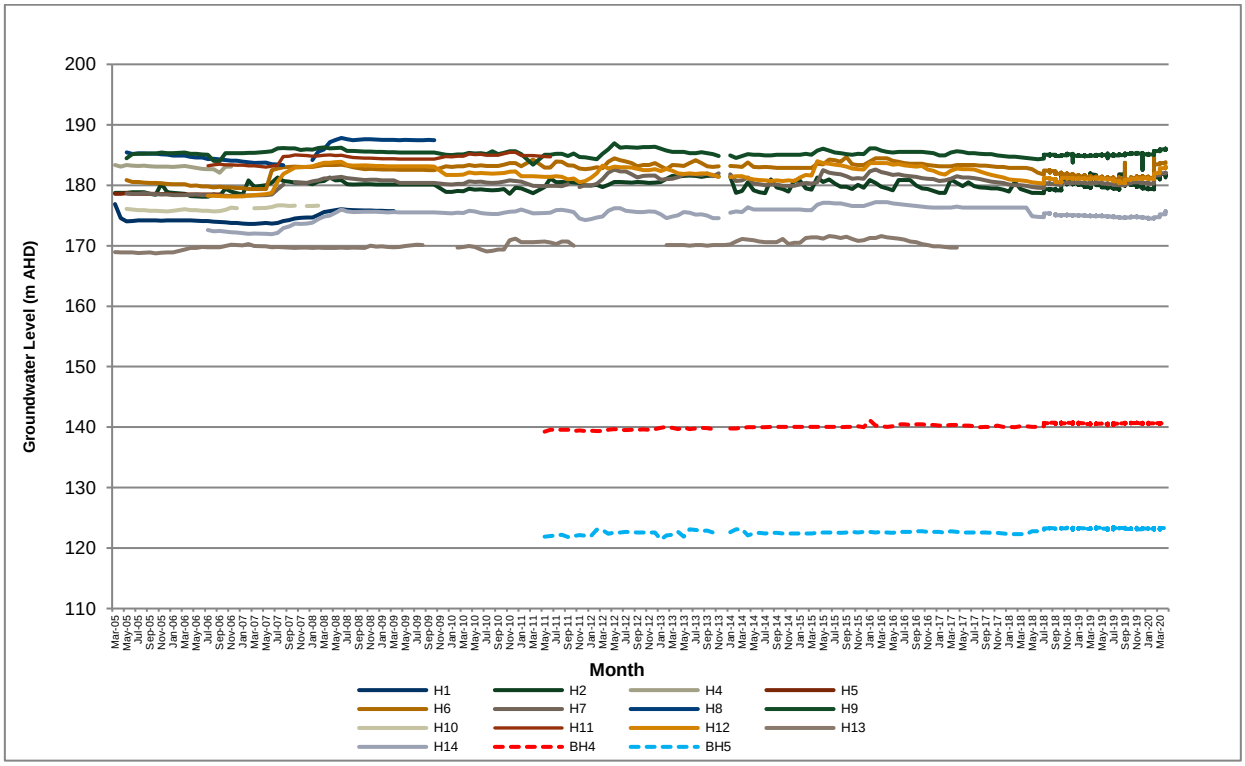

Chart 2.1 Long Term Groundwater Levels, 2005 - 2020

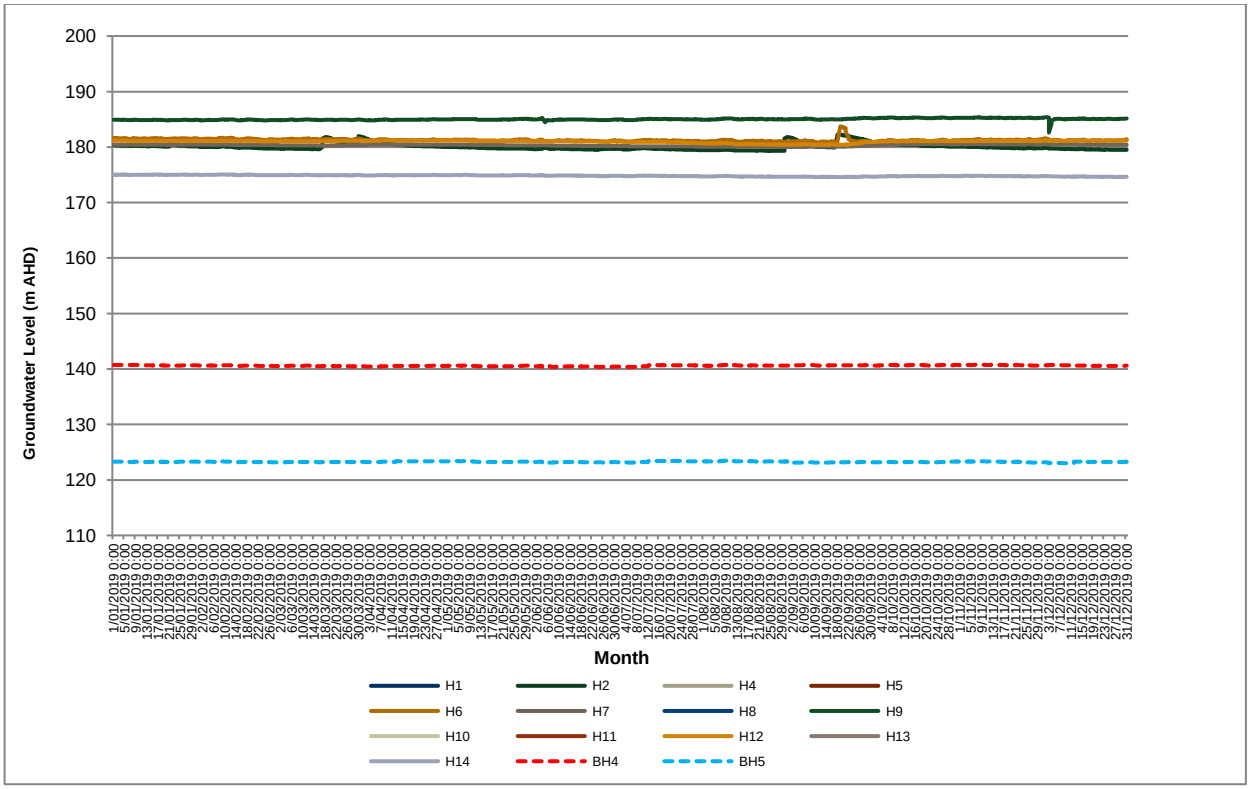

Chart 2.2 Groundwater Levels, 2019

2.2.2.3 Water Quality

Groundwater is sampled and analysed for pH and electrical conductivity (EC) for the 9 monitoring bores located in and around the Quarry. **Table 2.5** presents the baseline groundwater water quality statistics with the 20th percentile and 80th percentile results being the adopted site specific trigger values with respect to groundwater water quality. **Charts 2.3** to **2.6** presents the historical groundwater water quality monitoring data.

Groundwater quality test results for borehole H13 exhibited elevated pH, EC and turbidity results in December 2015. The elevated results were attributed to the application of organic fertiliser to the land immediately surrounding the borehole for agricultural soil conditioning impacting the quality of water infiltrating into the local perched aquifer. Groundwater quality monitoring results for H13 in June 2016 indicated that pH, EC and turbidity returned to baseline levels.

Table 2.5 Baseline Groundwater Water Quality Statistics and Trigger Values

Monitoring Location	pH			Electrical Conductivity (µS/cm)		
	20th Percentile	50th Percentile	80th Percentile	20th Percentile	50th Percentile	80th Percentile
H2	4.3	4.4	4.6	56	69	108
H6	4.2	4.3	4.4	161	182	205
H7	4.2	4.3	4.4	114	189	298
H9	4.4	4.6	4.7	116	127	145
H12	4.5	4.6	4.8	133	182	210
H13	4.3	4.6	4.7	94	117	193
H14	4.4	4.7	4.9	89	97	114
BH4	5.1	5.6	6.1	126	137	158
BH5	5.0	5.3	5.7	142	193	201

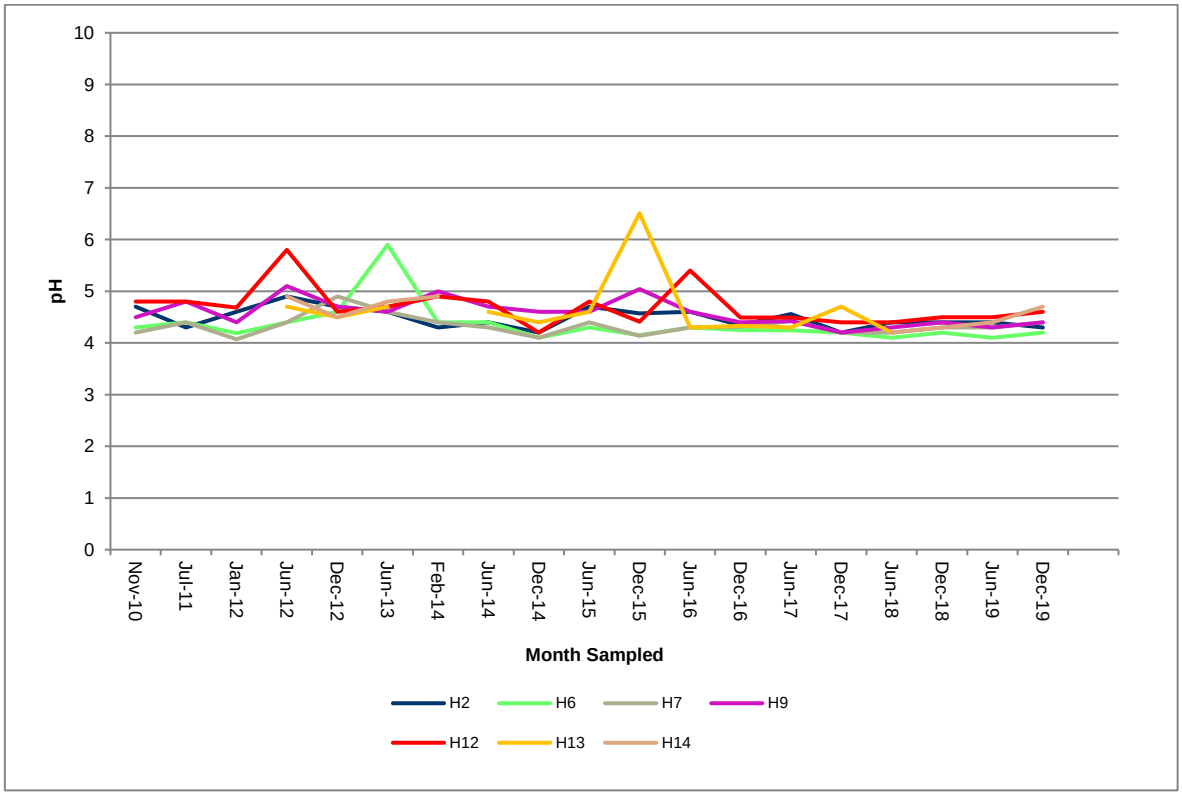

Chart 2.3 Groundwater pH (Bores H2, H6, H7, H9, H12, H13 and H14)

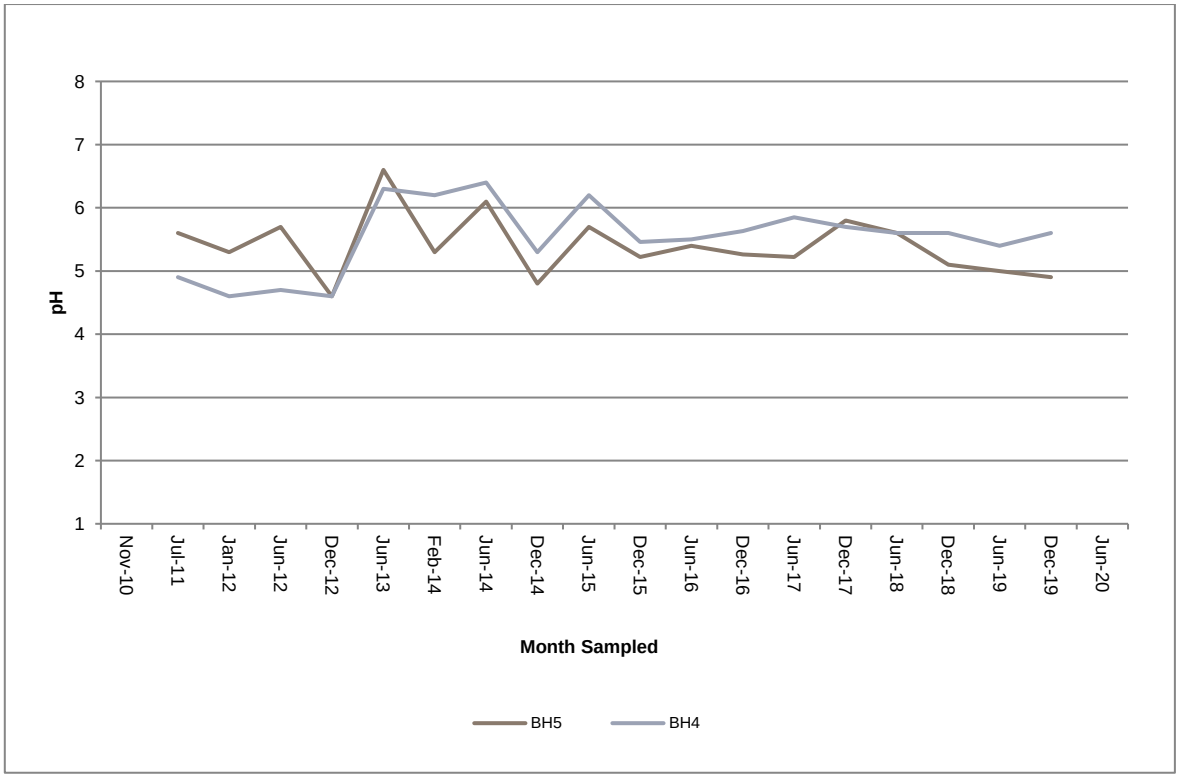

Chart 2.4 Groundwater pH (Bores BH4 and BH5)

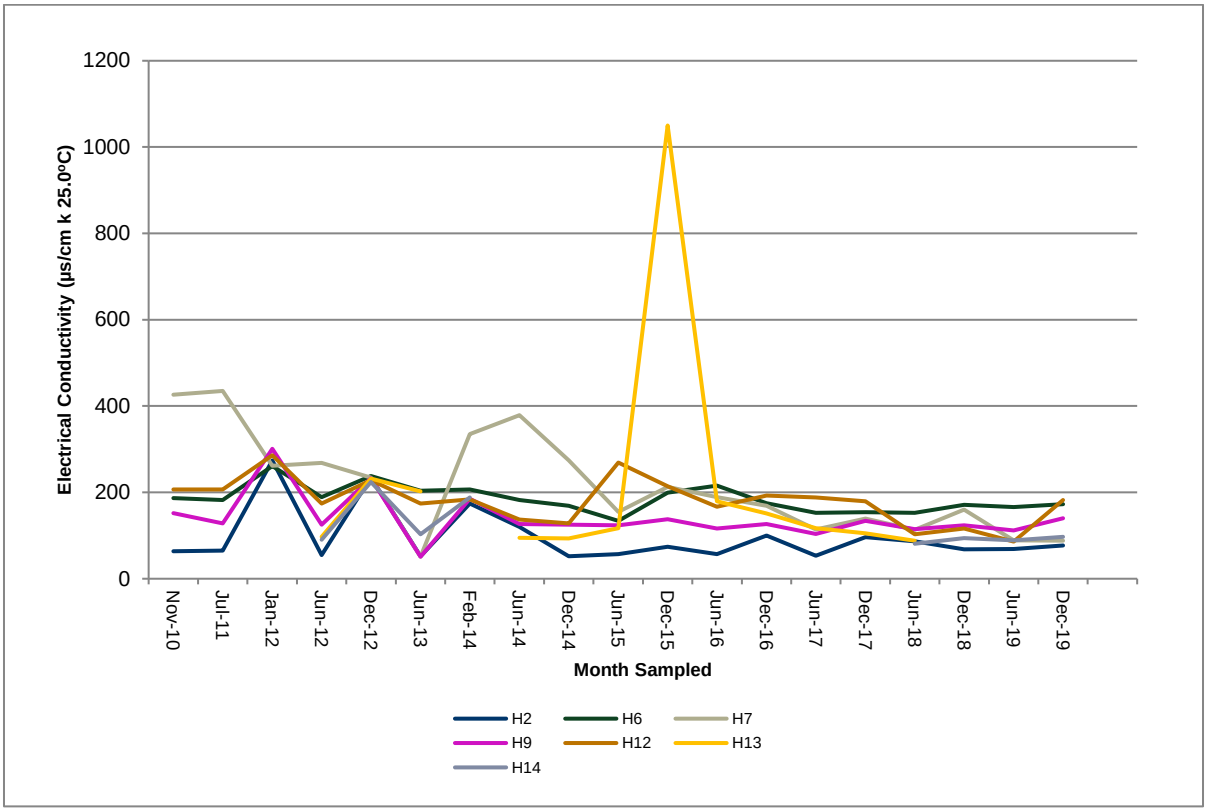

Chart 2.5 Groundwater EC (Bores H2, H6, H7, H9, H12, H13 and H14)

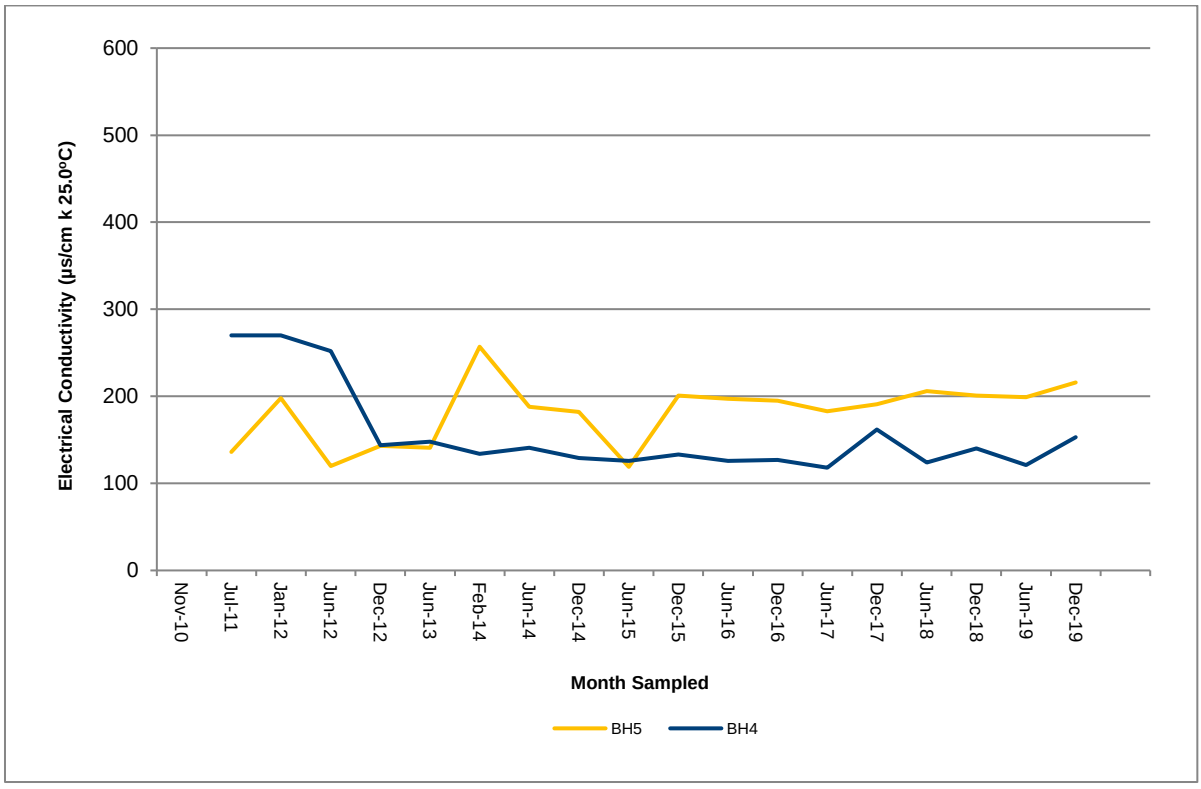

Chart 2.6 Groundwater EC (Bores BH4 and BH5)

3.0 Water Management System

3.1 Surface Water Strategy

3.1.1 Existing Operation – Original Extraction Stages

Figure 3.1 and **Figure 3.2** present a plan and schematic of the existing Quarry WMS respectively. **Table 3.1** presents the approximate areas of the surface water catchments (as of April 2018) that report to the Quarry WMS. **Table 3.2** presents the existing WMS water storage volumes.

The overall strategy for management of runoff for the existing site is to contain the runoff from disturbed catchments within the extraction pits and direct clean runoff from upslope catchments around the disturbed areas. As of April 2020, only Stage 1 and Stage 2 of the approved extraction area are being quarried. The Stage 3, Stage 4 and Stage 5 extraction areas are yet to be disturbed.

Extraction activities in Stage 2 have been undertaken in three distinct catchment areas within Stage2 (refer to **Figure 3.1**):

- Stage 2 East;
- Stage 2 West; and
- Stage 2 North.

Three of the four operating quarry pits as at April 2020 (Stage 1 Pit, Stage 2 West and Stage 2 North) can hold significant volumes of water without impeding sand extraction operations. Further, the high permeability of the floor will maintain current infiltration and groundwater recharge rates. The permeability of the materials will also ensure that the depth and duration of any surface water ponding within the Quarry is minimal (ERM, 2005).

Captured water is reused for dust suppression, in preference to clean water imports extracted in accordance with the conditions of the Quarry WALs and associated works approvals (refer to **Sections 1.4.4** and **5.1.1**) or allowed to infiltrate into the pit floor and evaporate. Runoff within the Stage 2 East Pit drains to a sediment basin (Stage 2 East Sediment Dam) on the eastern side of the pit which meets the requirements for a Type F sediment basin (Stage 2 Sediment Dam) designed in accordance with Landcom's *Managing Urban Stormwater Volume 2E Table 6.1* (DECC, 2008) (refer to **Section 3.2.2**). Stage 2 Sediment Dam is dewatered using a mobile pump to the Stage 2 West Pit following rainfall events (as required) to maintain adequate settling zone capacity.

There are also several undisturbed catchments within the project area that have previously been approved for sand extraction (Stage 3, Stage 4 and Stage 5) that at present do not report to the Quarry WMS (refer to **Figure 3.1**). Sand extraction in these catchments is not anticipated for at least 20 years. These catchments incorporate a number of existing farm dams including four dams which are licensed for surface water extraction (refer to **Sections 1.4.4** and **5.1.1**). The specified purposes of the WALs have been modified to include both irrigation and extractive industry.

Table 3.1 Existing Quarry WMS Catchments

Catchment	Primary Catchment Type(s)	Approximate Area as at April 2018 (ha)
Stage 1 Extraction Pit	Disturbed	5.5
Stage 2 North Extraction Pit	Disturbed	1.2
Stage 2 South Extraction Pit	Disturbed	7.6
Stage 2 East Extraction Pit	Disturbed	2.2

Table 3.2 Existing Water Storage Volumes

Storage	Storage Capacity (ML)[1]
Stage 1 Extraction Pit	421
Stage 2 North Extraction Pit	586
Stage 2 South Extraction Pit	113
Stage 2 East Sediment Dam	4

1. Volumes estimated based on top of dam dimensions and average depth of the pit/dam

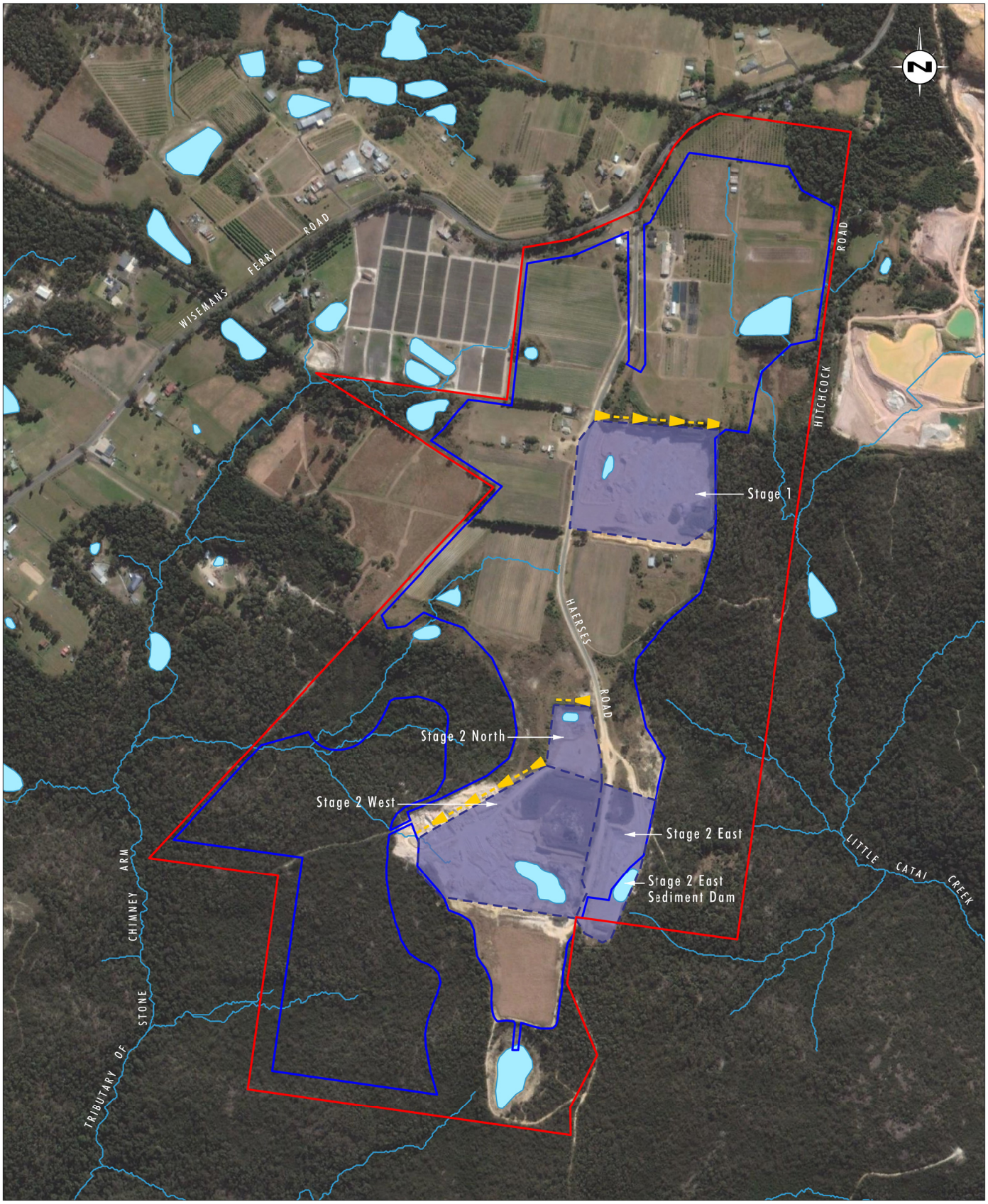

Image Source: Google Earth (Sep 2017)
Data Source: Mc Kinlay Morgan & Associates Pty Ltd (2014)

0 100 250 500m
1:10 000

Legend

- Haerses Road Quarry Site
- Approved Extraction Area
- Diversion Bund
- WMS Catchment Boundary
- Drainage Line
- Dam

FIGURE 3.1

Existing WMS Plan

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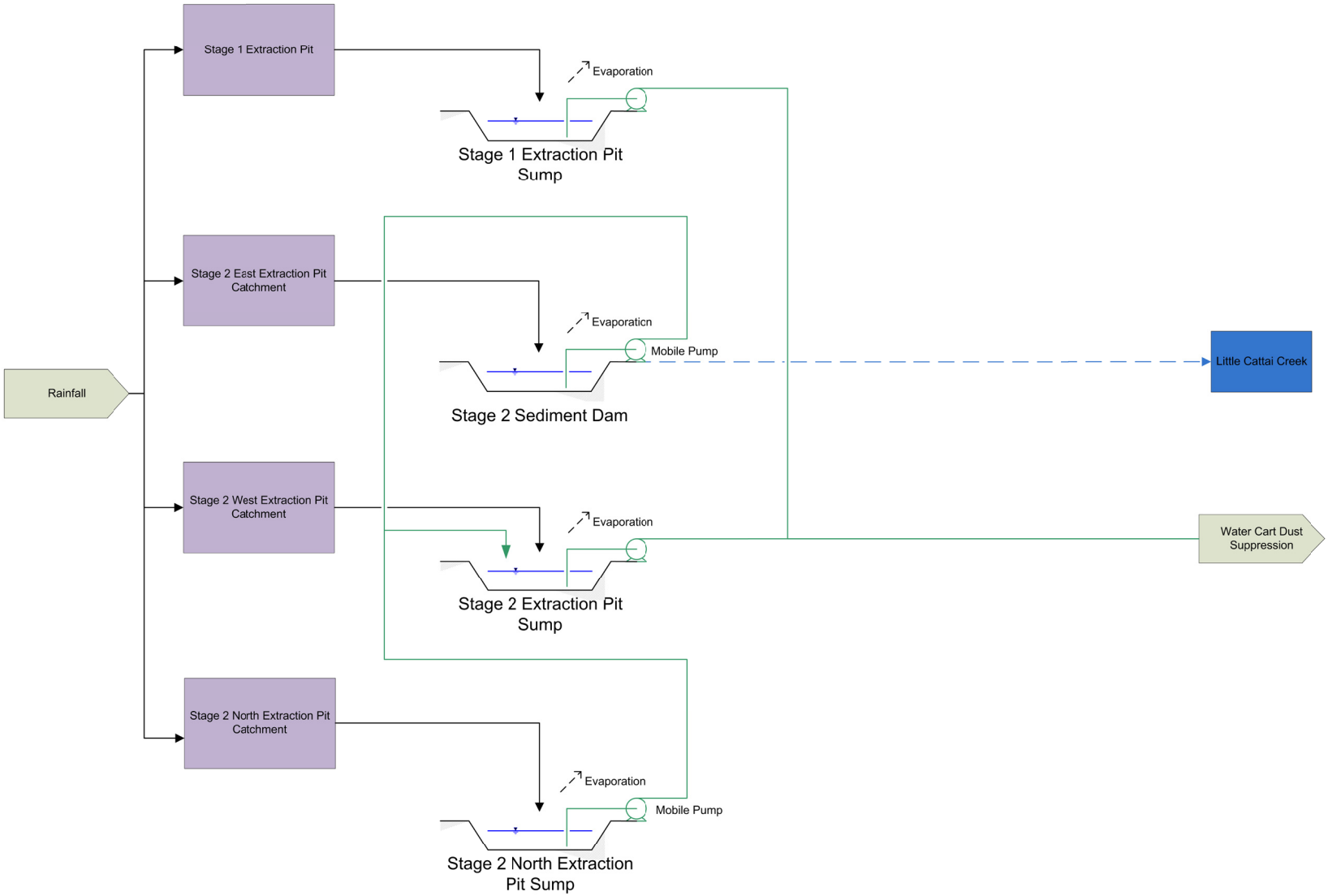

FIGURE 3.2

Existing WMS Schematic

3.1.2 Future Operation – Modified Extraction Cells

Figure 3.3 and **Figure 3.4** present a plan and schematic of the existing Quarry WMS respectively. The strategy for management of runoff for the presently operating Quarry pits as at April 2020 (Stage 1, Stage 2 East, Stage 2 West and Stage 2 North) will remain largely unchanged from the existing operation (refer to **Section 3.1.1**). The exception being that the Stage 2 East Sediment Dam will be dewatered to Basin 4 (refer to **Figure 3.3**) and water transfers from Stage 1 Pit and Stage 2 West Pit will also occur to supplement quarry operational water demands during prolonged dry periods.

The WMS for the future operating scenario presented in **Figure 3.3** includes the Mod 1 extraction area. The Mod 1 extraction area is delineated into 5 separate extraction cells (Cell 1, Cell 2, Cell 3, Cell 4 and Cell 5). Each extraction cell is further subdivided into two extraction areas based on their proximity to the MTSGS buffer zone as presented in **Table 3.3** and on **Figure 3.3**. **Table 3.4** presents the approximate areas of the surface water catchments (as of April 2018) that presently report to the Quarry WMS. **Table 3.5** presents the existing WMS water storage volumes.

Table 3.3 Mod 1 Extraction Cells

Extraction Cell	Extraction Area Outside of the MTSGS Buffer Zone	Extraction Area within the MTSGS Buffer Zone
Cell 1	1A	1B
Cell 2	2A	2B
Cell 3	3A	3B
Cell 4	4A	4B
Cell 5	5A	5B

The future WMS scenario presented in **Figure 3.3** assumes that the Stage 2 West Pit will encompass the Stage 2 North Pit workings, Cell 1 will incorporate tailings storage with the remainder of Cell 1 being fully rehabilitated (i.e. runoff can be considered clean).

Runoff within the Mod 1 extraction area will be captured in sediment basins (Basin 1, Basin 2 and Basin 3) and in-pit sumps and transferred to Basin 4 for reuse. These sediment basins will be constructed sequentially as sand extraction in the Mod 1 extraction area progresses to the north from Cell 1 to Cell 5. Where possible, runoff from upslope undisturbed catchments is directed away from the Quarry WMS using diversion bunds or drains (refer to **Figure 3.3**). This strategy minimises the inflow of clean water to the Quarry WMS and maximises reuse of water for sand processing, dust suppression and truck washout. Basin 1 , Basin 2 and Basin 3 have been sized as Type F sediment basins to accommodate a 90th percentile 5 day rainfall event in accordance with Landcom's *Managing Urban Stormwater Volume 2E Table 6.1* (DECC, 2008).

Initially, sand extraction will only occur in Area A of each cell (i.e. outside of the MTSGS buffer zone) within the Mod 1 extraction area. Sand extraction cannot proceed into Area B unless monthly groundwater monitoring (quality and levels) to be undertaken for a period of not less than two years can demonstrate that there will be no impact on the MTSGS associated with Quarry operations (refer to **Section 5.2.2**).

Water from Basin 4 will be utilised for dust suppression and sand processing if the approved wash plant is constructed and commissioned.

Prior to operation of the approved wash plant a tailings storage dam shall be constructed within Cell 1. Decant water from the tailings dam will be returned to Basin 4. Tailings storages in subsequent cells will be developed as the Quarry progresses to the north and cells where extraction activities are complete will be backfilled with tailings or clean fill and then rehabilitated.

Processing plant water demands will primarily be met with runoff collected from disturbed areas (i.e. pit and process plant catchments). Water demands will also be supplemented with clean water transfers from approved water supply works dams in accordance with WAL and Works Approval conditions (refer to **Sections 1.4.4** and **5.1.1**).

Water balance results for the future operation (refer to **Section 4.4.2**) indicate that there may be a requirement to discharge excess water off-site from Basin 4 during periods of high or prolonged rainfall. The present Quarry EPL (refer to **Section 1.4.3**) does not incorporate a licensed discharge point (LDP) for water. Dixon Sand will monitor site water inventories as sand extraction progresses in the Mod 1 extraction area and assess the requirement for off-site discharges and therefore whether an EPL variation to incorporate a LDP is required. If discharges from Basin 4 are required in the future a monitoring (water quality and quantity) and management program for these discharges will be developed. Further Basin 4 will be managed to ensure adequate freeboard capacity is available to capture the runoff from a 5 day 90th percentile rainfall event (approximately 0.5 ML) from its immediate catchment (refer to **Figure 3.3** and **Table 3.3**).

Table 3.4 Future Quarry WMS Catchments

Catchment	Primary Catchment Type(s)	Expected Maximum Area (ha)
Stage 1 Extraction Pit	Disturbed	5.5
Stage 2 North Extraction Pit	Disturbed	2.5
Stage 2 South Extraction Pit	Disturbed	7.6
Stage 2 East Extraction Pit	Disturbed	4.1
Basin 1	Disturbed and Undisturbed	5.9
Basin 2	Disturbed and Undisturbed	3.9
Basin 3	Disturbed and Undisturbed	6.6
Basin 4	Disturbed and Hardstand	5.9

Table 3.5 Future WMS Water Storage Volumes

Storage	Storage Capacity (ML)
Stage 1 Extraction Pit	>400[1]
Stage 2 North Extraction Pit	>500[1]
Stage 2 South Extraction Pit	>250[1]
Stage 2 East Sediment Dam	4[1]
Basin 1	0.8
Basin 2	0.3
Basin 3	0.6
Basin 4	0.7

Note: [1] Volumes estimated based on top of dam dimensions and average depth of the pit/dam

Extraction in Modification 1 Cell 1A has commenced as at April 2020.

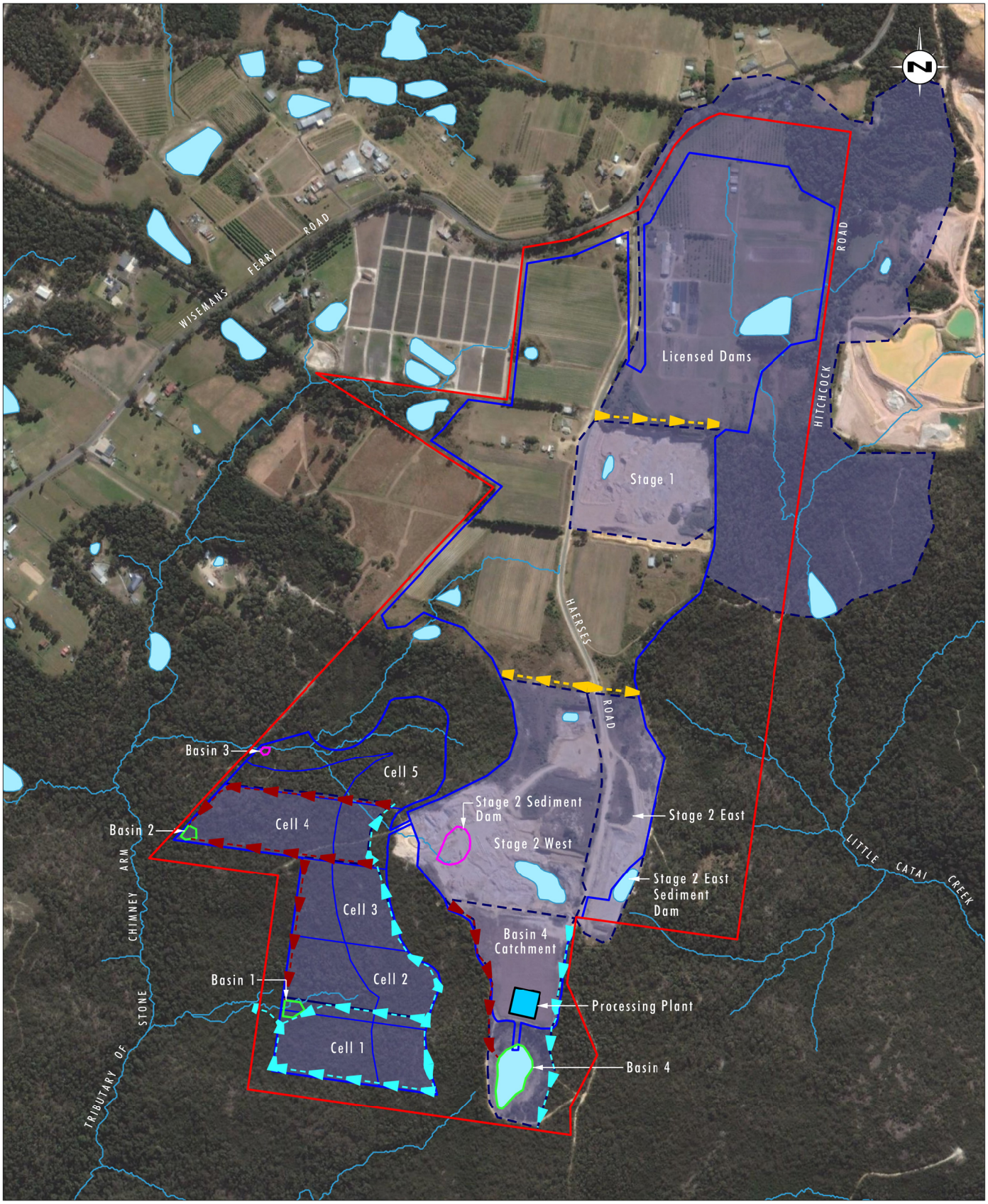

Image Source: Google Earth (Sep 2017)
Data Source: Mc Kinlay Morgan & Associates Pty Ltd (2014)

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Legend

- Haerses Road Quarry Site
- Approved Extraction Area
- Diversion Bund
- WMS Catchment Boundary
- Drainage Line
- Dam
- Basin
- Future basin to be constructed
- Clean Drain
- Dirty Drain

FIGURE 3.3

Future Scenario WMS Plan

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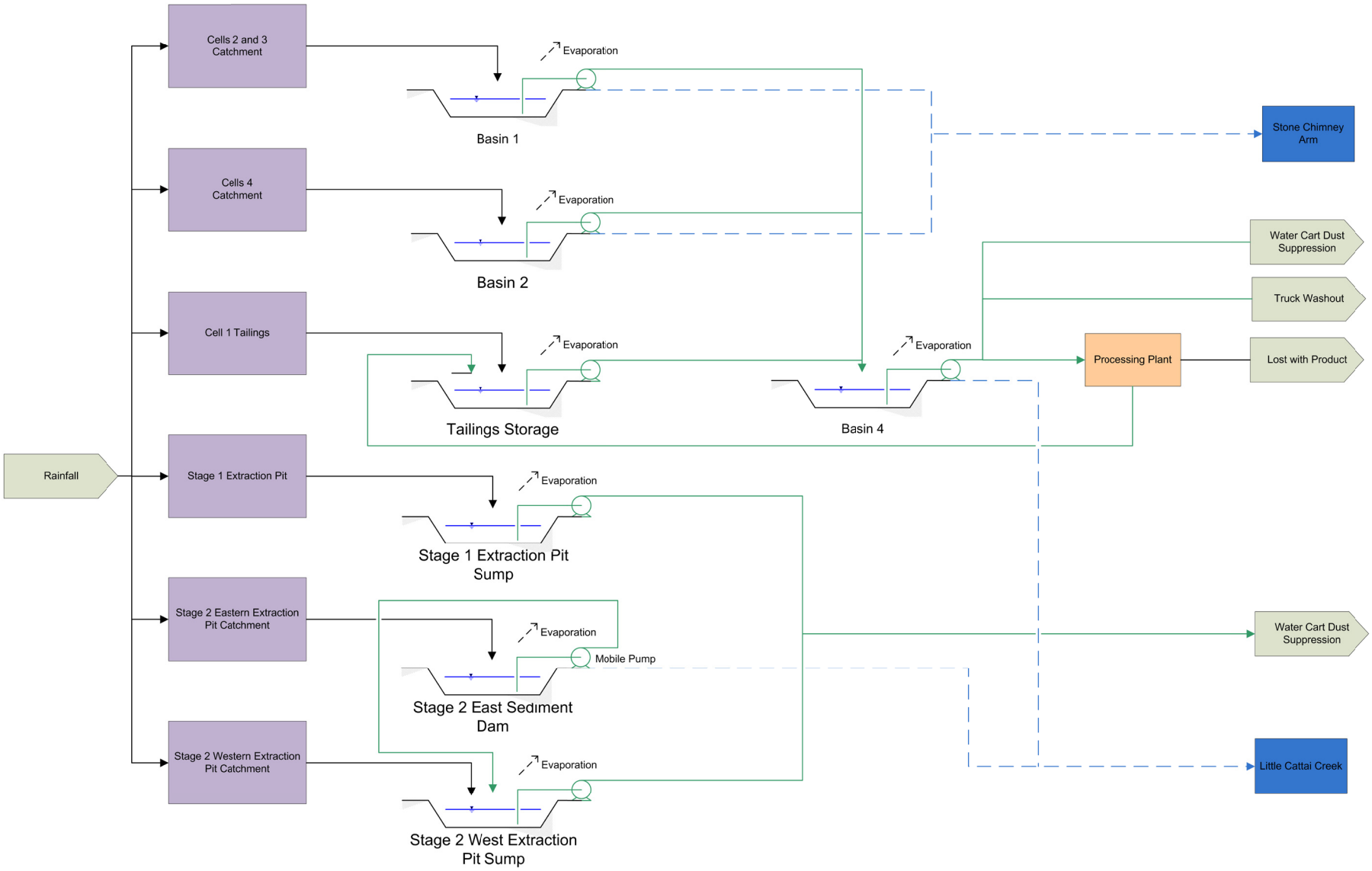


FIGURE 3.4

Future WMS Schematic

3.2 Erosion and Sediment Control

Activities which have the potential to cause erosion and generate sediment on site include:

- clearing and topsoil stripping ahead of quarrying operations;
- quarrying operations, noting that the majority of quarrying areas are internally draining;
- construction of site haul roads;
- construction of overburden emplacement areas (i.e. placement of overburden);
- rainfall/runoff on active work areas and overburden areas;
- runoff flowing across the disturbed area into drains; and
- irrigation of on-site grassland areas whilst dewatering dams to achieve freeboard.

Practical erosion and sediment controls will be implemented to minimise the generation of sediment on site and transport of sediment around and off-site, as described in the following sections.

3.2.1 Soils

As indicated in the Haerses Road Quarry 2006 SWMP (ERM, 2006), the soils on site range in classification from Type C, Type D to Type F. As detailed in **Section 2.1.2**, the soils on Lots 1 and 2 are considered highly erodible under concentrated flows. In order to minimise enhanced erosion and sedimentation erosion and sediment controls will be employed across the site in accordance with the Blue Book (Landcom 2004) and *Volume 2E* (DECC 2008).

3.2.2 Sediment Basins

While soils on the Quarry site range from Type C to Type F, all future sediment basins will be sized as Type F basins. Basins will have a settling zone capacity to capture runoff from a 5 day 90th percentile rainfall event and a sediment zone volume equal to 50% of the settling zone capacity (refer to **Section 3.2.3.2**).

The existing Stage 2 East Sediment Dam would require a capacity of approximately 0.4 ML to meet the above criteria, however, it has an estimated capacity of 4 ML.

3.2.3 General Erosion and Sediment Control Measures

Water quality measures will be implemented for the quarry to minimise impact on the surrounding environment. These controls are designed and constructed to a standard consistent with:

- *Managing Urban Stormwater – Soils and Construction, Volume 1* (the Blue Book) (Landcom 2004); and
- *Managing Urban Stormwater – Soils and Construction, Volume 2E: Mines and Quarries* (DECC 2008).

The measures are designed to minimise erosion and transport of sediment around and off-site and include:

- clearly identifying and delineating areas required to be disturbed and ensuring that disturbance is limited to those areas;
- clearing as little vegetation as required and minimising machinery disturbance outside of these areas;

- installing appropriate erosion and sediment controls prior to stripping topsoil or disturbing areas;
- limiting the number of roads and tracks established;
- stabilising site entry/exit points to ensure sediment is not tracked onto sealed roadways;
- construction of drains upslope of areas to be disturbed to convey clean runoff away from most disturbed areas where required;
- reshaping, topsoiling and vegetating road and cut and fill batters as soon as practical;
- construction of sediment dams where required to capture and treat runoff from disturbed catchment areas. Further details regarding construction and management of sediment dams can be found in **Section 3.2.2**;
- diversion of surface and road runoff away from disturbed areas;
- regular maintenance of all erosion control works and rehabilitated areas; and
- revegetation of areas as soon as practical following the completion of earthworks or operations.

3.2.3.1 Progressive erosion and sediment control plans

Progressive erosion and sediment control plans (ESCPs) will be developed in accordance with the Blue Book (Landcom, 2004) for high risk areas detailing the specific erosion and sediment controls, rehabilitation, monitoring and maintenance requirements for these areas. These progressive ESCPs will:

- Be prepared on relevant copies of drainage drawings for:
    - different construction stages (i.e. initial clearing, grubbing, topsoil stripping and stockpiling with revision for bulk earthworks); and
    - areas of high erosion hazard.
- Show sizing and design details for all sediment basins and erosion and sediment controls (such as diversion drains).
- Be revised when required by changing circumstances, if the site conditions change or if installed controls are not operating effectively.
- Be integrated with work procedures, construction method statements, activity statements and their scheduling.
- Be site specific and will not generally repeat the information contained in this primary ESCP.

3.2.3.2 Erosion and sediment control measure design criteria

As the duration of the disturbance at the Quarry will be greater than 3 years, sediment basins will be designed to the following standard as detailed in **Table 3.5** in accordance with Landcom's *Managing Urban Stormwater Volume 2E Table 6.1* (DECC, 2008):

Table 3.6 Sediment Basin Design Criteria

Design Parameter	Design Criteria
Basin Type	"Type F"
Design Settling Zone Capacity	Runoff from a 5 day 90th percentile rainfall event
Design Sediment Zone Capacity	50% of settling zone capacity
Primary Outlet	Rock protection on both primary and emergency outlets to ensure minimisation of scour.
Emergency Spillway	Designed to be structurally sound in the 100 year ARI storm event.

To ensure the structural stability of sediment basins and sediment basin emergency spillways and to prevent seepage, all sediment basins will be constructed in accordance with *Appendix B – Sediment Basin Design and Operation of Best Practice Erosion and Sediment Control* (International Erosion Control Association – Australasia – Draft document revision, https://www.austieca.com.au/documents/item/697, December 2016). Particular reference will be given to Section B4 of Appendix B – Default Construction Specifications. All water management dam walls will be grassed and kept free of trees and shrubs.

The existing sediment basin (Stage 2 East Sediment Dam) were constructed in bedrock sandstone (low permeability) and lined with clay to minimise seepage.

Temporary drainage (erosion) (e.g. diversion banks, perimeter banks, catch drains, level spreader, check dams and batter drains and chutes) and sediment controls (e.g. sediment fences, stacked rock sediment traps etc. on small catchments where used as a 'last line of defence' (i.e. without a down slope sediment basin)) will be designed to have a non-erosive hydraulic capacity when conveying the 20 year ARI storm event.

3.2.3.3 Soil and stockpile management

Ensure stockpiles of erodible material that have the potential to cause environmental harm if displaced are:

- constructed in accordance with Standard Drawing SD 4-1 Stockpiles (The Blue Book) (Landcom, 2004)) (included in **Appendix 4**).
- appropriately protected (for example, seeded or covered) from wind, rain, concentrated surface flow and excessive up-slope stormwater surface flows;
- constructed on the contour at least 2 m (preferably 5 m from hazard areas), particularly likely areas of concentrated water flows, e.g. roads, slopes steeper than 10% etc.;
- constructed greater than 40 m away from the top of bank of drainage lines;
- protected from run-on water by installing water diversion structures upslope; and
- formed with sediment filters placed immediately downslope to protect other lands and waterways from pollution.

3.2.3.4 Diversion Banks and Channels

A number of existing diversion banks and channels have been previously constructed to control slope lengths and to divert water to required locations. Diversion banks and channels will be implemented and maintained in accordance with the Blue Book (Landcom 2004) and DECC 2008 (refer to Blue Book standard drawings SD 5-5 and SD 5-6 included in **Appendix 4**). All diversion banks and channels will be constructed to remain stable whilst conveying peak discharges during a 20 year ARI storm event at less than erosive velocities for the channel construction materials.

3.2.3.5 Contour Banks and Drains

Contour banks will be installed where overland flow lengths exceed 80 m. Diversion drains will be provided at the ends of contour banking to convey stormwater to a sediment basin prior to treatment and management. All internal roads will grade to table drains which will convey flows to diversion drains.

All drains will be constructed to remain stable whilst conveying peak discharges during a 20 year ARI storm event at less than erosive velocities for the channel construction materials.

Drains will either be rehabilitated with grass species or rock armoured if required due to erosivity of flow. Catch drains will be constructed with 1:3 (v:h) side slopes or less and will be grassed or rock armoured channels. Peak velocities will generally be kept below 1.5 m/s. Where peak velocities are likely to exceed 1.5 m/s, rock bars will be placed along the drain at intervals no greater than 30 m to reduce peak velocities, or flumes will be used. In addition, where drains are used in locations where the grade of the drain is in excess of 5%, the drain is to be lined with a suitable material (refer to Table A3 of the Blue Book) to reduce the potential for erosion.

3.2.3.6 Inspections and Maintenance

Regular inspections of all disturbed areas and access tracks/roads will be undertaken to ensure drainage is working effectively and disturbed areas and tracks/roads are stable, particularly after rain. These inspections will be undertaken during construction and operation as follows.

- During construction all temporary controls will be inspected:
    - Daily for high risk controls such as within drainage lines;
    - Weekly for all other controls; and
    - Prior to significant forecasted rainfall events; and
    - After significant rainfall events.

- During the operational phase, monthly inspections of long-term erosion and sediment controls will be undertaken as well as inspections prior to and after forecasted rainfall events.

- Following storm events, undertake inspections of the sediment basins using the Sediment Basin Inspection Form contained in Appendix 5.

All erosion and sediment control measures, including drainage control measures, will be maintained in proper working order at all times during their operational lives. All erosion and sediment control measures will be maintained in a functioning condition during construction until all construction activities are completed and full stabilisation of the site is achieved (i.e. > 70% ground cover across the whole of the disturbed area within the catchment).

All sediment fences and detention systems (sediment basins) will be kept in good working condition. In particular, attention will be given to:

- recent works to ensure that they have not resulted in diversion of sediment laden water away from them;
- degradable products (i.e. sediment fence) to ensure they are replaced as required; and
- sediment removal as required.

Visual inspections of water quality in sediment basins will be undertaken after storm events and comments on the visual water quality will be recorded on inspection records.

3.2.3.7 Road and Intersection Works and Noise Bund Construction

In accordance with Condition O4.2 of EPL 12513, a specific control measure will be developed for:

- Road and intersection works, and
- Noise bund construction.

4.0 Water Balance

A daily time step water balance model was developed in GoldSim for the Quarry WMS. The water balance model utilises 77 years of historical rainfall records from the Old Telegraph Road, Maroota BoM station (Station 067014), a runoff model calibrated to the average regional runoff from undisturbed catchments in the Maroota area and average daily evaporation from the UWS Hawkesbury Campus (Station 067021) for years 1973 - 2016.

Water balance modelling was undertaken for the existing Quarry operation for the purpose of an initial model calibration and for a future Quarry operating scenario with worst case water demands and maximum disturbed catchment areas that will be comparable for various future operating stages of the Quarry.

4.1 Water Sources

Water sources considered in the water balance were rainfall on water storage surfaces and runoff from catchments reporting to the Quarry WMS as well as water extracted from clean water storage dams in accordance with the conditions of the WALs and associated works approvals (refer to **Sections 1.4.4** and **5.1.1**). As outlined in **Section 3.0** captured stormwater runoff from disturbed areas is used as a first priority for operational purposes in preference to imports of clean water.

4.2 Water Demands and Losses

Water demands considered in the water balance are:

Existing Operations

- Water cart dust suppression
- Evaporation from water storages
- Seepage from water storages.

Future Operations

- Sand processing plant demands associated with water lost with product and bound with tailings
- Water cart dust suppression
- Truck Washout
- Evaporation from water storages
- Seepage from water storages.

4.3 Assumptions and Bases

Following are the assumptions and bases used in the model:

Existing Operations

- A production rate of 250,000 tonnes/year of product sand
- An extracted sand moisture content of 5% by weight
- An average water cart dust suppression demand ranging from 20 kL/day in the Summer to 10 kL/day in Winter.

Future Operations

- A production rate of 250,000 tonnes/year of product sand
- An extracted sand moisture content of 5% by weight
- A product sand moisture content of 6.5% by weight
- A tailings/silt content in the extracted sand of 12% by weight on a dry basis
- A tailings/silt density of 2.65 tonnes/m^3
- An emplaced tailings density of 2.40 tonnes/m^3
- An average water cart dust suppression demand ranging from 40 kL/day in the Summer to 20 kL/day in Winter.
- An average truck washout demand of 10 kL/day.

4.4 Results

4.4.1 Existing Operation

The water balance was run for the existing Quarry WMS catchment. Results for the statistical 10th percentile, 50th percentile and 90th percentile gross water balance are presented in **Table 4.1**. Detailed results for the 50th percentile water balance are presented in **Table 4.2** and provide an indication of the most likely quarry inflows and demands/losses. The predicted minimum, average and maximum spills from the Stage 2 East Sediment Dam are presented in **Table 4.3**.

Table 4.1 Gross Water Balance Results (ML/year)

10th Percentile	50th Percentile	90th Percentile
-13.4	-4.2	30.7

Table 4.2 50th Percentile Year Water Balance Results

	Parameter	Result (ML)
Inflows	Rainfall and Runoff	12.5
	Moisture in Extracted Sand	12.5
	Total Inflows	***25.0***
Outflows	Evaporation from Stored Water Surfaces	-8.8
	Pit floor infiltration	-2.1
	Stage 2 Sediment Dam Spills	0.0
	Moisture in Dispatched Sand	-12.5
	Water Cart Losses	-5.8
	Total Outflows	***-29.2***
Change in Storage		-4.2
Net Water Balance		**0.0**

Table 4.3 Stage 2 East Sediment Dam Spills (ML)

Minimum	Average	Maximum
0	0.8	11.4

Gross water balance results for the existing operation demonstrate that the Quarry will typically operate with a neutral water balance. During dry years (e.g. 10th percentile gross water balance result) the Quarry will operate with a water deficit, however, there is adequate water storage on site to ensure water inventories are available for operational demands (dust suppression) is available. The water balance results are supported by site observations in which the Quarry has infrequent sediment dam spills and has not experienced a shortfall of water for operational demands.

4.4.2 Future Operations

The water balance was run for a representative future WMS scenario that includes the sand wash plant as well as the inclusion of licensed dam catchments. Results for the statistical 10th percentile, 50th percentile and 90th percentile gross water balance are presented in **Table 4.4**. Detailed results for the 50th percentile water balance are presented in **Table 4.5** and provide an indication of the most likely quarry inflows and demands/losses. The predicted minimum, average and maximum spills from the Stage 2 East Sediment Dam are presented in **Table 4.6** while the predicted minimum, average and maximum discharges from Basin 4 are presented in **Table 4.7**. The predicted minimum, average and clean water imports from the licensed dams are presented in **Table 4.8**. The 50th percentile net water balance is presented graphically in **Figure 4.1**.

Table 4.4 Gross Water Balance Results (ML/year)

10th Percentile	50th Percentile	90th Percentile
-17.6	-0.1	21.7

Table 4.5 50th Percentile Year Net Water Balance Results

	Parameter	Result (ML)
Inflows	Rainfall and Runoff	89.3
	Moisture in Extracted Sand	13.3
	Total Inflows	***102.6***
Outflows	Evaporation from Dam Surfaces	-40.5
	Pit floor infiltration	-10.3
	Basin 4 Discharges	-0.1
	Stage 2 Sediment Dam Spills	0.0
	Clean Water Dam (licensed dams) Overflow	-15.7
	Moisture in Dispatched Sand	-16.2
	Bound with Tailings	-2.1
	Water Cart Losses	-11.5
	Truck Washout	3.6
	Total Outflows	**-100.1**
Change in Storage		2.5
Net Water Balance		**0.0**

Table 4.6 Sediment Dam Spills

Parameter	Minimum	Average	Maximum
Volume (ML)	0.0	0.6	10.4
Frequency (spills/year)	0	<2	7

Table 4.7 Basin 4 Discharges (ML)

Minimum	Average	Maximum
0.0	6.4	43.2

Table 4.8 Clean Water Imports (ML)

Minimum	Average	Maximum
0.0	5.4	13.0

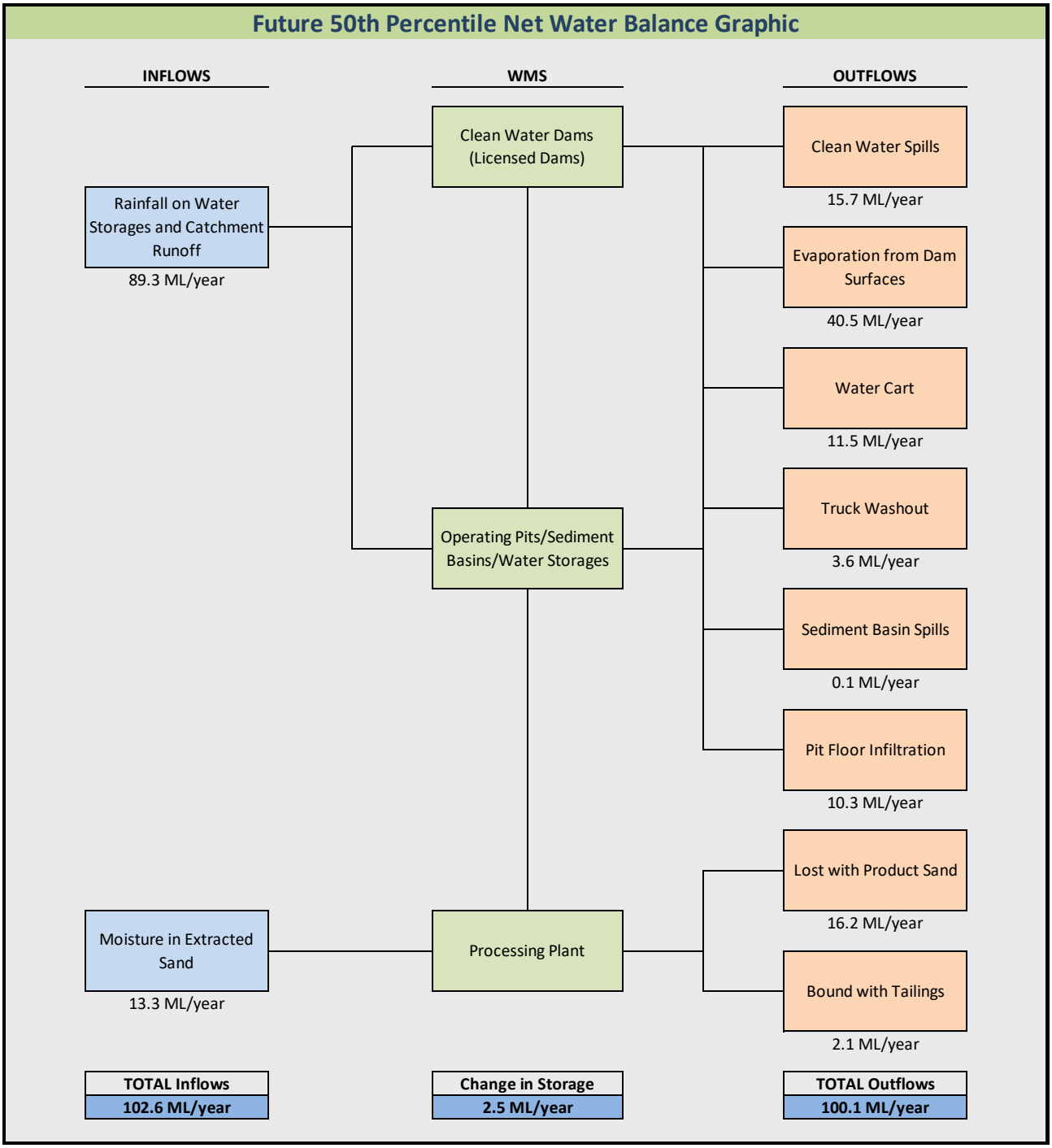


Figure 4.1 Future 50th Percentile Net Water Balance

Gross water balance results (refer to **Table 4.4**) for the future operating scenario demonstrate that the Quarry will typically operate with a neutral water balance. During dry years (e.g. 10th percentile gross water balance result) the Quarry will operate with a water deficit, however, it is predicted that there will be adequate water storage on site to ensure water inventories are available to meet operational demands (processing and dust suppression) is available.

Spills from sediment dams (refer to **Table 4.6**) are predicted to occur less than twice per year on average which is below the expected spill frequency of 2 - 4 per year provided in the Blue Book for sediment dams sized to contain a 5 day 90th percentile rainfall event.

Water balance results also indicate that there may be a requirement to discharge excess water off-site from Basin 4 (refer to **Table 4.7**) during periods of high or prolonged rainfall. The present Quarry EPL (refer to **Section 1.4.3**) does not incorporate a licensed discharge point (LDP) for water.

As required by the Development Consent, continuous level monitoring of all water storages will be implemented at the Quarry which will allow Dixon Sand to monitor site water inventories as sand extraction progresses in the Mod 1 extraction area and further calibrate the water balance model. This will allow an assessment of the requirement for off-site discharges and therefore and potential requirement for a LDP and EPL variation. Basin 4 will be managed to ensure adequate freeboard capacity is available to capture the runoff from a 5 day 90th percentile rainfall event (approximately 0.5 ML) from its immediate catchment (refer to **Figure 3.3** and **Table 3.3**). Further, water inventories in Basin 4 will be reduced prior to predicted high or prolonged rainfall events by transferring water to the Stage 1 and Stage 2 extraction pits to minimise the risk of uncontrolled discharges from Basin 4.

Water balance results also predict that surface water imports from the licensed dams will be required to meet operational dams during average to dry years. However, the maximum predicted import volumes are less than 10% of the maximum allowable extraction volumes based on an allocation of 1 ML per WAL unit share.

4.5 Water Balance Monitoring and Reporting

The following water balance related monitoring will be undertaken and recorded at the Quarry:

- Water inventories on site will be monitored by continuous level monitoring instrumentation;
- The number of Water Cart fills per month;
- Monthly water transfer volumes between water storages (based on rated pump capacity and run time);
- Monthly clean water import volumes; and
- Monthly processing plant water consumption (if constructed) (either metered or based on rated pump capacity and run time).

Water balance monitoring data will be entered into a tracking spreadsheet on a monthly basis to allow the Quarry to assess the adequacy of water inventories for ongoing production. Further, the monthly data will used to complete the annual site water balance that as required in the Annual Review (refer to **Section 5.1.3.2**).

A copy of the Water Cart and Water Transfer and Clean Water Import Forms are contained in Appendix 6.

5.0 Licensing, Monitoring and Reporting

5.1 Surface Water

5.1.1 Licences and Permits

The Quarry operates under EPL 12513 which does not include specific conditions with respect to water management but requires that Dixon Sands comply with Section 120 of the *Protection of the Environment Operations Act 1997* which prohibits the pollution of waters.

Dixon Sands holds two surface water access licences (WALs) (refer to **Section 1.4.4**).

5.1.2 Monitoring Program

5.1.2.1 Receiving and Site Water

Receiving water quality monitoring has not previously been undertaken at the Quarry. Dixon Sand have established two receiving water quality monitoring points in a tributary to Stone Chimney Arm to the west of the Quarry and a tributary to Little Cattai Creek to the east of the Quarry (refer to **Figure 2.2**). Receiving water quality will commence in September 2018 as outlined in **Table 5.1**. Monthly monitoring will be undertaken for a period of at least two years to establish a baseline data that can be used to develop site specific trigger values in accordance with ANZECC Guidelines. It is important to note that the monitoring points are located in ephemeral tributaries and water samples can only be collected when there has been sufficient rainfall to generate flows in the tributaries.

Water quality in the Mod 1 extraction pit sump will also be monitored on a monthly basis for the water quality parameters listed in **Table 5.1**.

Table 5.1 Receiving and site Water Monitoring

Parameter	Units	Frequency
pH	-	Monthly
Total Suspended Solids	mg/L	
Turbidity	NTU	
Stream Flow	No Flow, Low Flow, High Flow	

5.1.2.2 Erosion and Sediment Controls

Monitoring requirements for erosion and sediment controls are detailed **Section 3.2.3.6**.

5.1.2.3 Water Inventories and Transfers

The following parameters relating to water inventories and usage will be monitored to allow the preparation of an annual site water balance:

- Water storage levels/volumes (continuous level monitoring).
- The number of Water Cart fills per month;
- Monthly water transfer volumes between water storages (based on rated pump capacity and run time);

- Monthly clean water import volumes; and

- Monthly processing plant water consumption (if constructed) (either metered or based on rated pump capacity and run time).

5.1.2.4 Water Management Dams

All existing and proposed dams (i.e. farm dams, water supply, sediment retention, water quality management dams) are cut into sandstone or insitu material. No fill constructed dams require embankment construction or structural fill material currently exist or proposed on site under the current consent or associated management plans, and therefore, no structural assessment of dams will be required.

5.1.3 Reporting

5.1.3.1 Incidents

Where an incident relating to surface water management has occurred Dixon Sand will:

- immediately notify the Secretary in writing (through compliance@planning.nsw.gov.au) and any other relevant agencies of any incident; and

- within 7 days of the date of the incident, provide the Secretary (through compliance@planning.nsw.gov.au) and any relevant agencies with a detailed report on the incident, and such further reports as may be requested. This report must include the time and date of the incident, details of the incident, measures implemented to prevent re-occurrence and must identify any non-compliance with this consent.

5.1.3.2 Effectiveness of Water Management System

The effectiveness of the Quarry WMS will be assessed and reported on in the Annual Review (refer to **Section 5.1.3.3**) based on the following criteria:

- No receiving surface water quality results outside of trigger value range that can be attributed to Quarry operations (refer to **Table 2.3**).

- Sediment dam spills within expected frequency (refer to **Table 4.6)**.

- Clean water imports extracted in accordance with WAL conditions and extraction volumes are comparable to water balance predictions for similar rainfall years (refer to **Section 1.4.4** and **Table 4.4**).

5.1.3.3 Annual Review

The following information relating to water management is provided in the Quarry's Annual Review:

- An assessment of receiving water quality monitoring results with respect to baseline water quality and potential quarry impacts;

- A site water balance outlining water source inflows, operational water demands and quarry water inventory changes;

- Details of any complaints received in relation to surface water; and

- An assessment of the overall effectiveness of the WMS.

5.2 Groundwater

5.2.1 Licenses

There are no groundwater access licences for the Haerses Road Quarry landholdings. If unexpected groundwater inflows to the Quarry are observed the following protocol shall be applied to obtain the necessary licences:

1. Confirm the source of the groundwater as per the Unexpected Groundwater Inflow TARP (refer to **Table 6.5**). That is, is it a regional groundwater source (SBCGS or MTSGS) or a perched aquifer.

2. If the unexpected groundwater inflow is from the SBCGS or MTSGS respond in accordance with the Unexpected Groundwater Inflow TARP (refer to **Table 6.5**).

3. If the unexpected groundwater inflow is determined to be from a localised perched aquifer prepare an application for a groundwater licence in consultation with DOI Water. The volume of licensable take will be based on the monitoring methodology detailed in **Section 5.2.2.2**.

5.2.2 Monitoring Program

5.2.2.1 Extraction Levels, Groundwater Levels and Water Quality

In order to ensure that the depth of extraction does not exceed the extraction limits set out in the Development Consent, Quarry staff check extraction depth levels using a GPS during extraction down to within 5 m of the maximum extraction depth. When the extraction depth is found to be within 5 m of maximum extraction depth, professional surveyors are engaged to mark the 5 m level above maximum extraction depth point. Quarry staff will monitor extraction down to 2 m above the maximum extraction depth which may take 1 - 3 years depending on the rate of sand extraction. At this point, professional surveyors are again engaged. With professional surveyors present, excavations are made down to the maximum extraction depth and marked. The maximum extraction depth map for the Stage 1 to 5 extraction area is presented in **Figure 5.1**. The maximum extraction depth map for the Mod 1 extraction area is in **Appendix 3.**

Table 5.2 presents borehole details for the quarry groundwater monitoring network installed prior to the Mod 1 extraction area approval (refer to **Figure 2.2**). Groundwater levels in these boreholes have historically been monitored monthly but have now been equipped with continuous level monitoring data loggers to comply with Condition 16(c) of Schedule 3 of the consent. Water quality samples are collected from these boreholes on a 6-monthly basis and analysed for pH and EC. Water quality samples are also collected from the surface water storages listed below on the same 6-monthly basis and analysed for pH and EC to allow comparison with groundwater quality and assessment of possible interactions between the surface storages and groundwater.

- Stage 1 Pit Sump
- Stage 2 West Pit Sump
- Stage 2 East Sediment Dam
- Mod 1 Area Pit Sump
- Basin 4

- Tailings Storage Cells

Monitoring of groundwater levels (continuous data loggers) and water quality is undertaken to assist in identifying potential impacts on the groundwater source associated with sand extraction activities and ensure that sand extraction activities are maintained at least 2 m above the SBCGS and the MTSGS. All monitoring equipment and bores must be maintained in satisfactory working condition and repaired or replaced to ensure the groundwater monitoring program can be implemented as detailed in this section.

Section 6.2 contains TARPs detailing the required actions to take in the event that routine groundwater monitoring identifies results outside of the baseline range. If groundwater results fall outside of the site specific trigger values presented in **Table 2.4** or **Table 2.5** the relevant TARP in **Section 6.2** will be implemented.

Table 5.2 Existing Groundwater Monitoring Boreholes

ID	Easting	Northing	Top of Casing (mAHD)	Ground Surface Level (mAHD)	Borehole Depth (m)	Target Aquifer
H2	312512.3	6294610.5	182.57	181.88	4.9	MTSGS
H6	312991.8	6295062.7	195.16	194.34	14.8	MTSGS
H7	312856.0	6294641.5	193.80	193.00	16.8	MTSGS
H9	312797.2	6294228.9	193.83	193.04	14.8	MTSGS
H12	312710.9	6294089.1	192.49	191.64	17	MTSGS
H13	312608.9	6293545.7	186.2	185.31	19	MTSGS
H14	312657.1	6293362.7	184.69	183.87	13	MTSGS
BH4	312842.95	6293869.02	177.92	177.15	65	SBCGS
BH5	312159.37	6293753.90	153.2	152.5	65	SBCGS

Note: [1] No record of bore hole depth

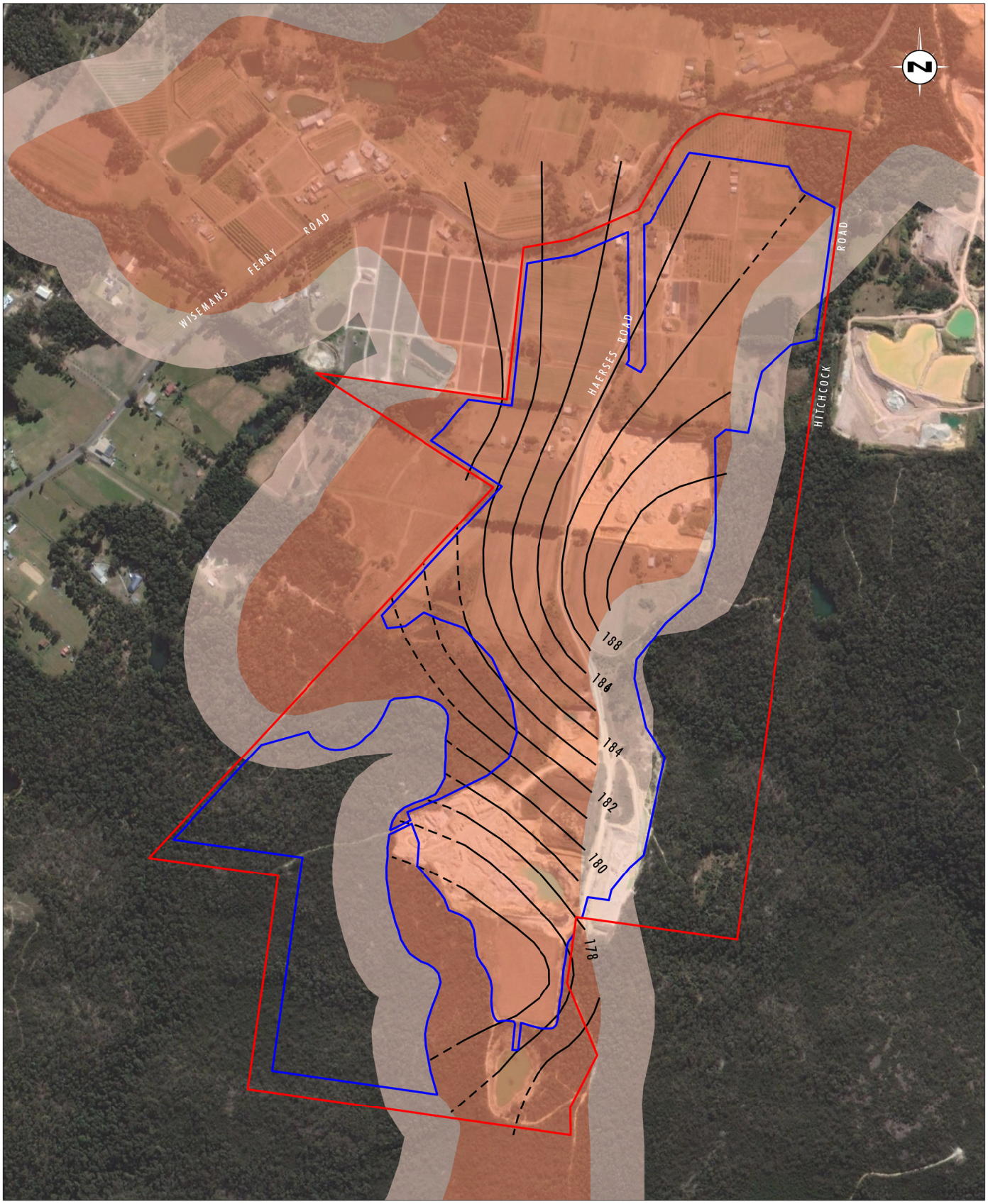


Image Source: Google Earth (Sep 2017)
Data Source: Mc Kinlay Morgan & Associates Pty Ltd (2014)

0 100 250 500m
1:10 000

Legend

- Haerses Road Quarry Site
- Approved Extraction Area
- Maroota Tertiary Sands
- 100m Buffer around Maroota Tertiary Sands
- Maximum Quarry Depth
- Inferred

FIGURE 5.1

Stages 1 to 5 Extraction Limit Map

File Name (A4): R04/4272_021.dgn
20180413 11.16

5.2.2.2 Groundwater Inflow Volume

In the event of an unforeseen groundwater inflow to one of the Quarry pits, the volume of groundwater intercepted needs to be estimated. In order to estimate the groundwater inflow rate, a sump is to be excavated at the extraction face to collect groundwater inflow seepage. Groundwater captured in the sump is periodically transferred to a nearby water storage. The volume of groundwater transferred is measured by a flow meter on the discharge piping from the pump or pump run time and capacity. The volume will also be also estimated by measuring the time taken for the sump to refill with groundwater inflows.

5.2.2.3 Mod 1 Extraction Area

Dixon Sand have installed 13 new monitoring bores at five sites; four within the MTSGS buffer zone upslope of Mod 1 Stage A extraction area and one downslope of the Mod 1 extraction area near the existing SBCGS monitoring bore BH5 (refer to **Figure 2.2** and **Table 5.3**). Cluster bores have been installed at Sites 1 to 4 and an additional bore has been installed at Site 5 adjacent to the existing bore BH5 to satisfy Condition 16(b) of Schedule 3 of the Consent.

The new bores have been installed with continuous level monitoring data loggers. Groundwater level data collected over the initial two year monitoring period will be used to develop site specific trigger values. Visual monitoring for seepage through pit walls in the Mod 1 extraction cells will also be undertaken on a daily basis.

The monitoring network is designed to assess the hydraulic connection between upper perched zones in the Hawkesbury Sandstone and the MTSGS and determine whether future extraction can take place in the MTSGS buffer zone (i.e Stage B of the Mod 1 extraction cells) (Dundon Consulting, 2017). The monitoring bores in the MTSGS buffer zone will target:

- perched water in weathered sandstone;
- perched water in the unweathered sandstone; and
- the deep regional groundwater system in unweathered sandstone.

The fifth monitoring bore (5A) just to the south of BH5 will be installed to satisfy monitoring requirements between other water extractors to the west and south west of the quarry (Dundon Consulting 2017).

Aquifer pumping tests will be undertaken for all aquifers or water bearing zones including the deep regional SBCGS. Short term pumping tests will be undertaken where there are sufficient bore yields. In the event that bore yields encountered during drilling and aquifer pumping tests are not feasible, falling head slug tests will be undertaken to determine aquifer permeability as an alternative. Detailed site specific aquifer testing procedures will be developed by a groundwater specialist prior to undertaking tests.

If a perched aquifer(s) be intercepted (refer to **Section 2.2.1**) during extraction, inflows will be collected in a sump at the site of the seepage. The inflow volume will be estimated based on the dimensions of the sump and the rate of level increase in the sump. The groundwater collected in the sump will be transferred to Basin 4 using a mobile pump with the pump capacity and pump run time used to provide a second estimate of the volume of groundwater intercepted from the perched aquifer(s).

Monthly water quality samples will also be collected from the additional monitoring bores to provide additional data to assess any potential groundwater interactions. Water samples will be tested for pH and EC as undertaken for the existing monitoring bore network. Water quality trigger values will be developed in accordance with ANZECC Guidelines using the monitoring data collected over the initial two year monitoring period.

Table 5.3 Mod 1 Consent Monitoring Bores

Site	Easting	Northing	Bore ID	Depth Below Ground Surface Level (m)
1	312187	6293967	BH1A	70
	312188	6293973	BH1B	40
	312182	6293968	BH1C	10
2	312304	6293794	BH2A	80
	312312	6293797	BH2B	42
	312304	6293799	BH2C	15
3	312341	6293579	BH3A	80
	312341	6293585	BH3B	23
	312340	6293582	BH3C	15
4	312376	6293347	BH6A	70
	312373	6293356	BH6B	38
	312373	6293361	BH6C	15
5	312160	6293752	BH5B	35

5.2.3 Reporting

5.2.3.1 Incidents

Where an incident relating to groundwater management has occurred Dixon Sand will:

- immediately notify the Secretary in writing (through compliance@planning.nsw.gov.au) and any other relevant agencies of any incident; and
- within 7 days of the date of the incident, provide the Secretary (through compliance@planning.nsw.gov.au) and any relevant agencies with a detailed report on the incident, and such further reports as may be requested. This report must include the time and date of the incident, details of the incident, measures implemented to prevent re-occurrence and must identify any non-compliance with this consent.

5.2.3.2 Annual Review

The following information relating to water management is provided in the Quarry's Annual Review:

- groundwater levels and water quality;
- a comparison of groundwater levels and water quality data with respect to historical trends;
- an assessment of groundwater levels and water quality with respect to potential quarry impacts; and
- details of any complaints received in relation to groundwater.

The Annual Review will be published on Dixon Sands website (http://www.dixonsand.com.au/environment).

5.2.3.3 Maximum Extraction Depth Map

In accordance with Condition 20(b) Schedule 2 of the Development Consent, within 6 months of the determination of Modification 1, Dixon Sand will submit a Maximum Extraction Depth Map (contour map or similar) to DPE for approval. This is to ensure compliance with the extraction depth limits set out in the Development Consent in Condition 19 Schedule 2. The Maximum Extraction Depth Map is provided in **Appendix 3**.

Dixon Sand will review and update the Maximum Extraction Depth Map for the development to the satisfaction of the Secretary annually and within 3 months of the completion of any Independent Environmental Audit.

5.3 Training and Awareness

All personnel and contractors working at the Quarry will undergo an induction. This induction includes information on the management of soil and water while working on site. After completing the induction, workers will sign a statement of attendance and records of this will be kept in the administration office.

Tool-box meetings are held to discuss whole-of-site production, management, safety and environmental issues. Matters relating to soil and water will be raised during these meetings, when necessary.

6.0 Trigger Action Response Plans

Section 6.1 contains Trigger Action Response Plans (TARPs) related to surface water monitoring results that are observed to be outside of the normal range. **Section 6.2** contains TARPs related to groundwater and extraction depth monitoring results that are observed to be outside of the normal range.

The procedures to be implemented in response to a water pollution incident are outlined in the Pollution Incident Response Management Plan included as Appendix 4 to the Haerses Road Quarry Environmental Management Strategy.

6.1 Surface Water TARPs

Table 6.1 Receiving Water Quality TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Receiving water quality outside of baseline trigger values range in Table 2.3	Water management strategy minimises the likelihood of off-site discharges.	SW1 and SW2	Repeat water quality sampling and analysis as required and continue monitoring on a monthly basis.	• Review monthly water quality monitoring results.
Three consecutive water quality results outside of the baseline trigger value range in Table 2.3	Water management strategy minimises the likelihood of off-site discharges.	SW1 and SW2	Maintain monthly monitoring until: • cause is identified; or • water quality results are confirmed not to be a result of quarry operations; or • water quality results return to within the trigger value range.	Investigate potential contributing factors: • Climatic conditions • Changes in quarry operating practices • Sample and analyse water quality from upslope catchments reporting to the quarry WMS (e.g. upslope farm land) • Assess sediment dams for excessive seepage • Engage a water quality specialist (if required) to undertake a preliminary investigation If the investigation determines that the contributing factors are not as a result of quarry operations, then the issue will be reported in the Annual Review only. If the deviation of receiving water quality is found to be a result of quarry operations: • Immediately notify the EPA, DPE and DoI • Take actions agreed in consultation with the EPA, DPE and DoI to mitigate the Quarry impacts on receiving water quality. Such actions are likely to include: ○ Transferring water from any water storages contributing to the deviation in water quality to another storage ○ Implementing water treatment measures to treat site water • Undertake remediation of the impacted receiving environment to the satisfaction of the EPA, DPE and DoI

6.2 Groundwater TARPS

Table 6.2 Extraction Depth Exceedance TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Extraction depths measured to be below extraction limits specified in Section 2.2.2	Monitoring of extraction depth by site personnel and professional surveyors as detailed in **Section 5.2.2.1**.	Extraction pit depth measurement	Professional surveyor to confirm extraction depth exceedance.	If exceedance of extraction limit confirmed immediately notify DPE. If there is groundwater inflow seepage is associated with the extraction depth exceedance DoI will also be notified immediately. Undertake remediation works as instructed by DPE and DoI. Investigate cause of extraction limit exceedance including a review of the adequacy of extraction depth monitoring.

Table 6.3 Groundwater Quality TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Water quality result outside of the baseline trigger value range in Table 2.5	Sand extraction to be maintained a minimum of 2 m above the wet weather SBCGS and MTSGS. Maintenance of machinery to be undertaken in workshop where possible. Any spills of machinery fluids (oils, fuel, coolants) to be immediately contained and all contaminated materials removed.	**Stages 1 to 5 Extraction Area** H2, H6, H7, H9, H12, H13, H14 and BH4 **Mod 1 Extraction Area** BH4, BH5 and Site 1 to Site 5 bores	Repeat water quality sampling and analysis as required and if result is confirmed increase monitoring frequency to monthly to establish trend.	Review monthly water quality monitoring results.

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Three consecutive water quality results outside of the baseline trigger value range in Table 2.5	Sand extraction to be maintained a minimum of 2 m above the wet weather SBCGS and MTSGS. Maintenance of machinery to be undertaken in workshop where possible. Any spills of machinery fluids (oils, fuel, coolants) to be immediately contained and all contaminated materials removed.	**Stages 1 to 5 Extraction Area** H2, H6, H7, H9, H12, H13, H14 and BH4 **Mod 1 Extraction Area** BH4, BH5 and Site 1 to Site 5 bores	Maintain monthly monitoring until: • cause is identified; or • water quality results are confirmed not to be a result of quarry operations; or • water quality results return to within the trigger value range.	Investigate potential contributing factors: • Climatic conditions • Changes in quarry operating practises • Sample and analyse water quality from site storages • Sample and analyse water quality from upslope catchments reporting to the quarry WMS (e.g. upslope farm land) • Engage a groundwater water quality specialist (if required) to undertake a preliminary investigation.

Table 6.4 Groundwater Level TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Continuous water monitoring shows level(s) outside of the baseline trigger value range in Table 2.4	Sand extraction to be maintained a minimum of 2 m above the wet weather regional groundwater table and MTSGS.	**Stages 1 to 5 Extraction Area** H2, H6, H7, H9, H12, H13 and H14 **Mod 1 Extraction Area** BH4, BH5 and Site 1 to Site 5 bores	Complete a manual water level(s) measurement to confirm continuous monitoring is measuring accurately.	Recalibrate/repair continuous level monitoring equipment if manual level measurement indicates a fault. Assess other monitoring bore levels for similar changes. If groundwater level stabilises outside the baseline trigger value range continue to observe groundwater level(s). If groundwater level appears to be trending further from the baseline trigger value range, implement the next monitoring and response steps in this TARP.

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Continuous groundwater level monitoring results outside of the baseline trigger value range in Table 2.4 for a continuous period of one (1) week	Sand extraction to be maintained a minimum of 2 m above the wet weather regional groundwater table and MTSGS.	**Stages 1 to 5 Extraction Area** H2, H6, H7, H9, H12, H13 and H14 **Mod 1 Extraction Area** BH4, BH5 and Site 1 to Site 5 bores	Repeat manual water level(s) measurement to confirm continuous monitoring is measuring accurately.	Investigate potential contributing factors: • Climatic conditions • Recent groundwater inflows to extraction areas from perched groundwater lenses • Engage a groundwater water specialist to undertake a preliminary investigation • Where investigations determine that impacts are the result of sand extraction activities, implement the Responsible Impacts Procedure outlined in **Section 6.2.1** below.

6.2.1 Responsible Impacts Procedure

Where investigations detailed in the TARP determine that groundwater impacts are the result of Quarry operations or could potentially impact on adjacent bores, the following procedure is actioned:

- Inform landholders adjacent to streams and/or private bore owners, and DoI of preliminary investigation outcomes, as appropriate.
- Undertake a detailed investigation and assess possible mitigation measures in consultation with the landowner and DoI, as appropriate.
- If deemed necessary prepare and implement a site mitigation/action plan to the satisfaction of DoI, in consultation with the landowner and DoI, as appropriate.
- Conduct a review of results from the follow up investigation.
- Further, the timing of the above includes, but is not limited to:
    - Results of preliminary investigation reported within one week of completion.
    - Commence preparation of detailed investigation including assessment of possible mitigation measures immediately.
    - Commence preparation of mitigation/action within one week of the need being identified.

Table 6.5 Unforeseen Groundwater Inflow TARP

Observation	Strategy for Mitigation	Monitoring	Monitoring Action	Response
Excessive seepage in excess of licence limits	Monthly review of monitoring data to ensure extraction is maintained a minimum of 2 m above the wet weather regional groundwater table and MTSGS.	**Stages 1 to 5 Extraction Area** H2, H6, H7, H9, H12, H13 and H14 **Mod 1 Extraction Area** BH4, BH5 and Site 1 to Site 5 bores.	Increase groundwater level monitoring frequency to weekly. (note that groundwater level monitoring will be continuous at all bores once new monitoring equipment is installed) Estimate groundwater inflow volume as detailed in **Section 5.2.2.2**.	Review groundwater level and inflow monitoring data to: • confirm regional groundwater table and MTSGS are at least two metres below pit depth. If the regional groundwater table or MTSGS has been intercepted, cease extraction activities in the vicinity and immediately notify DPE and DoI. After consultation with DoI and undertake remedial works to the satisfaction of the Secretary of DPE • review potential cause of variation in seepage and assess whether the inflow is subject to licensing submit application for additional groundwater licence units as required. The Pollution Incident Response Management Plan (procedures outlined in included as Appendix 4 to the Haerses Road Quarry Environmental Management Strategy) will also be initiated if required.

7.0 Incident, Non-Compliance and Exceedance Identification, Notification and Reporting

7.1 Pollution Incident

Environmental / pollution Incident identification, notification and response to be undertaken in accordance to the Quarry's Pollution Incident Response Management Plan and Section 7.1 of the Environment Management Strategy.

7.2 Identification of Exceedances and Non-Compliance

On identification of a non-compliance or environmental exceedance, the Quarry Manager and/or Environmental Officer will be notified and an investigation into the cause or source of the non-compliance or exceedance will commence. The Quarry Manager (or delegate) will implement appropriate corrective action to cease and/or remediate the incident.

An investigation into the cause of the incident will be undertaken with the personnel involved, Environmental Officer and the Quarry Manager (or delegate). The investigation will review all reasonable and feasible steps which may be taken to:

- prevent recurrence; and/or
- remediate any spill, pollution or other effects of the non-compliance.

7.3 Notification and Reporting of Incident and Non-Compliance

In accordance with Conditions 9 and 10 Schedule 5 of the Development Consent, in the event that Dixon Sand becomes aware of a set of circumstances that:

- causes or threatens to cause material harm to the environment; and/or
- breaches or exceeds the limits or performance measures/criteria in the development consent leading to non-compliance.

The Quarry Manager or delegate will notify the Department and any other relevant agencies of any such incident and/or non-compliance. The notification is to be in writing and clearly identify the development (including development application number and name) and the location and nature of the incident and/or non-compliance. Within 7 days of the date of the incident, Dixon Sand will provide the Department and any relevant agencies with a detailed report on the incident and/or non-compliance, and such further reports as may be requested. This report must include the time and date of the incident and/or non-compliance, details of the incident and/or non-compliance, measures implemented, or will be implemented, to prevent re-occurrence and must identify any non-compliance with the Development Consent.

In accordance with the Development Consent, a non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.

8.0 Review and Improvement

Ongoing monitoring and review on the performance and implementation of this SWMP will be undertaken in accordance with the quarry EMS and Development Consent, which require review of the plan within 3 months of the submission of:

- An incident report under Condition 10 Schedule 5 of the Development Consent;
- An annual review under Condition 12 Schedule 5 of the Development Consent;
- An Independent Environmental Audit report under Condition 13 Schedule 5 of the Development Consent; and
- Any modifications to the consent.

The Quarry will notify DPE in writing of any review of this SWMP. If a review leads to any revisions to this SWMP, the revised document will be submitted to DPE within 6 weeks of the review. Updated versions of this SWMP will be made publicly available on the Dixon Sand website in accordance with Condition 15 Schedule 5 of the Development Consent.

8.1 Adaptive Management

In accordance with Schedule 5, Condition 7 of the Development Consent, Dixon Sand will assess and manage soil and water related risks to ensure compliance with the water quality objectives outlined in this plan.

Where a non-compliance or monitoring result outside the normal range relating to soil or water impact has occurred, Dixon Sand will implement the mitigation, monitoring and contingency response strategies outlined in **Section 6.0** and at the earliest opportunity:

- take all reasonable and feasible steps to ensure the exceedance ceases and does not reoccur;
- consider all reasonable and feasible options for remediation (where relevant) ;
- within 7 days of the exceedance occurring submit a report to the Secretary describing those options and any preferred remediation measures or other course of action; and
- implement remediation measures as directed by the Secretary

to the satisfaction of the Secretary.

Following such an incident, the management and monitoring measures outlined in this plan will be reviewed to determine whether any changes are required to avoid recurrence of such an incident.

The Pollution Incident Response Management Plan (procedures outlined in included as Appendix 4 to the Haerses Road Quarry Environmental Management Strategy) will also be initiated if required.

9.0 Definitions

The terminology utilised within this SWMP is defined in **Table 8.1** below.

Table 9.1 Definitions

Term	Definition
CCC	Community Consultative Committee
CAA	Controlled Activity Approval
CLWD	Crown Land and Water Division (within the Department of Industry)
DA	Development Application
Development Consent	DA 165-7-2005
DoI	Department of Industry
DPE	Department of Planning and Environment
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EPL	Environment Protection Licence
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
ESCP	Erosion and Sediment Control Plan
Incident	An occurrence or set of circumstances that: • causes, or threatens to cause material harm to the environment; or • results in non- compliance with the consent
OEH	Office of Environment and Heritage
MTSGS	Maroota Tertiary Sands Groundwater Source
Secretary	The Secretary of the NSW Department of Planning and Environment, including any authorised delegate or nominee.
SBCGS	Sydney Basin Central Groundwater Source
SWMP	Soil and Water Management Plan
TARP	Trigger Action Response Plan
TSS	Total Suspended Solids
WAL	Water Access Licence

10.0 References

Australian Groundwater Technologies, 2016, *Haerses Road Quarry Groundwater Assessment*.

DECC, 2008, *Managing Urban Stormwater – Soils and Construction, Volume 2E*: Mines and Quarries.

DPE, 2006, *Conditions of Consent DA 165-7-2005 for the Haerses Road Sand Quarry Project.*

DPI Office of Water, 2012, *NSW Aquifer Interference Policy*.

Dundon Consulting Pty Limited, 2017, *Haerses Road Sand Quarry Site (DA 165-7-2005 MOD 1) – Comment on Response to Submissions (Letter date 9/6/17).*

ERM, 2004, *Dixon Sand Maroota Quarry Annual Environmental Management Plan: 7 July 2003 to 6 July 2004.*

ERM, 2005a, *Sand Quarry Haerses Road, Maroota Annual Environmental Management Report: 7 July 2004 to 6 July 2005.*

ERM, 2005b*, Proposed Sand Quarry at Haerses Road, Maroota, Environmental Impact Statement*, Report prepared for Dixon Sand (Penrith) Pty Ltd.

ERM, 2006, *Haerses Road Sand Quarry Site Water Management Plan.*

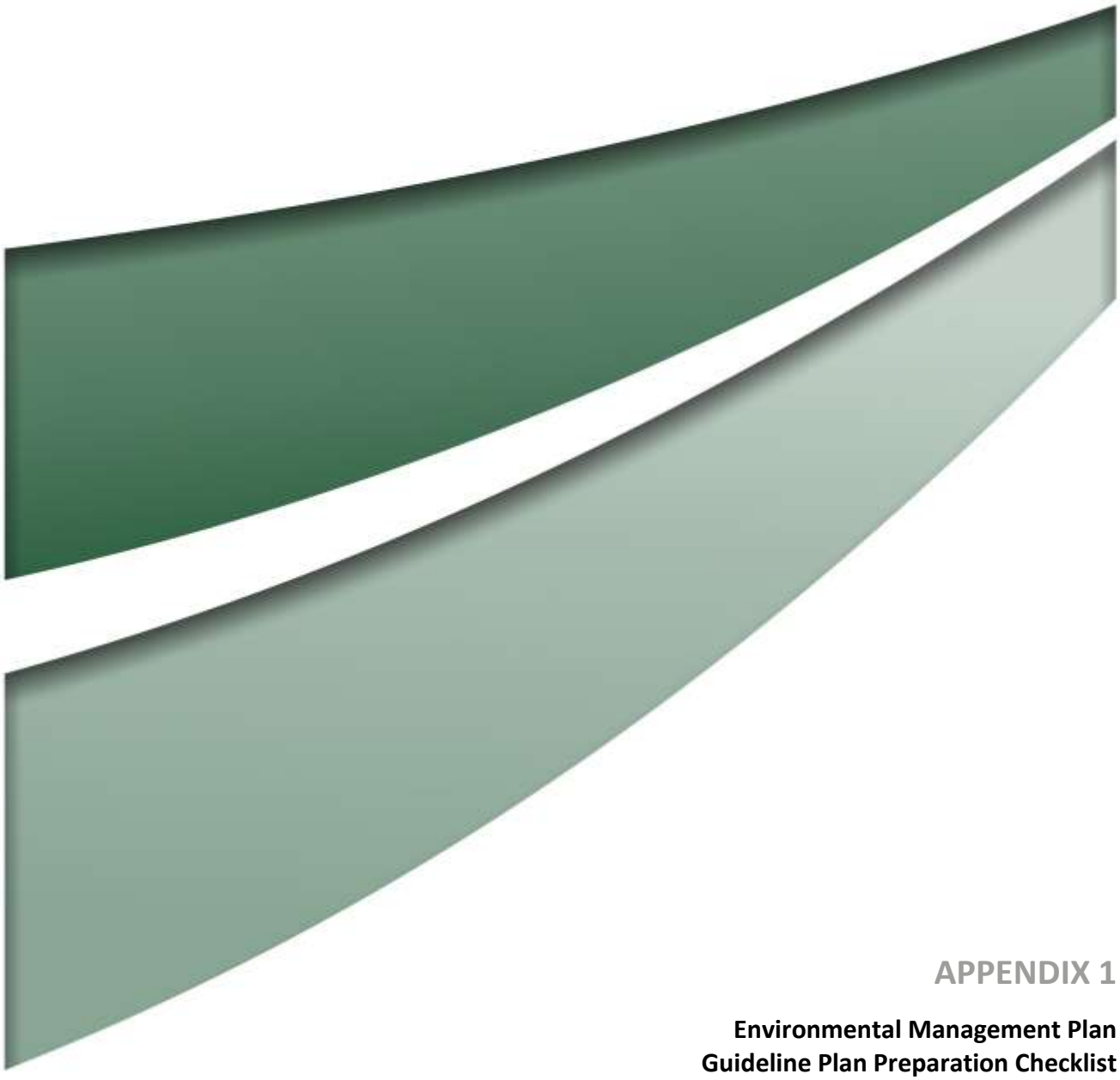
Landcom, 2004, *Managing Urban Stormwater*.

NSW EPA, 2015, *Environmental Protection Licence 3916.*

Project Environmental Services, 2016, *Haerses Road and Haerses Road Quarries, Maroota, Annual Review 2015 – 2016.*

Project Environmental Services, 2017, *Haerses Road and Haerses Road Quarries, Maroota, Annual Review 2016 – 2017.*

Umwelt (Australia) Pty Limited, 2016, *Environmental Assessment Dixon Sand Road Quarry Extraction Area Modification,* Report prepared for Dixon Sand (Penrith) Pty Ltd.



APPENDIX 1

Environmental Management Plan
Guideline Plan Preparation Checklist

Appendix 1 – Plan Preparation Checklist and Certification

The Environmental Management Plan Requirements guidelines state that the following checklist must be completed and supplied to the Department with an Environmental Management Plan (EMP) and Sub-plans. *(Note: items marked NA below are not required to be included in Sub-plans as per Table 1 of the guidelines).*

Requirement	Plan Reference	Yes/No/NA
Document preparation and endorsement		
Has the Plan been prepared in consultation with all relevant stakeholders? (Section 3.1)	Appendix 2	Yes
Have the views of the relevant stakeholders been taken into consideration, have appropriate amendments been made to the Plan and does the Plan clearly identify the location of any changes? (Section 3.1)	Appendix 2	Yes
Has the Plan been certified on behalf of the proponent? (Section 3.2)	Appendix 1	Yes
Version content		
Does the Plan include the required version control information? (Section 2.3)	Before table of contents	Yes
Does the Plan reference the project description as required in Section 2.4?	Section 1.0	Yes
Does the Plan identify the components of the project to which it applies (i.e. scope)? (Section 2.5).	Section 1.2	Yes
Does the Plan describe the proponent's Environmental Management System (EMS), and identify how the Plan relates to other documents required by the conditions of consent? (Section 2.6)	NA	NA
Does the Plan identify continuous improvements processes from the EMS that will be adopted? (Section 2.6)	Section 7.0	Yes
Does the Plan include (unaltered) all the conditions of consent to the addressed by the Plan and identify where in the Plan each requirement has been addressed? (Section 2.7.1)	Section 1.4.1	Yes
Have all other additional approvals been identified? Has appropriate information been provided regarding how each additional approval is relevant? (Section 2.7.2)	Sections 1.4.3, 1.4.4 & 5.1.1	Yes
Have all relevant guidelines, policies and standards been identified, including details of how they are relevant? (Section 2.7.3)	Section 1.5	Yes
Has the project's organisational structure been included? (Section 2.8)	NA	NA
Are the roles and responsibilities of key positions or personnel (including any specialists required by the conditions of consent) outlined? (Section 2.8)	Section 1.3.1	Yes
Is the process that will be adopted to identify and analyses the environmental risks included? (Section 2.9)	NA	NA
Does the Sub-plan identify the relevant sections of the EIA documents that contain the assessment of the matter/s addressed by the Plan? (Section 2.10)	Section 1.3.2	Yes

Requirement	Plan Reference	Yes/No/NA
Have all further studies required to support mitigating measures been identified and included? (Section 2.11)	Section 1.3.2	Yes
Have project hold points been identified and included? (Sections 2.7.2 and 2.12)	Section 1.3.3	Yes
Have all mitigation measures from conditions of consent been included unaltered? (Section 2.13)	Section 1.4.2	Yes
Have any new mitigation measures been written in committed language and all relevant information included? (Section 2.13)	Sections 3.2.3, 5.1.2 and 5.2.2	Yes
Have the tools that will be used to communicate Plan requirements to project personnel been included? (Section 2.14)	NA	NA
Is an environmental inspection program described as required? (Section 2.15.1)	Section 3.2.3.6 and 5.1.2.4	Yes
Are relevant details of environmental monitoring that will be carried out included? (Section 2.15.2)	Sections 3.2.3, 5.1.2 and 5.2.2	Yes
Is a compliance monitoring and reporting program (or similar) referenced? (Section 2.15.3)	Section 5.0	Yes
Is an independent auditing program referenced? (Section 2.16)	NA	NA
Are project status notification protocols that comply with conditions included? (Section 2.17.1)	NA	NA
Does the Plan reference a Community and Stakeholder Engagement Plan (or similar) or include community and stakeholder engagement actions (if required)? (Section 2.17.2)	NA	NA
Does the document include the incident notification and reporting protocols that comply with the relevant conditions of consent? (Section 2.17.3)	Sections 5.1.3.1, 5.2.3.1, 6.0 and 7.1	Yes
Does the document identify the project person or position that is responsible for deciding whether an occurrence is an incident? (Section 2.17.3)	Section 1.3.1, Table 1.1	Yes
Does the document describe corrective and preventative action protocols that address the requirements? (Section 2.18)	NA	NA
Does the document identify training and awareness programs as required? (Section 2.19)	Section 5.3	Yes
Does the document include details of a document review and revision process that complies with the requirements? (Section 2.20)	Section 7.0	Yes
Does the document include details of public availability requirements? (Section 2.21)	Section 7.0	Yes

Plan Preparation Certification

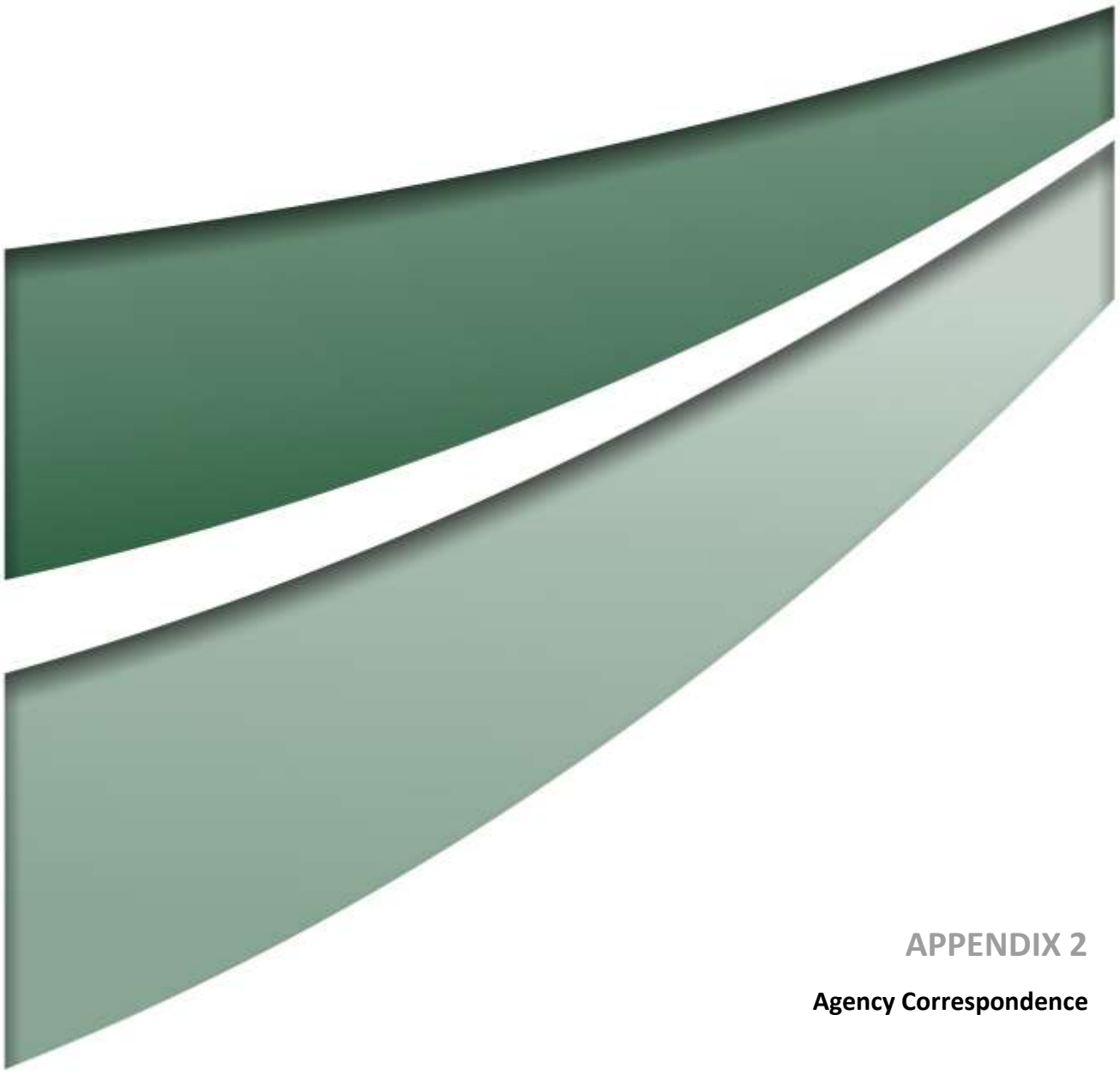
Document Certification Form	
Project Name	Haerses Road Quarry
Project Application Number	DA 165-7-2005
Proponent	Dixon Sand (No. 1) Pty Ltd
Document Title	Haerses Road Quarry Soil and Water Management Plan
Document Version	**V6**
Date of Issue	**12 November 2020**

Haerses Road Quarry Soil and Water Management Plan has been prepared by Umwelt (Australia) Pty Ltd in response to conditions of consent Schedule 3 Condition 19 DA 165-7-2005 for the Haerses Road Quarry. I am authorised to and have reviewed the document on behalf of Dixon Sand (Penrith) Pty Ltd.

I certify that the Old Northern Road Quarry Haerses Road Quarry Soil and Water Management Plan:

- has been prepared in accordance with the relevant condition/s and the Department's Environmental Management Plan
- adequately identifies and addresses all relevant conditions of consent
- has been prepared in accordance with relevant requirements of the conditions of consent regarding stakeholder consultation.

Name of Certifier	**Hunny Churcher**
Position	**Environmental Officer**
Company	**Dixon Sand Pty Ltd**
Date	**12 November 2020**



APPENDIX 2

Agency Correspondence

Planning Services
Resource Assessments
Contact: Philip Nevill
Phone: 8275 1036
Email: philip.nevill@planning.nsw.gov.au

Ms Trish McDonald
Senior Environmental Scientist
Umwelt (Australia) Pty Limited
75 York Street
Teralba NSW 2284

SENT BY EMAIL

Dear Ms McDonald,

Dixon Sand (DA 165-7-2005)
Soil and Water Management Plan

I refer to your emails dated 9 March 2018 and 17 April 2018 requesting the Secretary's endorsement of two suitably qualified and experienced persons to prepare the updated Soil and Water Management Plan for Dixon Sand's Haerses Road Quarry (DA 165-7-2005) following its recent modification (MOD 1).

The Department has reviewed the credentials of Mr Chris Bonomini and Ms Melissa Swan of Umwelt (Australia) Pty Limited and agrees that they are suitably qualified. In accordance with condition 19(a) of Schedule 3 of the above consent, the Secretary endorses Mr Chris Bonomini and Ms Melissa Swan to prepare the updated plan.

If you wish to discuss this matter further, please contact Philip Nevill at the details listed above.

Yours sincerely

Howard Reed 18.4.18

Howard Reed
Director Resource Assessments
as the Secretary's nominee

Appendix 2. Summary of issues raised during consultation on the SWMP and how they were addressed.

Issue	Response
EPA	
Ensure all reasonable measures are undertaken not to affect the water quality of the main groundwater sources at the MTSGS and the SBCGS by the Quarry.	Noted. The management measures in this SWMP will be implemented.
The SWMP should be audited to an industry standard or certified to the ISO 14001 standard (if applicable) as part of any overall environmental management system.	Noted. This SWMP will be audited in accordance with Condition 13(d) Schedule 5 of the Development Consent which requires an independent environmental audit to include a review of the adequacy of plans required by the Development Consent.
Department of Crown Lands Water Division (CLWD)*	

*Note: SWMP provided to CLWD on 25 May 2018. No comments have been received to date. This SWMP will be updated should comments be received in the future.

A copy of the Agency correspondence is also provided in **Appendix 2**.

DOC18/360752-01

Ms Trish McDonald
Senior Environmental Consultant
Umwelt Australia Pty Ltd
75 York Street
Teralba NSW 2284

Dear Ms McDonald

7 June 2018

Dixon Sand (Penrith) Pty Ltd - Haerses Road Quarry - Draft Soil and Water Management Plan

The Environment Protection Authority ("EPA") refers to your email dated 25 May 2018 seeking a review of the Draft Soil and Water Management Plan ("SWMP") for the quarry operated by Dixon Sand (Penrith) Pty Ltd ("Dixon Sand"), located at Haerses Road, Maroota.

The EPA encourages the development of Environmental Management Plans to ensure that proponents have determined how they will meet their statutory obligations and environmental objectives as specified by any development approval and/or conditions of an environmental protection licence. However, the EPA does not review these plans (unless in circumstances deemed necessary) as the role of the EPA is to set conditions/criteria for environmental protection and management, not to be directly involved in the development of strategies to comply with such conditions/criteria.

The EPA noted the presence of perched groundwater aquifers near the quarry, which may be intercepted by extraction activities. These aquifers might be connected to the two main groundwater sources namely the Maroota Tertiary Sands Groundwater Source (MTSGS) and Hawkesbury Sandstone, part of the Sydney Central Basin Groundwater Source (SBCGS). Dixon Sand must ensure that all reasonable measures are undertaken not to affect the water quality of the main groundwater sources at the MTSGS and the SBCGS by the proponent's operational activities.

As a management tool, such plan should assist Dixon Sand in meeting their commitment to statutory compliance and wider environmental management and where appropriate should be integrated with other operational or management plans. The implementation of the SWMP involves various commitments. Therefore, the EPA recommends that such plan be audited to an industry standard or certified to the ISO 14001 standard (if applicable) as part of any overall environmental management system.

Should you have further enquiries in relation to this matter please contact Lilian De Torres at lilian.DeTorres@epa.nsw.gov.au or phone 02 9995 5059.

Yours sincerely

Cmitchell.

Christine Mitchell
A/Unit Head– Sydney Industry
Environment Protection Authority

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info@epa.nsw.gov.au
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From: Trish McDonald
Sent: Wednesday, 18 July 2018 5:14 PM
To: 'Ryan Shepherd'
Subject: RE: 4272 - Assistance with DPI Water contact office - draft SWMP Haerses Rd Quarry

Thanks Ryan.

Trish McDonald
Senior Environmental Consultant

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

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Mobile: 0436 694 644

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From: Ryan Shepherd [mailto:ryan.shepherd@nrar.nsw.gov.au]
Sent: Wednesday, 18 July 2018 10:10 AM
To: Trish McDonald
Cc: Hunny Churcher (environment@dixonsand.com.au); Mark; Luke Bettridge
Subject: Re: 4272 - Assistance with DPI Water contact office - draft SWMP Haerses Rd Quarry

Hi Trish,

Thanks for the heads up. I have informed our groundwater team of your requirement to submit to DPE today. I am hoping they will expedite any comments.

Regards,

Ryan Shepherd | Water Regulation Officer (East)
Natural Resources Access Regulator
Department of Industry | Lands & Water
Level 3 | 26 Honeysuckle Drive | Newcastle NSW 2300 | PO Box 2213, Dangar NSW 2309
T: 02 4904 2650 | F: 02 4904 2501 | E: ryan.shepherd@nrar.nsw.gov.au
W: www.industry.nsw.gov.au

On Wed, Jul 18, 2018 at 8:33 AM, Trish McDonald <tmcdonald@umwelt.com.au> wrote:

Hi Ryan

Appreciate your assistance with this.

This is just a courtesy email to advise that the SWMP for the Haerses Road Quarry will be submitted today to DPE in line with the timeframe for submission required by the development consent (DA 165-7-2005 MOD 1).

Any comments that DPI Water may provide in due course as part of the consultation regarding the SWMP (as per emails below) will still be addressed. But this will now occur following receipt of comments by DPE.

Kind regards

Trish McDonald
Senior Environmental Consultant

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

Phone: (02) 4950 5322

Mobile: 0436 694 644

www.umwelt.com.au

Inspired People | Dedicated Team | Quality Outcomes

Newcastle ph. 02 4950 5322 | **Perth** ph. 08 6260 0700 | **Canberra** ph. 02 6262 9484 | **Sydney** ph. 1300 793 267 | **Brisbane** ph. 1300 793 267

From: Ryan Shepherd [mailto:ryan.shepherd@nrar.nsw.gov.au]
Sent: Wednesday, 27 June 2018 5:05 PM
To: Trish McDonald
Cc: Hunny Churcher (environment@dixonsand.com.au); Mark
Subject: Re: 4272 - Assistance with DPI Water contact office - draft SWMP Haerses Rd Quarry

Thanks for the email Trish,

I have sent another follow up email to the groundwater team. I will let you know when I hear from them.

Cheers,

Ryan

Regards,

Ryan Shepherd | Water Regulation Officer (East)
Natural Resources Access Regulator
Department of Industry | Lands & Water
Level 3 | 26 Honeysuckle Drive | Newcastle NSW 2300 | PO Box 2213, Dangar NSW 2309
T: 02 4904 2650 | F: 02 4904 2501 | E: ryan.shepherd@nrar.nsw.gov.au
W: www.industry.nsw.gov.au

On Wed, Jun 27, 2018 at 3:49 PM, Trish McDonald <tmcdonald@umwelt.com.au> wrote:

Hi Ryan

Just wondering if you could provide an update on when we may expect comments on the SWMP.

For information, under the Development Consent for the project, Dixon Sand is required to submit the draft plan to DPE in July.

We can either submit the SWMP and note that DPI Water's comments are still to be received, or we could request an extension of the submission date to allow the comments to be received, considered and addressed.

Not trying to rush your review by any means. Just trying to timeframe so we can liaise with DPE accordingly.

Many thanks

Trish McDonald
Senior Environmental Consultant

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From: Ryan Shepherd [mailto:ryan.shepherd@nrar.nsw.gov.au]
Sent: Tuesday, 19 June 2018 1:41 PM
To: Trish McDonald
Subject: Re: 4272 - Assistance with DPI Water contact office - draft SWMP Haerses Rd Quarry

Hi Trish,

I am the right contact for review the draft SWMP. I have referred the plan to our groundwater team on 6 June, and agave them until 20 June for a reply. I think they have been a little late with replies in recent times. I will follow them up and see where their comments are at.

Cheers,

Ryan

Regards,

Ryan Shepherd | Water Regulation Officer (East)
Natural Resources Access Regulator
Department of Industry | Lands & Water
Level 3 | 26 Honeysuckle Drive | Newcastle NSW 2300 | PO Box 2213, Dangar NSW 2309
T: 02 4904 2650 | F: 02 4904 2501 | E: ryan.shepherd@nrar.nsw.gov.au
W: www.industry.nsw.gov.au

On Fri, Jun 15, 2018 at 1:11 PM, Trish McDonald <tmcdonald@umwelt.com.au> wrote:

Hi Ryan

I've been given your name as you have previously dealt with Dixon Sand in relation to groundwater drilling and well installation at the Haerses Road Sand Quarry in Maroota NSW.

I understand that you are most likely not the correct person to deal with, but if you could point me in the right direction that would be very much appreciated.

We lodged the draft Soil and Water Management Plan (SWMP) with the Department via the 'referrals' email address on 25 May 2018, as directed by Dept. Planning and Environment. I have attached the email for information.

Just wondering how I might go about finding out who is looking after this to understand when we may expect a response.

Many thanks

Trish McDonald
Senior Environmental Consultant

Umwelt (Australia) Pty Limited
75 York Street
Teralba, NSW 2284

Phone: (02) 4950 5322

Mobile: 0436 694 644

www.umwelt.com.au

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Newcastle ph. 02 4950 5322 | **Perth** ph. 08 6260 0700 | **Canberra** ph. 02 6262 9484 | **Sydney** ph. 1300 793 267 | **Brisbane** ph. 1300 793 267

---------- Forwarded message ----------
From: Trish McDonald <tmcdonald@umwelt.com.au>
To: "water.referrals@dpi.nsw.gov.au" <water.referrals@dpi.nsw.gov.au>
Cc: "Hunny Churcher (environment@dixonsand.com.au)" <environment@dixonsand.com.au>
Bcc:
Date: Fri, 25 May 2018 06:48:36 +0000
Subject: 4272 - Haerses Road Quarry DA 165-7-2005 Mod 1 - Draft Soil & Water Management Plan for Consultation

Good afternoon

Dixon Sand (Penrith) Pty Ltd operates the Haerses Road Quarry, a sand extraction and processing operation, located on Haerses Road, Maroota in NSW.

A recent modification to the quarry's development consent (DA 165-7-2005 MOD 1) requires a Soil and Water Management Plan (SWMP) to be prepared for the quarry in consultation with the CLWD. On behalf of Dixon Sand, please find below a link to the draft SWMP. We request your review and any comments on the plans by **Friday 8 June 2018**.

Link to draft SWMP - https://umwelt.sharefile.com/d-s7d676e881994e6c8

A copy of the development consent and associated environmental impact assessment documentation can be found on the Department of Planning website at http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=7377

If you require any further information, please contact myself or Hunny Churcher of Dixon Sand on 0405 844 207.

Kind regards

Trish

Trish McDonald
Senior Environmental Consultant

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75 York Street
Teralba, NSW 2284

Phone: (02) 4950 5322

Mobile: 0436 694 644

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Newcastle ph. 02 4950 5322 | **Perth** ph. 08 6260 0700 | **Canberra** ph. 02 6262 9484 | **Sydney** ph. 1300 793 267 | **Brisbane** ph. 1300 793 267

This message is intended for the addressee named and may contain confidential information. If you are not the intended recipient, please delete it and notify the sender. Views expressed in this message are those of the individual sender, and are not necessarily the views of their organisation.

---

27 March 2020 Project No. 1780381-L007-Rev1

Hunny Churcher
Dixon Sand (No. 1) Pty Ltd

EXTRACTION DEPTH FOR DA 165-7-2005

Introduction

Dixon Sand (No. 1) Pty Ltd (Dixon Sand) operates the Haerses Road Quarry, Maroota. The site covers 128 ha either side of Haerses Rd (Figure 1). The quarry operates in accordance with Development Consent DA 165-7-2005, which has been subsequently modified on two occasions.

An Independent Environmental Audit was completed and the report submitted in January 2020. In accordance of Condition 22 (b) of Schedule 2 of the development consent Dixon Sand is required to review and update the Maximum Extraction Depth Map within 3 months of the completion of an Independent Environmental Audit, to the satisfaction of the Secretary. This review and revision of the Maximum Extraction Depth Map is undertaken to fulfil the above requirement.

The Maximum Extraction Depth Map is the *wet weather groundwater elevation* and is determined by the quarry groundwater monitoring network. In accordance with development consent condition 20 of DA 165-7-2005, we have undertaken a review of historical groundwater level monitoring data and made an assessment of the *wet weather groundwater level* to establish the maximum depths to which extraction can be undertaken within the following areas:

- Teriary sands extraction area; and
- Western friable standstone extraction area (Figure 1).

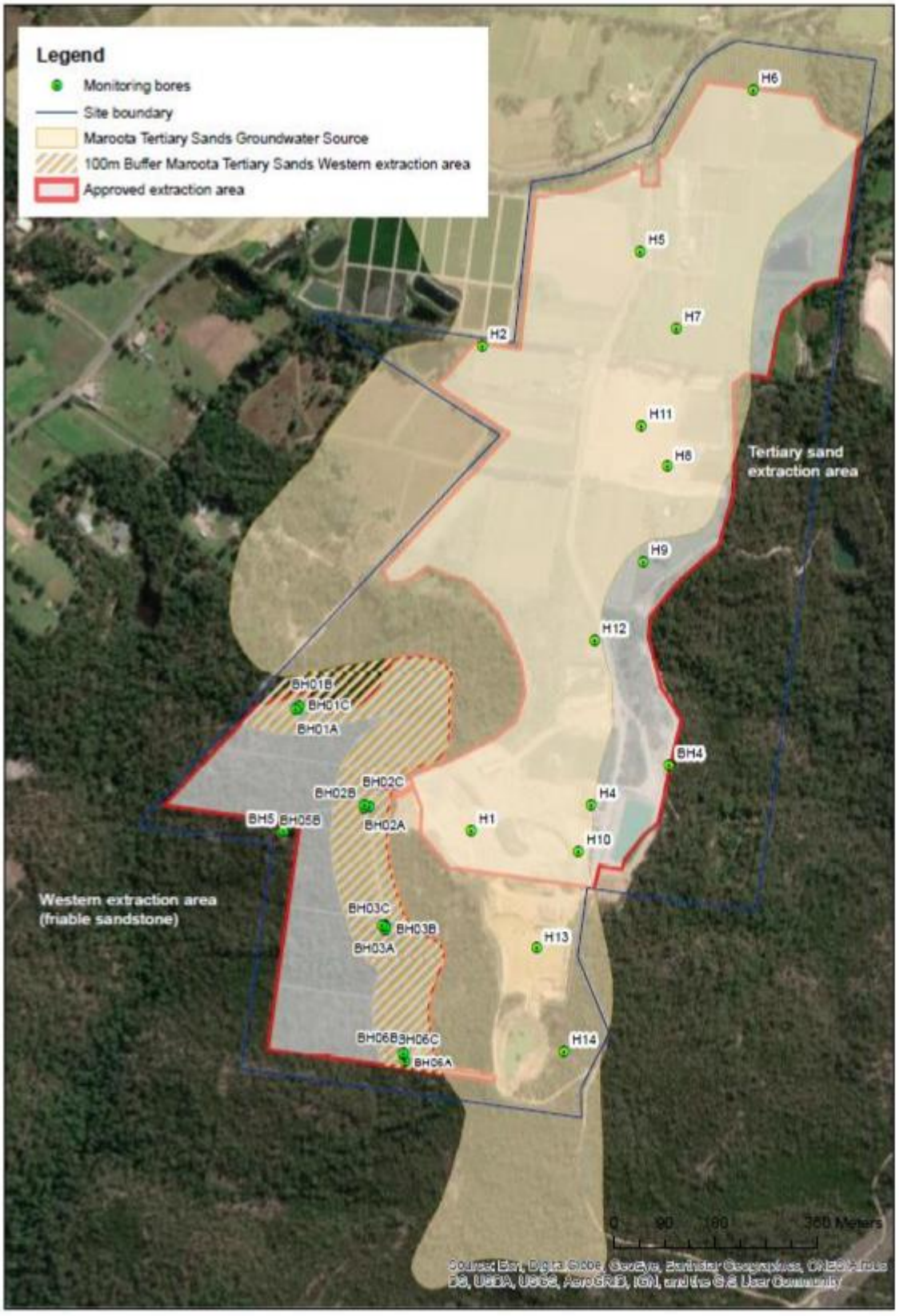
Extraction depths within the Teriary sands extraction area are restricted to 2 m above the wet weather elevation of the underlying Maroota Tertiary Sands Groundwater Source (MTSGS). Extraction depths within the western friable sandstone extraction area are restricted to 2 m above the wet weather elevation of the underlying Sydney Central Basin Groundwater Source (SBCGS). There is a buffer zone which extends 100 m from the western boundary of the MTSGS, which is referred to as the MTSGS buffer zone (Figure 1). This buffer zone overlies the friable sandstone, however in accordance with Condition 17 of the consent, Dixon Sand must not commence quarrying operations within the MTSGS buffer zone without the prior approval of the Secretary (and groundwater monitoring results have shown that quarrying can be undertaken in this area without incurring water loss from the MTSGS).

There are other buffer zones that prohibit extraction but these a related to land uses rather than for hydrogeological purposes.

Golder
118 Franklin Street Adelaide, South Australia 5000 Australia T: +61 8 8213 2100 | F: +61 8 8213 2101

A.B.N. 64 006 107 857

Figure 1: Extraction Areas and Buffer Zones



Groundwater Elevation and Extraction Depth

The wet weather groundwater level of the MTSGS was calculated based on the maximum water level reached in H series monitoring bores following a 50 mm rainfall event in a 24 hour period. The historical daily rainfall records for the nearest BoM rainfall recording station have been analysed to determine the relevant groundwater level at each of the sites that have been monitored over the quarry life. Since 2005, the recorded rainfall at the nearest BoM station 67014 (Maroota Old telegraph Road) have included approximately 32 days when the total daily rainfall exceeded 50 mm, as listed in Appendix A. Table 1 shows the peak water level measured at each of the bores completed in the MTSGS.

Table 1: Peak Water Level After >50 mm/day Rainfall Event – Tertiary Sands Extraction area

Monitoring Bore ID	Peak Water Table Elevation (mAHD)
*H1	176.87
H2	182.05
*H4	183.37
*H5	178.6
H6	184.46
H7	182.6
*H8	187.59
H9	186.93
*H10	176.68
*H11	184.8
H12	183.69
*H13	171.3
H14	177.19

*Denotes obsolete monitoring bores

The length of groundwater monitoring records in the western extraction area (and buffer zone) is much shorter than the MTSGS as the majority of monitoring bores were installed in 2018. For this reason, the wet weather elevation was based on the highest recorded groundwater level to date.Table 2 shows the peak groundwater water level measured at each of the bores completed in the deep SCBGS (BH01A, BH02A, BH03A, BH06A, BH04 and BH05). *Note,* the shallow cluster monitoring bores located in the buffer zone are also shown for reference, but their groundwater levels reflect perched groundwater in the upper unweathered sandstone and as such their purpose is to assess water loss form the adjacent MTSGS. Ongoing monitoring from these bores will be used to assess extraction depth in the buffer zone subject to the approval of the Secritary.

Table 2: Peak Water Level Observed in the Friable Sandstone (Western) Extraction Area

Bore ID	Groundwater source	Peak Water Table Elevation (m AHD)	Monitoring Since
BH01A	SBCGS	133.26	Jul-18
BH02A		136.72	Jul-18
BH03A		101.33*	Jul-18
BH06A		127.66	Jul-18
BH04		140.18	May-11
BH05		123.2	May-11

*groundwater level doesn't reflect the regional tend and has been excluded from the wet weather groundwater elevation contours

Contours of the wet weather groundwater elevation based on the values in Table 1 and Table 2 are shown on Fgure 2. Contours of maximum extraction depth have been created by adding 2 m to each wet weather groundwater level and these are presented on Figure 3. Note whilst extraction depth contours are shown for the MTSGS buffer zone, Dixon Sand must not commence quarrying operations within the MTSGS buffer zone without the prior approval of the Secretary.

Figure 2: Wet weather Groundwater Elevations (mAHD) of the MTSGS and SCBGS

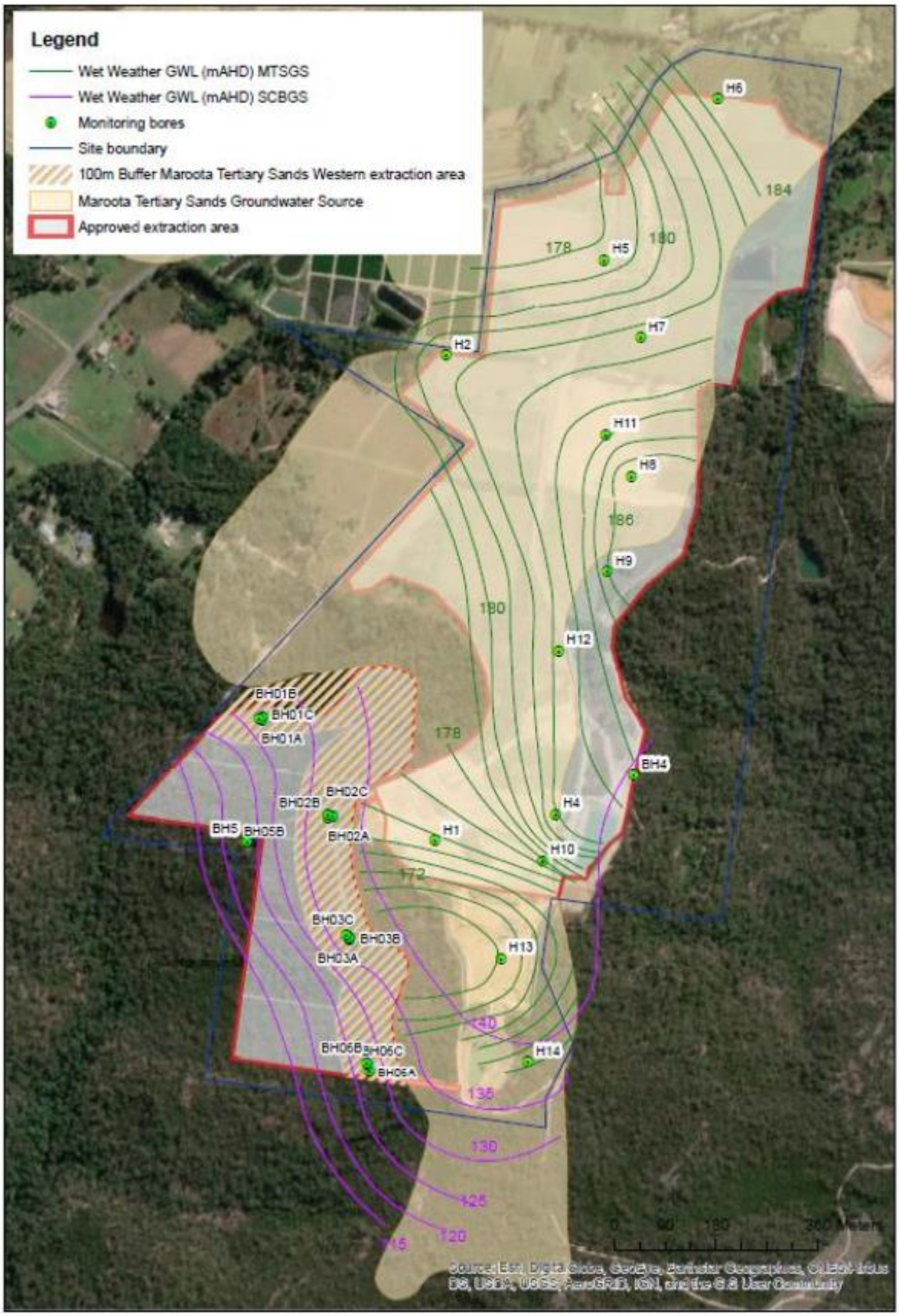
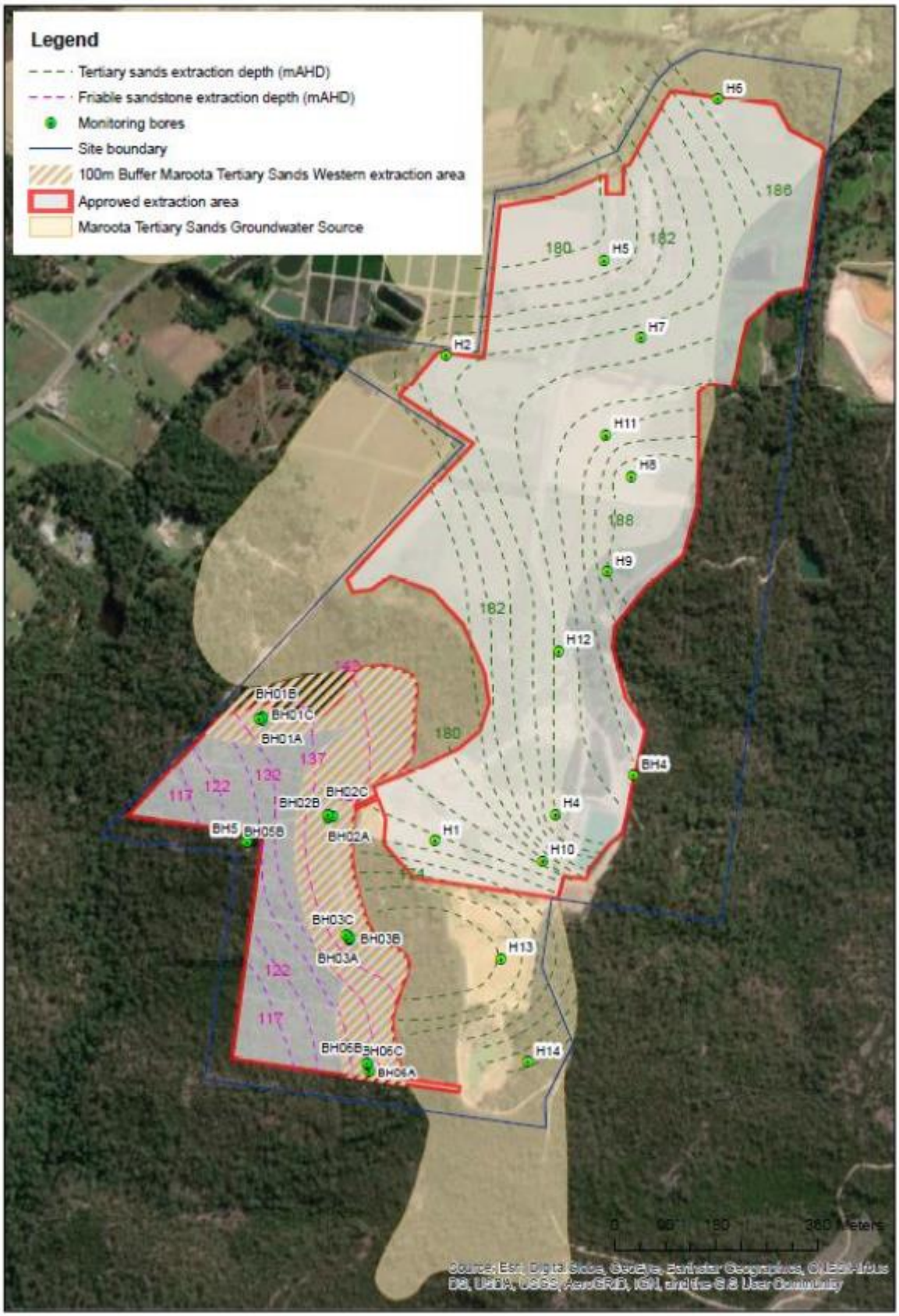


Figure 3: Maximum extraction depth (mAHD) in the Tertiary sand extraction area and western friable sandstone extraction area



The maximum extraction depth map on Figure 3 shows:

- Maximum extraction depth of the Tertiary sands extraction area based on revised groundwater level contours should be limited to a depth not greater than 188 m AHD in the east, gradually reducing to 174m AHD in the west.
- Maximum extraction depth outside the buffer zone of the western extraction (friable sandstone) based on revised groundwater level contours should be limited to a depth not greater than 137 m AHD in the east, gradually reducing to 117 m AHD in the west.
- Extraction within the MTSGS buffer zone is not currently permitted and requires approval from the Secritary once the level of hydraulic connection ot the MTSGS has been understtod. This will be established through groundwater level monitoring of the cluster bores within the buffer zone.

Important Information

Your attention is drawn to the document – "Important Information", which is included in Attachment B of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

We trust the above satisfies your requirements, however please contact us if you would like ot discuss the findings

GOLDER ASSOCIATES PTY LTD

Jason van den Akker
Principal Hydrogeologist

JV/jd

Attachments: A - Wet Weather groundwater level calculations
B – Important Information

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ATTACHMENT A

Wet Weather Groundwater Level Calculations

Table 3: Weat Weather Level Calculated for the MTSGS

Maroota Daily Rainfalls Exceeding 50mm – 2005 to 2020																
Year	Date	Rainfall	Comment	Peak water level after >50mm/day rainfall												
				H1	H2	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14
2006	7 September	65.0		173.66	179.42	163.09	176.50	179.64	176.26	165.32	165.32	175.93	163.39	176.17	169.97	172.35
2007	13 February	52.2		173.79	179.77			179.36	176.35	163.70	165.35	176.23	163.20	176.36	169.96	172.00
	9 June	172.0		173.79	161.30			162.75	179.32	163.45	166.10	176.66	163.26	160.59	169.79	172.11
	20 July	136.5		174.09	161.66			162.96	160.10	163.33	166.14	176.66	164.75	161.66	169.74	172.91
	6 December	50.6		174.66	160.16			163.03	160.64	164.19	165.69	176.59	164.79	163.13	169.66	173.62
2008	5 June	51.0		175.96	160.17			163.26	161.20	167.59	165.66		164.76	163.34	169.63	175.69
2009	2 April	51.0			160.12			162.56	160.39	167.49	165.42		164.35	163.13	169.94	175.53
	22 May	76.0			160.11			162.54	160.39	167.46	165.43		164.34	163.12	170.17	175.52
2010	7 February	75.0			179.02			163.14	160.25		165.11		164.60	161.74	169.60	175.42
2011	20 August	74.5			160.47			163.26	160.20		164.63			160.99	170.70	175.79
2012	16 April	52.0			160.57			164.46	162.60		166.93			163.09		176.19
2013	29 January	116.0			161.06			162.69	160.24		165.73			162.72	170.10	174.57
	23 February	72.0	154.4 mm over 2 days (23-24 February 2013)		161.57			163.36	161.00		165.51			162.39	170.10	174.65
	24 February	82.4			161.57			163.36	161.00		165.51			162.39	170.10	174.65
2014	19 August	52.6			179.67			162.86	160.10		165.03			160.79	170.60	175.99
	7 December	55.0			160.77			162.86	160.20		165.03			161.29	170.50	175.99
2015	21 April	161.0	279 mm over 2 days (21		160.57			163.46	162.50		166.03			163.69	171.20	177.09
	22 April	118.0			160.57			163.46	162.50		166.03			163.69	171.20	177.09

Maroota Daily Rainfalls Exceeding 50mm – 2005 to 2020																
			to 22 April 2015)													
	22 December	63.6			160.67			163.96	162.30		166.13			163.69		176.69
2016	5 January	105.0	221.2 mm over 4 days (4 to 7 January 2016)		160.37			164.46	162.60		166.13			163.69		177.19
	6 January	66.0			160.37			164.46	162.60		166.13			163.69		177.19
	5 June	69.0	147.4 mm over 3 days (4 to 6 June 2016)		160.67			163.66	161.60		165.53			163.29		176.79
	6 June	66.0			160.67			163.66	161.60		165.53			163.29		176.79
2017	16-Mar	54.6			160.97			163.36	161.50	-	165.63			162.79	171.3	176.49
	31-Mar	55.0			160.97			163.36	161.50	-	165.63			162.79	171.3	176.49
2018	26-Feb	66.0			160.57			162.66	160.00		164.73			160.99	170.3	176.29
	5-Oct	55.0			162.05			162.01	160.26		164.92			161.24		175.06
2019	16-Mar	66.0	66 mm from 16 to 18 March 2019		161.90			161.43	160.32		164.95			161.12		174.91
2020	17-Jan	51.0	51 mm over 17th to 20th Jan													
Average peak water level after >50mm/day rainfall event				174.90	160.46	163.23	176.56	162.72	160.62	165.33	165.50	176.25	164.16	162.16	170.13	175.42
Highest peak water level after >50mm/day rainfall event				176.67	162.05	163.37	#####	164.46	162.60	#####	166.93	176.66	#####	163.69	171.30	#####

ATTACHMENT B

Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

This Report is provided for use solely by Golder's Client and persons acting on the Client's behalf, such as its professional advisers. Golder is responsible only to its Client for this Report. Golder has no responsibility to any other person who relies or makes decisions based upon this Report or who makes any other use of this Report. Golder accepts no responsibility for any loss or damage suffered by any person other than its Client as a result of any reliance upon any part of this Report, decisions made based upon this Report or any other use of it.

This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

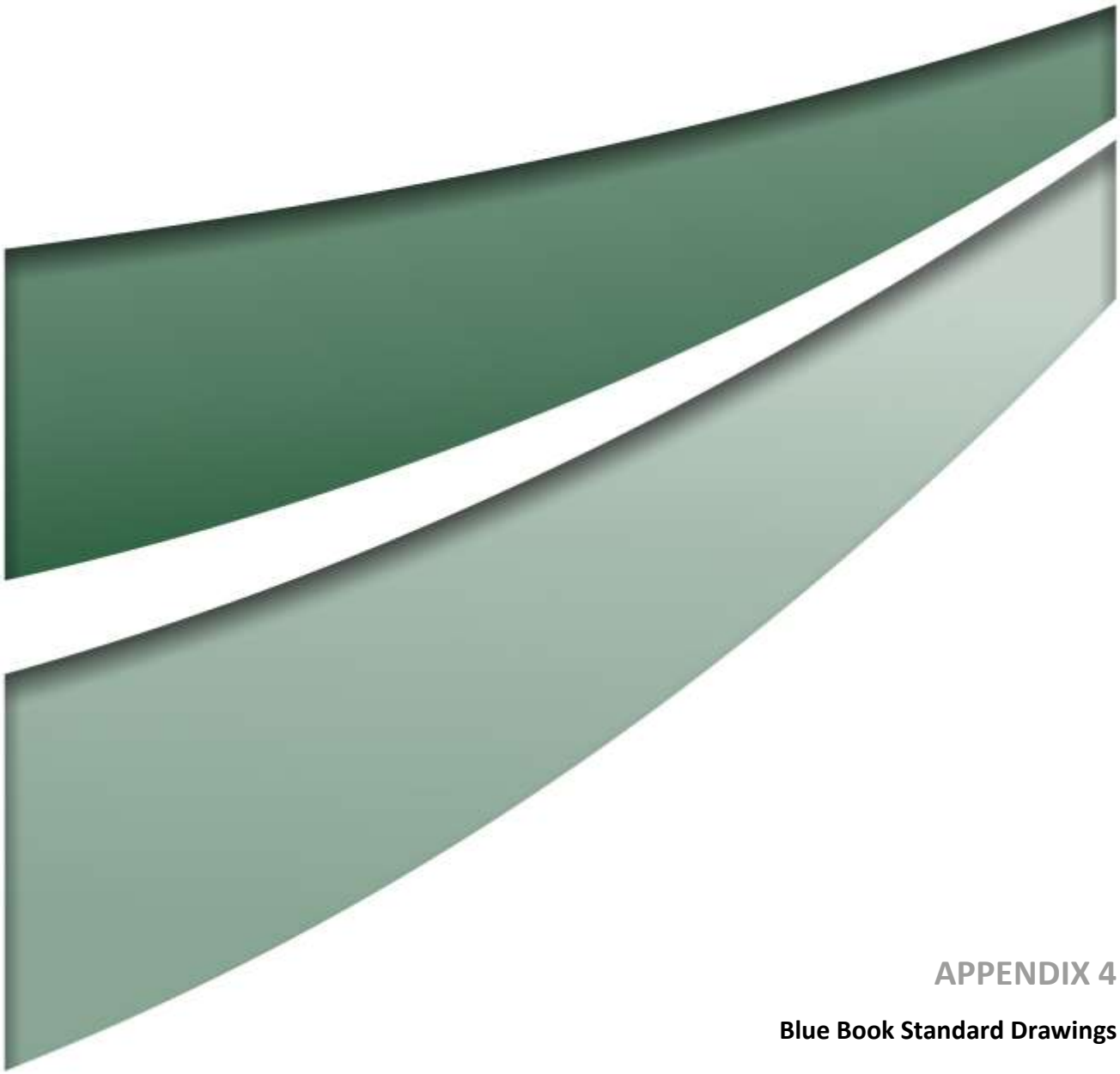
Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

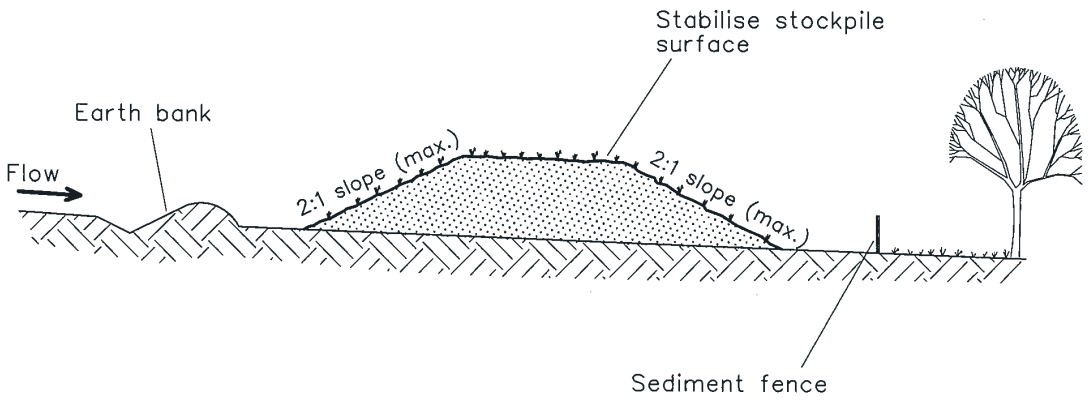
By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification



APPENDIX 4

Blue Book Standard Drawings

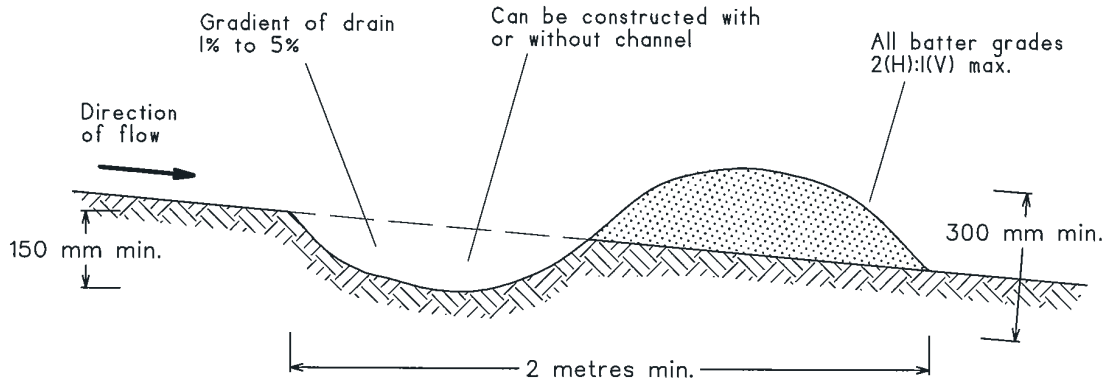


Construction Notes

1. Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
2. Construct on the contour as low, flat, elongated mounds.
3. Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
4. Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
5. Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

STOCKPILES

SD 4-1

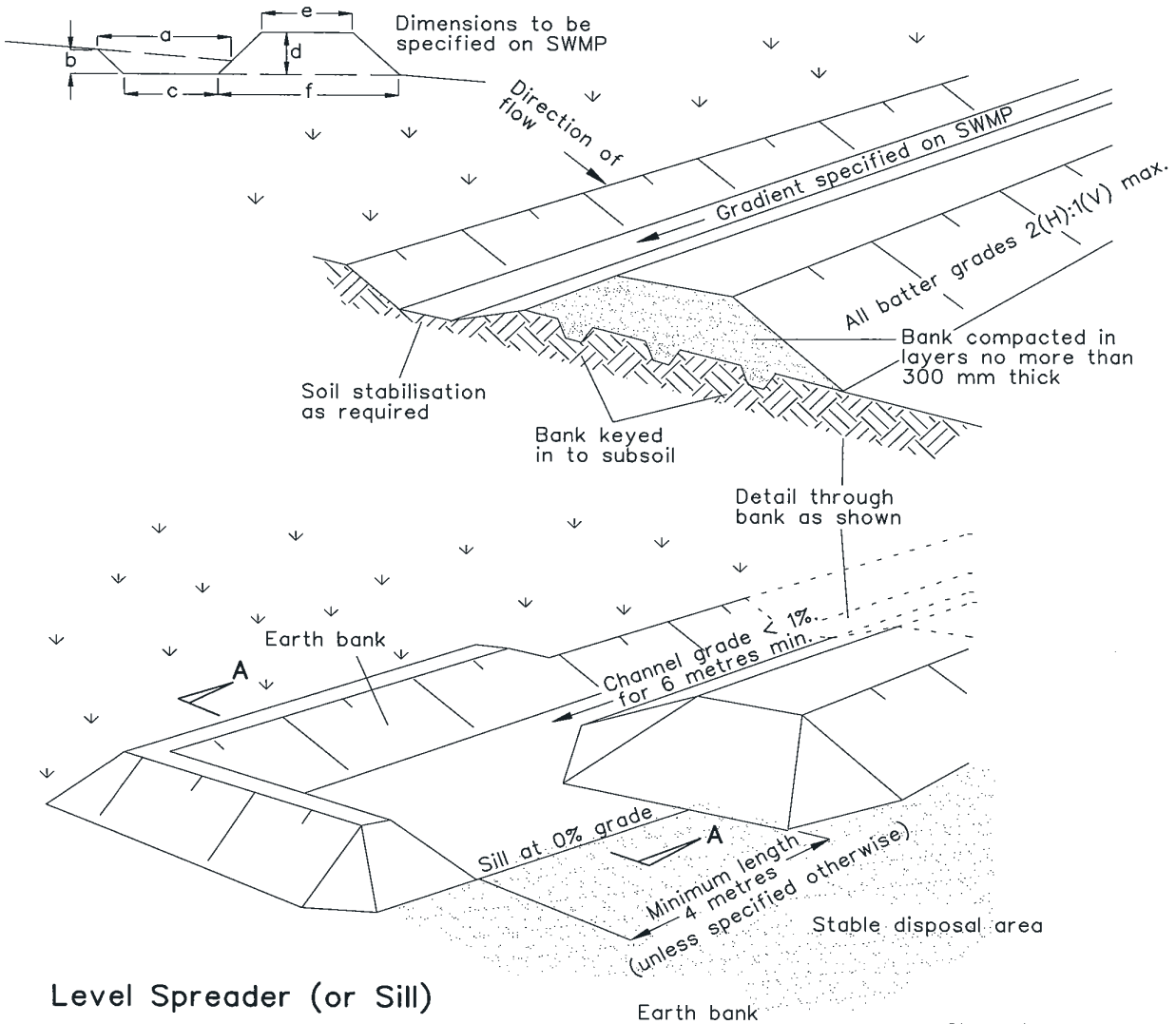


NOTE: Only to be used as temporary bank where maximum upslope length is 80 metres.

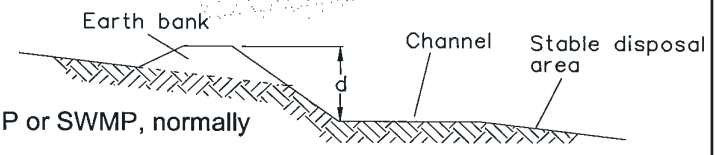
Construction Notes

1. Build with gradients between 1 percent and 5 percent.
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction.

EARTH BANK (LOW FLOW) SD 5-5



Level Spreader (or Sill)



Section AA

Construction Notes

1. Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
2. Avoid removing trees and shrubs if possible - work around them.
3. Ensure the structures are free of projections or other irregularities that could impede water flow.
4. Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
5. Ensure the banks are properly compacted to prevent failure.
6. Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
7. Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
8. Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
9. Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

EARTH BANK (HIGH FLOWS) SD 5-6

SEDIMENT BASIN INSPECTION FORM

Quarry Name		**Inspection By:**	
Basin Name / No.		**Inspection Date:**	
Is Inspection following a rainfall / storm event		Y N |	
If Yes, record rainfall for previous 24 hours		Rainfall = mm	

#	Control Measure	Y	N	Comments
1	Is maintenance to the basin / infrastructure required? For example: • Sediment accumulation at inflow points? • Structures i.e. pits, pipes, ramps in satisfactory condition?			If **YES**, alert the Quarry Manager / Environmental Officer immediately
2	Are there any structural concern visible during the inspection? (e.g. scouring outlet, eroding walls, washout etc)			If **YES**, alert the Quarry Manager / Environmental Officer immediately
3	Does the basin need de-silting? (i.e. refer to marker)			
4	Is oil and/or grease visible on the surface of the water? (if visible consult Env. Officer for removal / treatment option)			
5	Is there sufficient storage capacity in the basin?			If **YES**, no further action required If **NO**, proceed to #6 for methods of reducing water level
6	To reduce water level in the basin, water can be: a) used for dust suppression onsite by the water cart, and or b) transferred to another storage facility, and or c) tested and discharged offsite (where permitted by the EPA Environment Protection Licence)	Record the method for reducing water level in the basin. If Option c) is selected, follow the protocols of the ***Permit to Discharge DS-ENV-00103***		

Important Note: No offsite discharge of water is permitted at Haerses Road Quarry

Comments / Diagrams / Photos

WATERCART DESPATCH SHEET

Quarry Name		Month / Year	

Watercart Usage					
Date	**Number of Dispatch**	**Date**	**Number of Dispatch**	**Date**	**Number of Dispatch**
1st		11th		21st	
2nd		12th		22nd	
3rd		13th		23rd	
4th		14th		24th	
5th		15th		25th	
6th		16th		26th	
7th		17th		27th	
8th		18th		28th	
9th		19th		29th	
10th		20th		30th	
				31st	

Summary Usage	
Total Monthly Watercart Despatch	
Total Monthly Water Volume	
Comments	

WATER TRANSFER & CLEAN WATER IMPORT SHEET

Quarry Name		Month / Year		
Water Transfer Record				
Location	**Time**	**Pump Reading**	**Total Water Transferred**	**Comments**
Transfer 1	**Beginning of the Month**			
	End of the Month			
Transfer 2	**Beginning of the Month**			
	End of the Month			
Transfer 3	**Beginning of the Month**			
	End of the Month			
Transfer 4	**Beginning of the Month**			
	End of the Month			
Transfer 5	**Beginning of the Month**			
	End of the Month			
Transfer 6	**Beginning of the Month**			
	End of the Month			
Transfer 7	**Beginning of the Month**			
	End of the Month			
Summary Usage				
Total Monthly Water Transfer between Basins				
Total Monthly Clean Water Import onto Site				
Comments				

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