5 WATER MANAGEMENT SYSTEM

5.1 RESPONSIBILITY FOR IMPLEMENTATION

The Quarry Manager carries ultimate responsibility for the implementation of this WMP and providing the necessary resources as required. The site Environmental Officer is responsible for carrying out and/or coordinating the monitoring and reporting requirements of this plan.

Operations personnel (Quarry Supervisors) are responsible for responding to adverse site water quality conditions and adjusting quarry operations as appropriate to minimise impacts on the environment. Other site personnel are responsible for reporting adverse site water quality conditions and reporting them to the shift Supervisor.

5.2 SURFACE WATER MANAGEMENT

5.2.1 Overview

The system is based on capturing and reusing stormwater runoff for use in the quarry processes, dust suppression and environmental controls. Figure 5.1 contains a schematic of the site surface water management system.

The water management system is managed in order to minimise/mitigate impacts to the flow and quality of surrounding surface water and groundwater systems. This system is based on the following approach:

- diversion of clean water runoff away from site activities;
- containment of potentially contaminating activities within sealed and bunded areas and the inclusion of interceptor systems to contain contamination;
- appropriate storage of potentially contaminating substances;
- retention and treatment of “dirty water” to prevent sediment laden or contaminated runoff leaving the site;
- specific erosion and sediment control systems and monitoring to minimise the development of sediment laden runoff;
- recycling and treatment of all water used in quarrying activities to minimise demand for top-up water from the clean water dams and to minimise the flow of dirty water to the Pit storage;
- construction of a vegetated bio-retention swale upstream of the primary water storage dam to improve the quality of runoff entering the water supply dam and act as a filter for excess flows from the in-pit storages;
- release of environmental flows, equivalent to a minimum of 10% of average daily flows, to mimic natural flow patterns; and
- monitoring of surface water and groundwater quality and quantity to confirm the efficiency of the proposed water management system and to ensure there are no detrimental impacts upon groundwater systems or surface receiving waters.

5.2.1.1 Segregation of Stormwater

Stormwater runoff from clean, non-operational areas (i.e. building roofs and undisturbed land) will be directed away from potentially dirty operational areas (i.e. areas of the site where spills and/or leaks may occur— workshops, wash bays, chemical storage facilities, refuelling facilities etc) by use of controls such as:

- site contouring
- diversion trenches
- roof guttering
- rainwater pipes
- drains

Segregated, clean stormwater can then be discharged directly off site while dirty stormwater will be contained, treated and tested before it can be discharged off site.

'Clean' runoff from undisturbed areas is diverted around operational areas where practical. This reduces the risk of flooding in the pit as well as the potential for clean runoff to be impacted by quarry activities. Diversion of clean water is effected by diversion drains, contour drains and, where necessary, bunds, levees, weirs and pipe culverts. Clean water is diverted to the main water storage dam wherever possible.

'Dirty' water runoff from disturbed areas (overburden emplacements, haul roads and processing plant) is directed to sediment basins and then directed into Dam K or Dam 1 via pumping or gravity flow. Excess water from Dam K is discharged back into Dam No. 1.

5.2.1.2 Use of Recycled Water

Where possible, measures will be implemented to allow for conservation of potable water (i.e. town water) resources through recycling or reuse of water for activities such as truck washing or dust suppression etc. The site's water supply is generally provided from Dam No. 1, located on Tangarang Creek. The water supply dam captures water prior to being reused on the site or released to Tangarang Creek as environmental flow.

Demand on potable water resources can be reduced through:

- site water balance assessment and minimisation programs
- capturing and harvesting of stormwater for on site reuse
- recycling and reuse of processed water
- treatment and reuse of wastewater

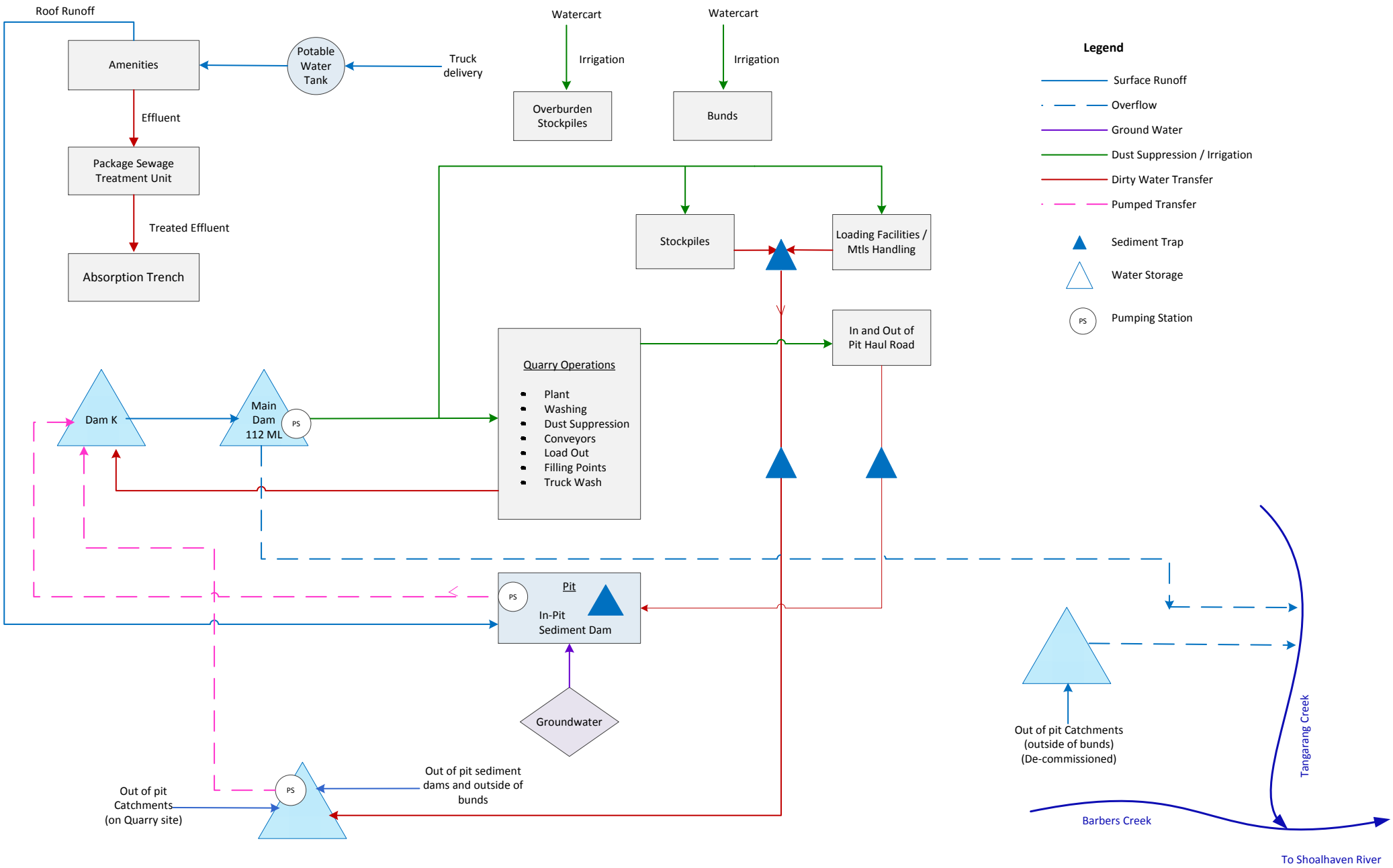
5.2.1.3 Control and Monitoring of Offsite Discharges

Potentially contaminated water should be directed and captured in appropriate on site storage facilities (i.e. tanks and dams) for treatment (if necessary) and on site reuse (where possible).

A water sampling and testing program has been developed and implemented to meet any relevant regulatory requirements associated with offsite discharges (refer Sections 7.2 and 7.3)

Appropriate management and monitoring of volume levels within storage facilities will be carried out. This is to minimise the potential for uncontrolled off site discharges due to overflows and heavy rainfall events.

Figure 5.1
Flow Diagram of water management plan
Water Management Plan / Peppertree Quarry



5.2.2 Site Sub-Catchments

The site is subdivided into twelve sub catchment areas, five of which are clean water catchments where water is diverted around the site and the remainder are dirty water catchments. The locations of the dams and associated catchments are shown in Figure 5.2, with details of each provided in Table 5.1.

A number of catchments within the site drain to the quarry pit, Dam K and Dam 1 from where water is either used for dust suppression purposes, reused in operations or discharged to Tangarang Creek as environmental flows. Other catchments within the quarry drain to a series of small sediment dams, mainly located on the outer edge of the northern noise bund or the eastern side of the Eastern Overburden Emplacement. In large storm events these dams drain directly to either Tangarang Creek or Barbers Creek.

Two catchments will discharge to the Marulan South Limestone mine as part of the Southern Overburden emplacement.

Table 5.1: Site Drainage Sub-Catchments

Catchment	Area (ha)	% disturbed	Land usage	Water Management
Dirty Water Catchments				
Processing area	13.98	100	Crushing and processing plant with rock storage	Graded to boundary drains discharging to Dam K with overflow to Dam 1. Boundary drains are rock lined.
Pit floor	34.87	100	Quarry extraction area with some rock storage	Internal sumps with pumps with fixed permanent pipe to Dam K and the turkeys nest
Overburden emplacement	13.97	100	weathered granidiorite engineered emplacements	Graded to drain in 3 directions. Top of overburden drains via large rubble drain to heritage dam for reuse. Western slope drains to Heritage Dam. Southern slope drains to OB south dam which is pumped to the turkeys nest. Eastern slope drains to the OB east drain which is pumped to the heritage dam
Heritage area / farm office	17.08	80	Workshop for HME, office and topsoil stripping	Overground flow and drains to the haul road dam and heritage dam for reuse
Train load out	971 (m2)	100	Rail operations with rock storage	Gravity drainage to sediment pit to allow sediment to be collected as well as drainage to grass swale at the head of Dam 1
Workshop	1.57	100	Servicing of HME and equipment with carpark and storage	Drains to boundary rock lined drain to Dam K. Oily water areas drain to oil separator and reused oil tan, with clean water overflow to boundary drain

Catchment	Area (ha)	% disturbed	Land usage	Water Management
Turkeys nest	6.65	100	Open grassland and cleared areas	Drainage from farmland and disturbed area as well as in pit sump collected in a Turkeys nest. This water is used for dust suppression or pumped to diversion drain to the head waters of Dam 1.
Clean Water Catchments				
Western overburden	16.99	nil	grassland	Water collected in diversion drain and directed to the head waters of Dam 1. West OB dam in place for sediment and flow control
Noise bund	12.2	Revegetated	Noise bunds	Clean water runoff collected in remaining sediment ponds from construction of the bund. OB North dam pumped to OB east dam. All others evaporate between rain events or overflow in excessive storms.
Habitat management area	28.72	Revegetated	Protected	Surface water runoff only occurs during storm events to dam 1 and Tangarang Creek
Southern overburden emplacement	12.8	nil	Open grasslands	Surface water runoff only occurs during storm events Barbers Creek and the Marulan south mine. This will change in time to include a number of sediment ponds, sediment fence and associated drainage with water being returned to the Peppertree Quarry site, the marulan south mine with large storm overflows to Barbers Creek.
Southern parkland	11.17	nil	Open grassland	Clean water is captured by a diversion drain and discharged to Dam 1

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Figure 5.2
Location of site dams and catchments
Water Management Plan / Peppertree Quarry

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5.2.3 Dams and Sediment Basins

There are a total of 16 dams/sediments basins currently located within the site as shown in Figure 5.2. Information about the operation of the dams is summarised in Table 5.2. The dams have been sized to capture flow from a 100 year ARI 24 hour rainfall event in accordance with CoA 28. When flow in excess of this volume occurs, the sediment dams will overflow. The sediment dams, which have the potential to overflow to Tangarang Creek, however are managed such that they are emptied as soon as possible after rain. It is also a requirement that the Southern Overburden dams be emptied within 5 days of rainfall events.

The main water supply dam (Dam 1) is located within Tangarang Creek. It provides water to meet the quarry's operational water supply. Water from Dam 1 is reused via a pump and fixed pipe line. Dam 1 receives inflow from the quarry operations as well as overflow from the surrounding farm dams via the three tributaries of Tangarang Creek which enter the site. The dam wall is constructed such that there is an underflow which provides the required 10% environmental flow to Tangarang Creek.

Three new sediment dams, South OB dam A, south OB dam B and South OB dam C, will be constructed prior to the emplacement of material for the Southern Overburden emplacement. These dams are shown on Figure 5.3 in association with each of the relevant catchments.

Table 5.2: Site Dam Details

Name	Dam area (m^2)	Estimated volume (ML)	Associated Catchments	Comments
Dam 1		112 ML	1,2,5,6,7, 8,10	Main water supply dam for the site Dam wall height is 7 m AHD
In pit sump	4	12	2	Collects water in pit
Dam K	2331	9324	1, 2, 6,	Receives water from the pit and processing areas. Discharges to main dam. Used for water tanker
OB east dam	899	2697	3	Sed dam receiving runoff from eastern face of the OB. Pipe in place under overburden and water pumped back to heritage dam. Spillway in place and 2 small sediment traps in case of intense storm overflows
OB north Dam (X)	1913	5739	9	Sed dam receiving runoff from small north portion of OB. Pumped to OB dam east
OB south dam	2317	6951	3, 12	Sed dam receiving runoff from south area of the OB and from farm dam. Water pumped to the heritage dam
Turkeys nest	1674	2511	7	Installed at the south east of the pit. Collects remaining stormwater from open areas to the south east and collected by the clean water diversion drains
Heritage dam	10160	17520	3,4	Overflow from the haul road dam – end point for water collection. Runoff from the stripped heritage areas and remaining vegetation
OB west dam	354	354	8	Small dam collecting runoff from clean water diversion drain
Haul road dam	1745	1745	3,4	Collects water from internal OB haul road and other dams

Name	Dam area (m^2)	Estimated volume (ML)	Associated Catchments	Comments
Dam W1	459	1377	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation
Dam W2	459	1377	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation
Dam W	180	540	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation. Geofab installed on the face of the dam wall initially to ensure clean water discharge
Dam V	720	2160	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation
Dam V1	459	1377	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation
Dam U	437	1377	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation
South OB Dam A	400	0.8	A	To be installed prior to the emplacement of material for the southern overburden
South OB Dam B	600	1.8	B	To be installed prior to the emplacement of material for the southern overburden
South OB Dam C	280	0.6	C	To be installed prior to the emplacement of material for the southern overburden

5.2.4 Potable Water

Potable water is used for toilet and hand-washing, dishwashing, showering and drinking. The site is not connected to a reticulated potable water supply and as such water is purchased and delivered to site by a water tanker. Potable water is stored in a dedicated tank adjacent to the workshop and office. Certificates to validate the quality of the water are provided annually.

5.2.5 Production Bore

The production bore has not been used since construction of Dam 1 in 2012 however 15 ML of water per annum can be utilised if needed.

5.2.6 Waste Water Sewage Management

Sewage is managed onsite via an Aerated Wastewater Treatment System (AWTS) with land application to an aboveground transpiration bed.

An onsite wastewater report for the proposed effluent management system consistent with the requirements of *WaterNSW – "Developments in Sydney's Drinking Water Catchment" – Water Quality Information Requirements, 2011* was prepared by Harris Environment Consulting in 2012 in accordance with the requirements of CoA 23A. The report is provided in Appendix B. The effluent management system was constructed in 2013 in accordance with this report. An approach has been

made to Goulburn Mulwaree Council to review the operation of the system. Routine maintenance and review of the system is undertaken in accordance with the requirements of the wastewater report.

The location of the absorption trench will be assessed during 2017. The construction of the western Overburden will be in the same footprint so an investigation as to the operation of the trench in this location will be required. Should it be decided to move the trench this will be done in consultation with Council.

5.2.7 Reuse Process Water System

Water for operational purposes is provided by a pump located on a gantry at the eastern end of Dam 1. Water is delivered to the site via pipework underbored through the rail line and routed throughout the site. Two separate reticulated water systems for the fire fighting system and the process water system are in place on site.

Site process water use is summarised in Table 5.3 and depicted on Figure 5.1.

Table 5.3: Site Process Water Usage

Area	Operation	Water application	Frequency
In pit	LT160	Water sprays on feeder to suppress dust from feeding and initial crushing of materials.	Water sprays are operational when the LT160 is in operation
	Raw material stockpiles	Water cart or sprinklers to wet material if fines and dust are present. Not usually required once ”clean rock “ is being processed	As required
	Overburden excavation	Water cart used to suppress dust during excavation. Water sourced from nearest available dam.	Usage determined on weather and work
	Vehicle movements	Water cart used to suppress dust during vehicle movements. Water sourced from nearest available dam.	Usage determined on weather and work
Primary	Surge stockpile	Water is applied to materials at the base of CV199 as well as the head of CV199 where rock discharges to the surge stockpile.	Water sprays are operational as required. This is dependent on the “dampness of the material being processed.
Crushing and screening	Crusher	Water is applied to materials as it is discharged from the surge to the conveyors transporting the materials to the crusher	Water sprays are operational as required. This is dependent on the “dampness of the material being processed.
	Screening	A water based dust suppressant (Polo Citrus) is applied to key parts of the screening process.	Polo citrus is applied as required. This is dependent on the “dampness of the material being processed.
	Filler	Water is applied to the filler dust as it is pugged to make the material easy to handle	Operational at all times associated with the discharge of the filler dust
	Wash down	Water is used for cleaning within in the operations.	As required
Train load out	Loading of trains	Application of 3% water to product to maintain moisture during travelling and minimise dust	Every wagon during loading

Area	Operation	Water application	Frequency
	Wash down	Water is used for cleaning of spillages	As required
Road and open area dust suppression	Water cart	Water is applied to the roads and open areas.	Managed through the use of Weatherzone forecasting system and as required.
	Conveyor sprays	Sprays located on the underside of conveyors parallel to roads to suppress dust	As required
Vehicle and equipment washing	Car wash	Light vehicle car wash for the use of staff	Main use at change of shift
	Workshop	Wash down bay in place to clean equipment and vehicles prior to maintenance	There is limited use of the wash bay as minimal vehicles used on site. Possibly 3 times a week
	Tray decontamination	Wash out of truck trays is required to ensure there is no cross contamination of materials when product is moved on the quarry.	Dependent on need to load train manually and stockpile of product
Fire Management system	Processing plant operations	Fire fighting	Minimal – sometimes used for wash down

5.3 Surface Water Management for the Southern Overburden Emplacement

The Southern Overburden Emplacement is located to the south east of the Peppertree quarry on a ridge above the Barbers Creek gorge as shown in Figure 5.3. The drainage arrangements for the Southern Overburden Emplacement will follow the same principles applied across the quarry.

As shown in Figure 5.3, runoff is directed as follows:

- Catchments A, B and C will drain eastwards to three small sediment basins that overflow to existing drainage lines to Barbers Creek;
- Catchments D and E will drain overland to an existing drainage line that drains towards the north pit of the Limestone Mine; and
- Catchment F will drain (or be pumped) overland north towards the Quarry Pit.

The water management system for the Southern Overburden Emplacement approved under Modification 4 includes appropriately designed and managed landforms, conveyance systems and sediment basins. The conveyance system will follow the same general principles as for the existing Quarry, including:

- Constructing sediment basins at the locations on the eastern side of the emplacement where runoff would drain to Barbers Creek. These basins would be sized to comply with the requirements for basins that discharge to 'sensitive' receiving environments in accordance with Table 6.1 in *Managing Urban Stormwater: Soils & Construction, Volume 2E – Mines and Quarries* (DECC, 2008);
- Operation of the sediment basins to restore the 'capture capacity' of each basin within 5 days of the end of a storm event either by re-use of the water for dust suppression or irrigation, or transfer of the water to the quarry pit, from where water would be managed in accordance with the WMP; and

- Sediment control fencing on the western side of the emplacement where runoff will drain to the northern pit of the adjacent Limestone Mine.
- Will include appropriate scour protection at discharge points to ensure the potential for erosion and transport of sediment to downstream waters is minimised.

Detailed drawings of the water management system will be prepared prior to the construction of the Southern emplacement dams and drainage system. This will ensure the water management system meets the requirements of the Blue Book and erosion and sediment controls such as scour protection is identified.

All sediment controls including the dams will be installed prior to the construction of the emplacement materials.

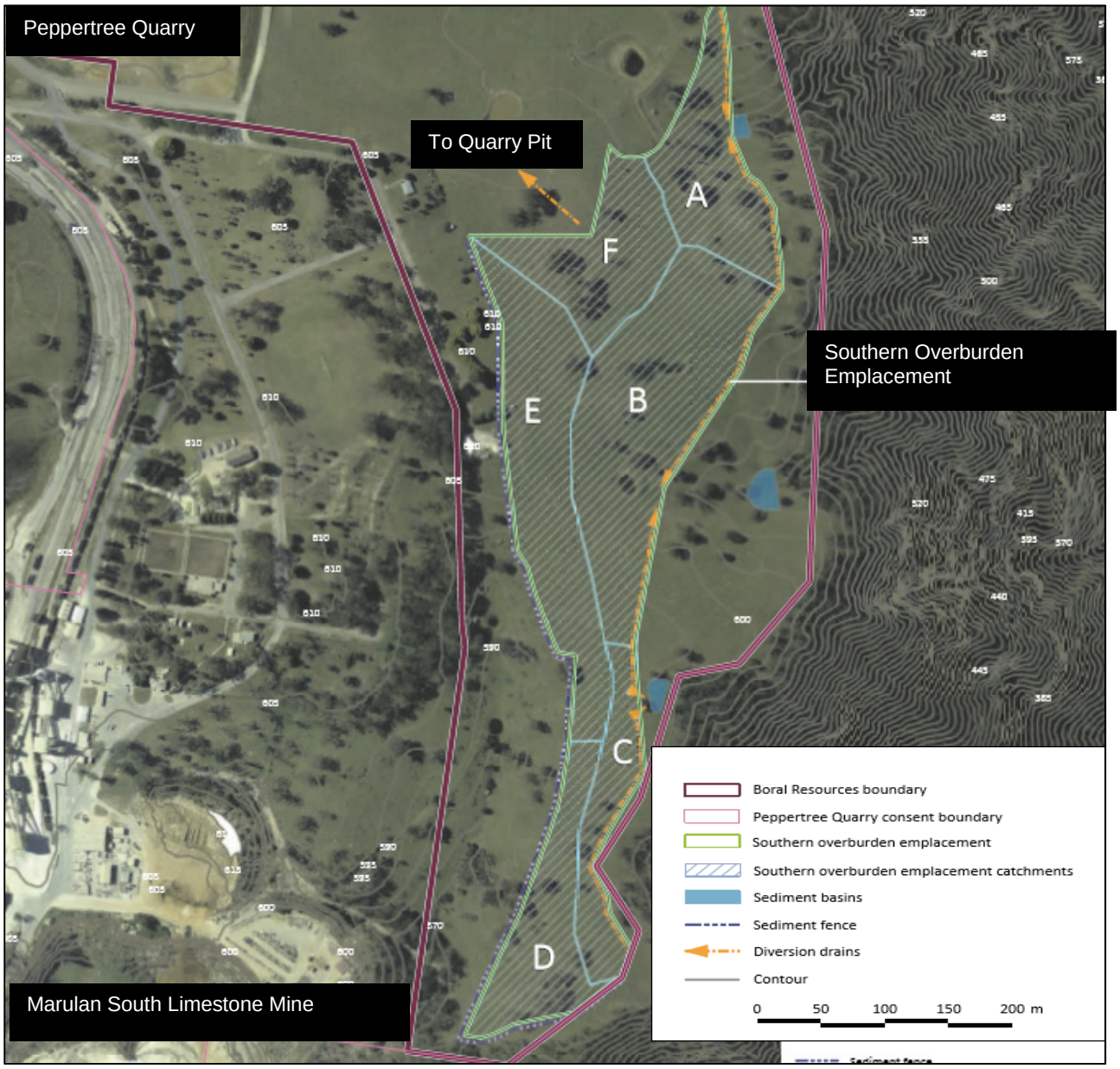

Figure 5.3: Southern Overburden Emplacement Surface Water Management

5.4 SITE WATER BALANCE

In accordance with the requirements of CoA 26, a water balance analysis has been carried out for the Quarry based on the operational systems and water use. The water use figures are based predominantly on assessment of usage and knowledge of flow rates of sprays and piping. Water usage is generally not metered or recorded at individual locations. The water balance is based on operational data collected during the 2015 – 2016 period.

Table 5.4 shows indicative annual water availability for the Quarry. Table 5.5 shows the process water demand.

Table 5.4: Quarry Water Availability (2015 - 2016 data)

Water Source	Indicative annual water availability (ML)
Dam 1	145
Production Bore	15
Total water availability per annum	160

Table 5.5: Quarry Water Demand and Discharge

Area	Operation	Indicative annual water usage (ML)
In pit	LT160	Not determined separately
	Raw Material stockpiles	Refer water cart
Primary	conveyors	0.15
Crushing (STQ)	Tunnel	0.15
	Polo citrus application	2.9
	cool fog application	1.2
Train Load out	Product moisture	50
Road and open area dust suppression	Water cart	38
Fire suppression system		
Total water usage per annum		92.40

Based on the estimates, the total non-potable annual water demand for the operations is estimated as 92.40 ML.

Water applied to the product leaving the site is the highest water demand at 50 ML per annum.

The water cart is estimated to use a minimum of 38 ML per annum. The Cart sources its water from the sediment and out of pit dams depending on the water volumes available after rain. There is an estimated volume of 44,000 m^3 available. It does not use water from Dam 1.

Disregarding the water used for the water cart, as it sources its supply from sediment dams, the quarry utilised 54.40 ML in the operations, sourced from Dam 1.

An environmental flow to Tangarang Creek is also required. This flow is directly measured downstream of Dam 1 with a flow meter. This was measured at 94.28 ML for the 2015-2016 period.

The amount of water entering Dam 1 over the same period was measured at 51.3 ML.

During 2017, water meters are being installed at a number of sites to better understand the inflow and usage of water. These sites include the in pit sump pump, Dam K discharge to Dam 1 and the Dam 1 pump back to the production water tank.

A log book will be utilised to capture water cart data. A review of the environmental flow monitoring to Tangarang Creek is also proposed to confirm measurements

Monitoring should commence in June with the updated water balance available in the 2017 AEMR.

5.5 EXTREME RAINFALL EVENT MANAGEMENT

An extreme rainfall event procedure, based on a commercially available weather forecasting dashboard, is used to predict meteorological conditions that may generate extreme dust and rain events. The implementation of the procedures enables Boral to proactively prepare for and manage extreme weather events. Based on the level of an alert, controls and contingencies for stormwater management are effectively and efficiently implemented. Boral has trained staff and developed procedures to take appropriate levels of action based on the dashboard predictions.

The procedure for extreme rainfall event management is contained in Appendix C.