APPENDIX G

Revised Surface Water Impact Assessment

AUSTRALIAN RESOURCE DEVELOPMENT GROUP

Revised Surface Water Impact Assessment

Stone Ridge Quarry

NC3013_001-REP-001-2

5 MARCH 2024

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Rev	Date	Description	Author	Reviewer	Project Mgr.	Approver
0	31/01/2024	Draft Issue	Chris Bonomini	Adam Wyatt	Chris Bonomini	Adam Wyatt
1	28/2/2024	Draft Issue	Chris Bonomini	Adam Wyatt	Chris Bonomini	Adam Wyatt
2	5/3/2024	Client Issue	Chris Bonomini	Adam Wyatt	Chris Bonomini	Adam Wyatt
Signatures:						

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1. INTRODUCTION

1.1 Background

The Stone Ridge Quarry Project (the Project) is proposing to access a high quality, hard rock resource suitable for producing a wide range of quarry products for the construction material market. If approved, the Project will produce up to 1.5 million tonnes per annum (Mtpa) of quarry product over an initial 30-year quarrying period.

The Project is a State Significant Development (SSD 10432) under the State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP) as proposed extraction will exceed 500,000 tonnes per year. A development application (DA) for the Project is required to be submitted under Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

In response to feedback from Government Agencies and the Community the conceptual quarry layout has been refined to amend the quarry design and associated water management infrastructure which reduces the overall associated disturbance area. This revised Surface Water Impact Assessment (SWIA) assesses the potential impacts associated with the revised conceptual quarry layout and has been prepared to support the Amendment Report for the Project. This report replaces the SWIA submitted with the Project Environmental Impact Statement (EIS) (Appendix 10).

1.2 Project Overview

The Project is located within Wallaroo State Forest at Balickera, NSW, approximately 30 km north of Newcastle. Wallaroo State Forest is located on the northern side of the Pacific Highway, and extends from Italia Road, in the west, to the Karuah River in the east. The Project Area covers 139 ha in the western part of Wallaroo State Forest (see Figure 1.1), immediately adjacent to Italia Road and to the immediate northeast of Boral's Seaham Quarry, which has been in operation since 1991.

The Project Area is located fully within the boundary of the licence area and comprises the portion of the licence area within which quarry operations will occur. The revised conceptual quarry layout is shown in Figure 1.2.

The cadastre of the Project Area is described as follows:

- Lots 36 and 65 DP 753200
- Lot 1 DP 724372
- Part Lot 540 DP 1207159.

All lots are located on land managed by FCNSW.

The Project Area is located within the Grahamstown Dam and Williams River catchments. Both Grahamstown Dam and the Williams River are part of Hunter Water's drinking water catchment and as such, any development within the catchments must have a neutral or beneficial effect (NorBE) on water quality.

The construction phase of the Project consists of earthworks and clearing of vegetation for site preparation to enable access to target resources and development of the quarry extraction area. Construction of a weighbridge and associated administrative buildings combined with the installation of on-site processing plant and associated equipment are also required to facilitate the Project. A site access point off Italia Road would also need to be constructed. A summary of the of key Project aspects is provided in Table 1.1.

TABLE 1.1: SUMMARY OF KEY PROJECT ASPECTS

Aspect	Proposed for the Project
Project life	30 years
Limits of production	Up to 1.5 Mtpa of quarry product/sales per year
Project Area	Approximately 139 ha (including extraction, processing and stockpiling area and buffers), with a disturbance area of approximately 68 ha
Extraction method	Drill, blast, load and haul
Material processing	Processing on site with provision for both mobile crushing and screening plant, as well as modular/fixed processing plant
Overburden management	Overburden will be minimal and any topsoil and overburden will be stockpiled on site for use in rehabilitation
Product	Concrete, asphalt and sealing aggregates, gabion, armourstone, roadbase and other crushed rock products
Product transport	Road transport of up to 1.5 Mtpa of product via the Pacific Highway
Site access	1.5 Mtpa equates to average of 334 heavy vehicle movements (167 inbound and 167 outbound) each day (based on the transportation of materials using truck and dog combinations with a typical capacity of around 30 tonnes)
Employment	Construction: 10 to 15 full time employees Operation: Up to 10 full time employees, 3 to 5 part-time employees
Hours of operation	Construction: • 7.00 am to 6.00 pm Monday to Friday • 8.00 am to 1.00 pm Saturday • No work on Sunday or Public Holidays Operation: • Quarrying and processing - 7.00 am to 6.00 pm Monday to Friday, and 7.00 am to 3.00 pm Saturdays • Truck loading, product transport and maintenance - 6.00 am to 10.00 pm Monday to Friday, and 7.00 am to 3.00 pm Saturdays • No operation on Sundays or Public Holidays apart from maintenance activities as required
Rehabilitation and final landform	Rehabilitation will be undertaken progressively where appropriate in the context of further resources remaining available in the Project Area at the end of the planned 30-year approval life. A conceptual final landform will be prepared for the Project.

1.3 Secretary's Environmental Assessment Requirements

Table 1.2 presents the SEARs relating to the surface water and where each element is addressed in this SWIA report.

TABLE 1.2: SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Requirement	SWIA Section(s) where addressed
The Environmental Impact Statement (EIS) for the development must comply with the requirements in Clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000. In particular, the EIS must include: • A full description of the development, including: - a water management strategy;	Section 3
The EIS must address the following key issues: • Water – including:	
- a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures;	Sections 3 and 4
- identification of any licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000;	Section 7.1
- demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP);	Sections 4, 6.2.2 and 7.1
- a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo;	Section 6.2.2
- an assessment of any likely flooding impacts of the development;	Section 6.2.4
- an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives;	Section 6
- an assessment of the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, the Grahamstown Dam drinking water catchment, Balickera Channel, Balickera Tunnel and any other related infrastructure, and other water users; and	Section 6
- a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts;	Section 3 and Section 7.2

1.4 Agency Advice

Agency advice in regarding the original EIS relating to surface water that requires addressing in this revised SWIA was received from DPE's (now Department of Climate Change, Energy, the Environment and Water (DCCEEW)) Biodiversity and Conservation Division (BCD) as well as DPE Water (now DCCEEW Water). Following is BCD's comment and associated recommendation which are addressed in Section 3.3of this revised SWIA:

> ***11. The proposed sedimentation basins appear to be located within a waterway***
>
> *The proposed plans suggest that sedimentation basin SW1 is to be constructed in a 2nd order stream. This is not in line with best practice, which is to locate pollution controls offline, away from waterways. This is to prevent pollutants from being remobilized by high flows and to protect property, people, and the environment in the event of a failure.*
>
> ***Recommendation 11***
>
> *The sediment basin SW1 should not be located within a waterway.*

DCCEEW Water advice and the section(s) where the advice is addressed in this SWIA (or other studies/reports that have been prepared as part of the Project approvals process) are presented in Table 1.3.

TABLE 1.3: DPE WATER ADVICE

DPE Water Recommendation	DPE Water Explanation	SWIA Section(s) where addressed
1.0 Water licensing and take		
1.1 Recommendation – Prior to approval That the proponent clarifies the volume to be obtained for a water access licence noting this must cover the maximum potential water take, and demonstrate the ability to obtain entitlement in accordance with the requirements of the NSW Aquifer Interference Policy.	Based on the EIS predictions, groundwater take is between 26.7 ML/year and 183.9 ML/year for the Main Pit and between 6.1 ML/year and 42.4 ML/year for the Northern Pit during stage 8 (section 6.5.2.3 of the EIS). This would result in a maximum of 226.1 ML/year. An additional maximum potential take of 134 ML/year from a proposed bore is also noted. However, the proponent notes the proposal to obtain a water licence for between 33 ML/year and 57 ML/year (Section 6.5.2.3 of the EIS and noting this conflicts with 27-47 ML/year stated in Appendix 10) which would be insufficient to account for the maximum predicted water take as required by the NSW Aquifer Interference Policy. The relevant water source to obtain entitlement is the New England Fold Belt Coast Groundwater Source.	Section 4.4.3 and the Stone Ridge Quarry Groundwater Impact Assessment Version 2 (GHD, 2024)
1.2 Recommendation – Prior to approval That the proponent provides an assessment of the ability to obtain the proposed water supply volume from a bore to meet the water supply requirements of the project.	No assessment has been provided to confirm the availability of the 134ML/year water demands from a bore proposed for the project. The information in the Groundwater Impact Assessment (Appendix 10) indicates indicative bore yields of less than 1 L/s and has not clearly demonstrated the security of water supply. This represents a significant risk for the project.	Section 6.2.2 and the Stone Ridge Quarry Groundwater Impact Assessment Version 2 (GHD, 2024)
1.4 Recommendation – Prior to approval That the proponent confirms the design of the sediment dams meets the criteria to be exempt from a water access licence.	Sediment dams must be solely for this purpose to meet the exemption listed in Schedule 1 Clause 3 of the Water Management (General) Regulation 2018. According to Table 3.1 of the Surface Water Assessment these will be a higher capacity than is required by the Managing Urban Stormwater guide so confirmation that they meet this exemption is requested.	Section 7.1.2.1
1.5 Recommendation – Post approval That works within waterfront land are designed and constructed in accordance with the Guidelines for Controlled Activities on Waterfront Land (DPE 2022).	The proposed development includes works on waterfront land (including the quarry, outlets and roads) which will need to be designed and constructed in accordance with the Guidelines for Controlled Activities on Waterfront Land found at https://water.dpie.nsw.gov.au/licensing-and-trade/controlled-activity-approvals/guidelines	Section 6.3
1.7 Recommendation – Post approval The proponent must ensure sufficient water entitlement is held in a water access licence/s to account for the maximum predicted take for each water source prior to take occurring.	-	Sections 4.4.3, 6.2.2 and the Stone Ridge Quarry Groundwater Impact Assessment Version 2 (GHD, 2024)

1.5 Scope

The scope of the revised SWIA is to:

- update the conceptual water management system (WMS) design to address the changes associated revised conceptual quarry layout;
- update the operational water balance model to reflect the WMS design for the revised conceptual quarry layout;
- update the NorBE assessment based on discharge volumes (controlled and uncontrolled discharges) predicted by the revised operational water balance model; and
- assess and document the impacts to surface water resources associated with the Project for the revised conceptual quarry layout.

FIGURE 1.1: PROJECT LOCALITY (SOURCE: UMWELT 2024)

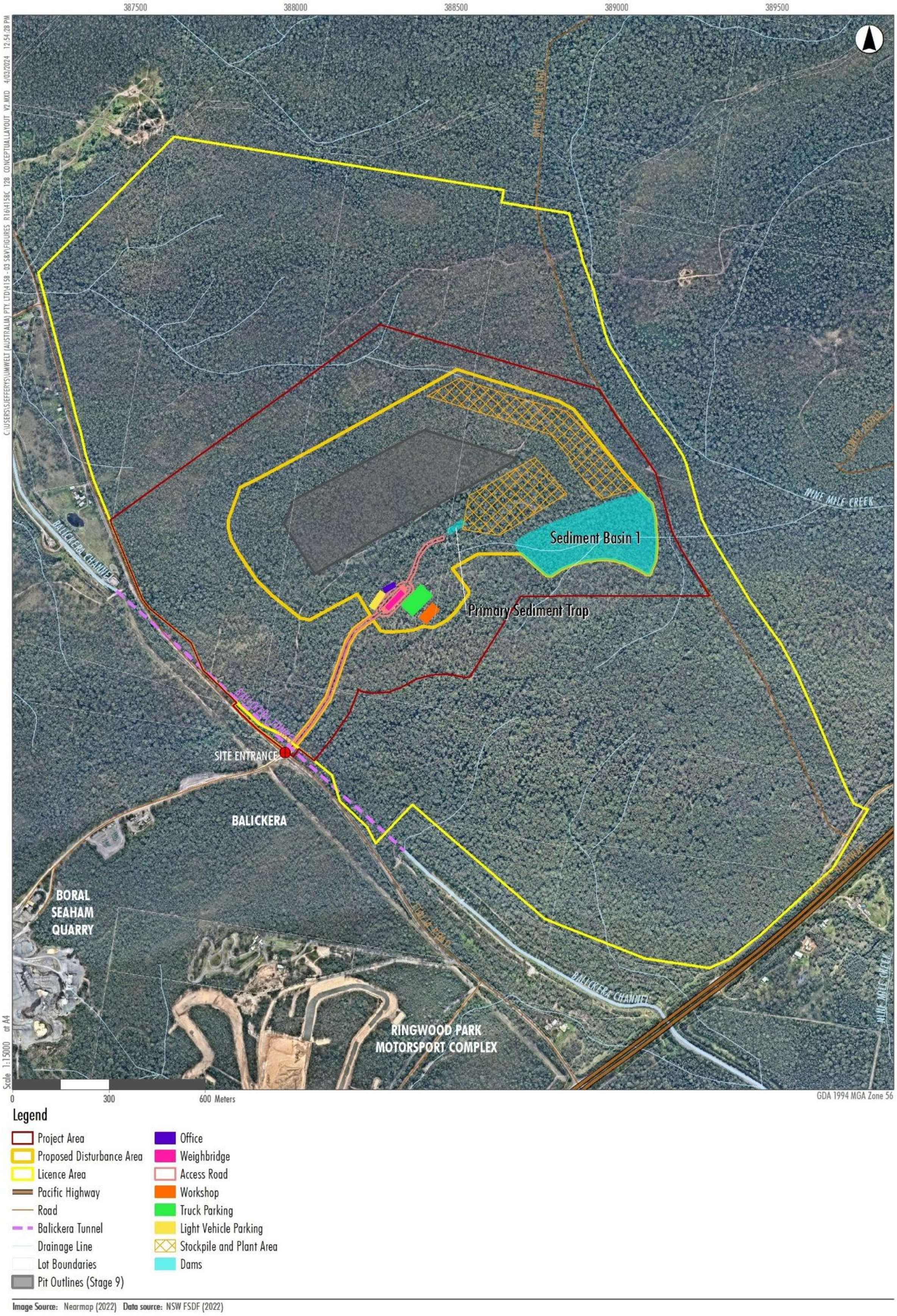


FIGURE 1.2: REVISED CONCEPTUAL PROJECT LAYOUT (SOURCE: UMWELT, 2024)

2. SURFACE WATER CONTEXT

The Project is within the Grahamstown Dam catchment and the Williams River catchment which are both part of Hunter Water's drinking water catchment. Grahamstown Dam has a total catchment area of approximately 115 km^2 (Hunter Water, 2022) and provides approximately 40% of the Hunter's potable water demand and meets up to 75% of daily supply requirements. Inflows to Grahamstown Dam are via catchment rainfall runoff inflows as well as extraction from the Williams River via the Seaham Weir Pumps and the Balickera Pump Station. The Balickera Pump Station transfers water from the western side of Balickera Canal to the eastern side of the canal which drains to Grahamstown Dam (refer to Figure 2.1).

The Williams River has its headwaters in the Barrington Tops forests with the remainder of the catchment consisting primarily of agricultural land and rural townships (Hunter Water, 2017). The Williams River has a catchment area of approximately 974 km^2 and is a tributary of the Hunter River which has a total catchment area of approximately 21,500 km^2. Water is transferred from the Williams River at the Seaham Weir into Balickera Canal and provides approximately 50% of the inflows to Grahamstown Dam (Hunter Water, 2017).

The Project Area catchment is typically steep, covered with woodland areas and has historically been utilised for forestry activities. Vegetation density across the Project Area varies but is considerably less dense on the upper slopes where soils are skeletal and much of the surface is dominated by weathered rock.

Catchment inflows to Grahamstown Dam primarily drain from the northern and eastern shores of the dam. Approximately 75% of the total catchment runoff to Grahamstown Dam is received from the north, and inflow from the eastern catchment is received from the urban settlement of Medowie through the Campvale Swamps and into the dam via the Campvale Pump Station (Hunter Water, 2022). Water sourced from the Williams River is pumped into the Balickera Canal at Seaham Weir and then raised approximately 15 m at the Balickera Pump Station into the eastern end of Balickera Canal which drains into the northern end of Grahamstown Dam.

The north-western part of the Project Area drains either Balickera Canal or to ephemeral tributaries of Caswells Creek. Caswells Creek drains to Balickera Canal upstream of the Balickera Pump Station. Runoff from the eastern part of the Amended Project Area drains to Nine Mile Creek, a fourth order stream that drains under Nine Mile Road and the Pacific Highway prior to discharging into the northern end of Grahamstown Dam approximately two kilometres southeast of the Amended Project site.

Further detail regarding the Project locality environmental setting including topography, soils, climate, surface water users and baseline receiving water quality is provided in the SWIA submitted with the Project EIS (Umwelt, 2023).

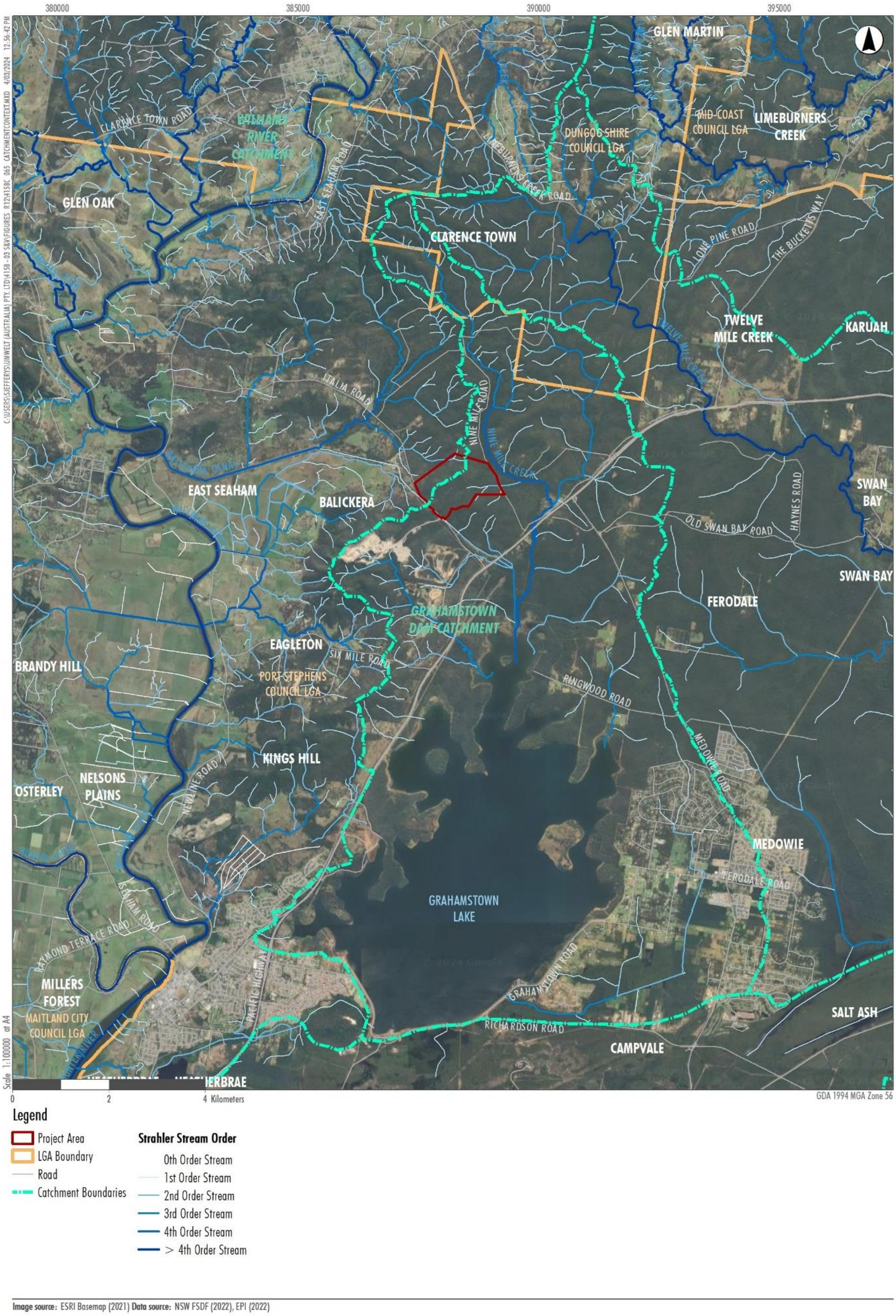


FIGURE 2.1: CATCHMENT CONTEXT (SOURCE: UMWELT, 2024)

3. WATER MANAGEMENT

A conceptual operational Water Management System (WMS) has been developed for Stage 1 and Stage 9 of the revised conceptual quarry operation. The conceptual WMS strategy is to:

- direct undisturbed catchment runoff around disturbed operational areas, where practicable, to minimise the quantity of dirty water runoff to be managed;
- contain and reuse as much dirty water runoff from disturbed operational areas as possible to minimise import demands;
- minimise the volume and frequency of controlled discharges from the WMS to the receiving environment;
- minimise the risk of uncontrolled discharges from the WMS in storm events not exceeding the 24-hour duration, 0.2% Annual Exceedance Probability (AEP) storm event (i.e. the 24 hour duration, 500 year Average Recurrence Interval storm event); and
- treat water prior controlled discharge to an appropriate standard to as far as practicable ensure the average total pollutant loads in controlled and uncontrolled discharges have a NorBE on water quality when compared to pre-development Project site runoff pollutant loads.

The SWIA submitted with the Project EIS (Umwelt, 2023) provides details of the proposed erosion and sediment controls during all phases of the Project, including the construction phase and progression of the quarry disturbance footprint, which remain valid for the amended quarry design.

3.1 Conceptual Stage 1 Water Management System

The conceptual Stage 1 WMS has an area of approximately 30 ha and includes the features presented in Table 3.1. Plan and schematic drawings of the conceptual Stage 1 WMS are presented in Figure 3.1 and Figure 3.2 respectively.

Notwithstanding the preliminary proposed water storage capacities indicated in Table 3.1, different water storage capacities may be determined during detailed Project design. However, installed water storages will have adequate capacity to contain runoff from the 24-hour duration, 0.2% AEP storm event. Further, water storages will have adequate capacity such that they are not predicted to spill under the historical climatic conditions modelled in the operational water balance (refer to Section 4).

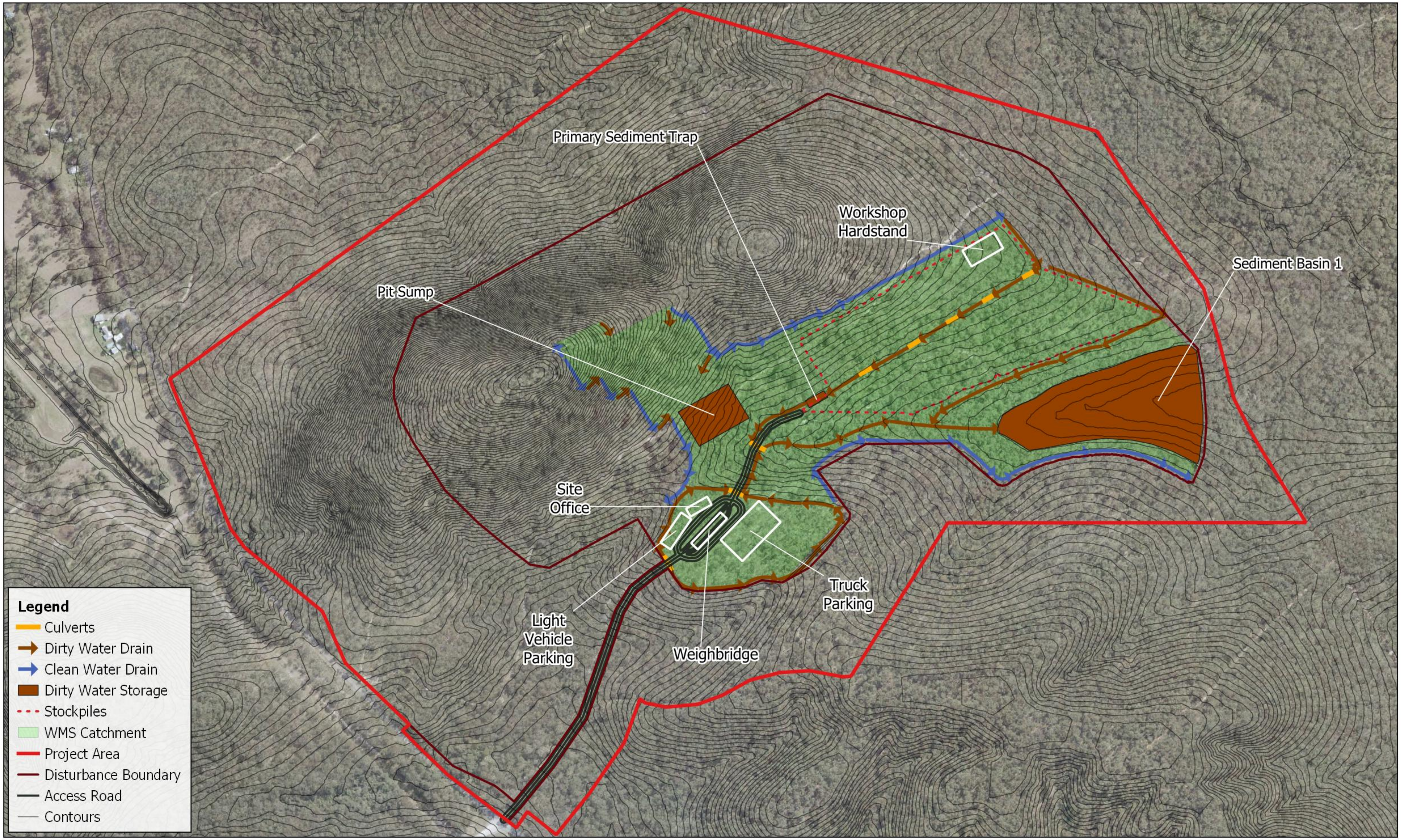
TABLE 3.1: STAGE 1 WMS COMPONENTS

Item	Functional Description	Preliminary Proposed Minimum Capacity
Pit Sump	• Capture runoff from the western portion of the Pit. • Serve as surge storage capacity during wet periods (i.e. will receive transfers of surplus water from Sediment Basin 1).	86 ML
Primary Sediment Trap	• Capture coarse sediment in runoff from the processing plant area before it drains to SB1. • Will operate as a flow through sediment trap. • Additional sediment traps may be constructed in the processing and stockpile areas to reduce SB1 sediment loads.	0.2 ML
Sediment Basin 1 (SB1)	• Constructed on a second order tributary of Nine Mile Creek. • Capture runoff from the stockpile areas and carpark, office/amenities and weighbridge and overflow from the Primary Sediment Trap. • Primary site water storage and supply for operational demands. • Sized to minimise the risk of uncontrolled discharges in storm events not exceeding the 24-hour duration, 0.2% AEP storm event (as specified by Hunter Water). • Exceeds the required capacity determined in accordance with the Blue Book of 22.8 ML (15.2 ML settling zone[1] and 7.6 ML sediment zone[2]). • Will be managed to maintain a storage inventory of at least 15 ML but with a target maximum operating capacity of approximately 20 ML to minimise the risk of uncontrolled discharges. • Should water inventories exceed the required freeboard to accommodate the Blue Book settling zone capacity (i.e., 15.2 ML), SB1 will be dewatered to ensure freeboard is restored within five days of runoff generating rainfall. • Water inventory to be managed, in the following order of priority, through supply of operational demands (material processing and dust suppression), irrigation of undisturbed Project Area catchments and controlled discharges. Irrigation will be applied within the Project area at a rate that does not result in runoff to local drainage lines.	110 ML
Clean Drains	• Direct runoff from undisturbed catchment upslope of SB1 around SB1.	To be determined during detailed design phase
Licensed Groundwater Bore	• To supply water to meet operational demands during dry periods.	Up to 87 ML/year
Water Treatment Plant	• Removal of suspended solids and nutrients prior to controlled discharge. • Water treatment plant technology to be confirmed during Project detailed design phase.	Up to 65 ML/year

Notes

[1] Settling zone capacity based on runoff from the Newcastle 5 day 95th percentile rainfall depth of 76.7 mm sourced from the Blue Book

[2] Sediment zone equal to 50% of the settling zone capacity



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0 100 200 m

Scale in metres (1:5,500 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

Stone Ridge Quarry SWIA
Figure 3.1 - Stage 1 Water Management System

Job Number: NC3013_001
Revision: 0
Drawn: GC
Checked: CB
Date: 25 /1 /2024

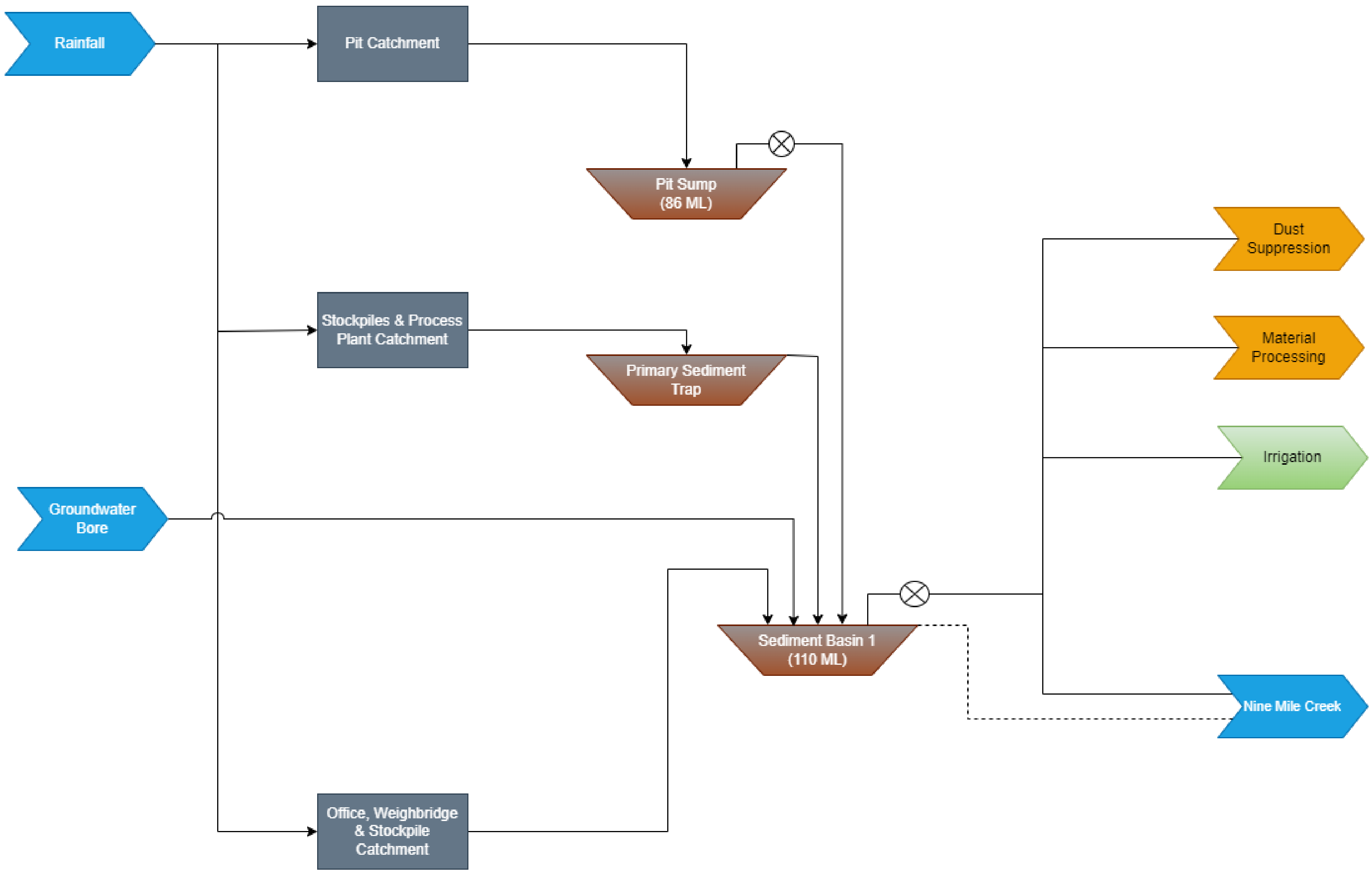


FIGURE 3.2: STAGE 1 CONCEPTUAL WATER MANAGEMENT SYSTEM SCHEMATIC

3.2 Conceptual Stage 9 Water Management System

The conceptual Stage 9 WMS has an area of approximately 62 ha and is generally the same as the conceptual Stage 1 WMS but includes increased storage within the Pit Sump as well as some changes to the clean water drainage network as presented in Table 3.2. Plan and schematic drawings of the conceptual Stage 9 WMS are presented in Figure 3.3 and Figure 3.4 respectively.

Notwithstanding the preliminary proposed water storage capacities indicated in Table 3.2, different water storage capacities may be determined during detailed Project design. However, installed water storages will have adequate capacity to contain runoff from the 24-hour duration, 0.2% AEP storm event. Further, water storages will have adequate capacity such that they are not predicted to spill under the historical climatic conditions modelled in the operational water balance (refer to Section 4).

TABLE 3.2: STAGE 9 WMS COMPONENTS

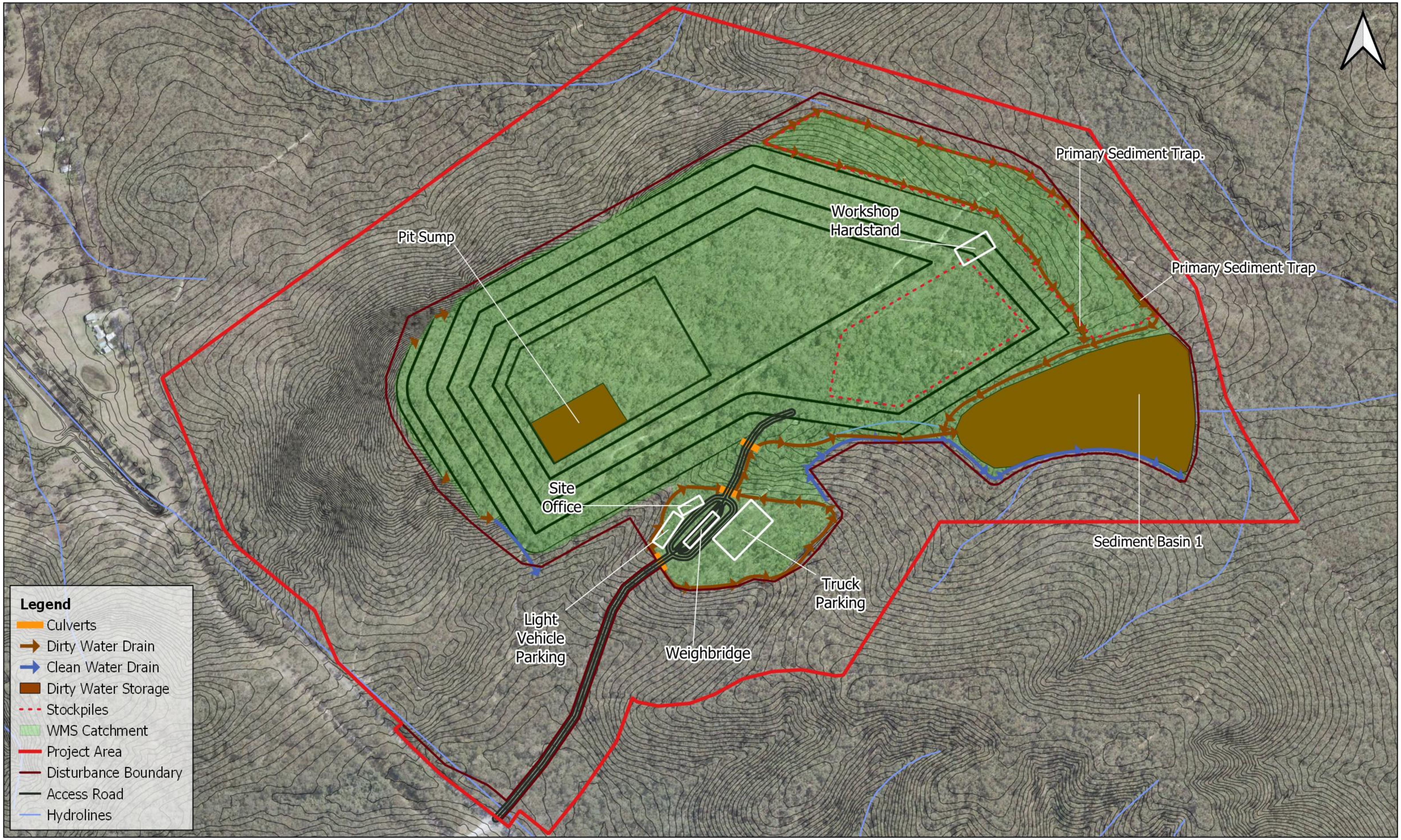
Item	Functional Description	Preliminary Proposed Minimum Capacity
Pit Sump	• Capture runoff from the western portion of the Pit. • Serve as surge storage capacity during wet periods (i.e. will receive transfers of surplus water from Sediment Basin 1).	100 ML[3]
Primary Sediment Traps	• Capture coarse sediment in runoff from the processing plant area before it drains to SB1. • Will operate as a flow through sediment traps. • Additional sediment traps may be constructed in the processing and stockpile areas to reduce SB1 sediment loads.	0.2 ML (pre sediment trap)
Sediment Basin 1 (SB1)	• Constructed on a second order tributary of Nine Mile Creek. • Capture runoff from the stockpile areas and carpark, office/amenities and weighbridge and overflow from the Primary Sediment Trap. • Primary site water storage and supply for operational demands. • Sized to minimise the risk of uncontrolled discharges in storm events not exceeding the 24-hour duration, 0.2% AEP storm event (as specified by Hunter Water). • Exceeds the required capacity determined in accordance with the Blue Book of 18.8 ML (12.5 ML settling zone[1] and 6.3 ML sediment zone[2]). • Will be managed to maintain a storage inventory of at least 15 ML but with a target maximum operating capacity of approximately 30 ML to minimise the risk of uncontrolled discharges. • Should water inventories exceed the required freeboard to accommodate the Blue Book settling zone capacity (i.e., 12.5 ML), SB1 will be dewatered to ensure freeboard is restored within five days of runoff generating rainfall. • Water inventory to be managed, in the following order of priority, through supply of operational demands (material processing and dust suppression), irrigation of undisturbed Project Area catchments and controlled discharges. Irrigation will be applied within the Project area at a rate that does not result in runoff to local drainage lines.	110 ML
Clean Drains	• Direct runoff from undisturbed catchment upslope of SB1 around SB1.	To be determined during detailed design phase
Licensed Groundwater Bore	• To supply water to meet operational demands during dry periods.	Up to 56 ML/year
Water Treatment Plant	• Removal of suspended solids and nutrients prior to controlled discharge. • Water treatment plant technology to be confirmed during Project detailed design phase.	Up to 286 ML/year

Notes

[1] Settling zone capacity based on runoff from the Newcastle 5 day 95th percentile rainfall depth of 76.7 mm sourced from the Blue Book

[2] Sediment zone equal to 50% of the settling zone capacity

[3] Note that exceedance of in-pit sump capacity will not result in spills to the WMS or environment as surplus water will be contained in the larger pit shell



Scale in metres (1:5,500 @ A3)

Map Projection: Tranverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 56

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Figure 3.3 - Stage 9 Water Management System

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Date: 5 /3 /2024

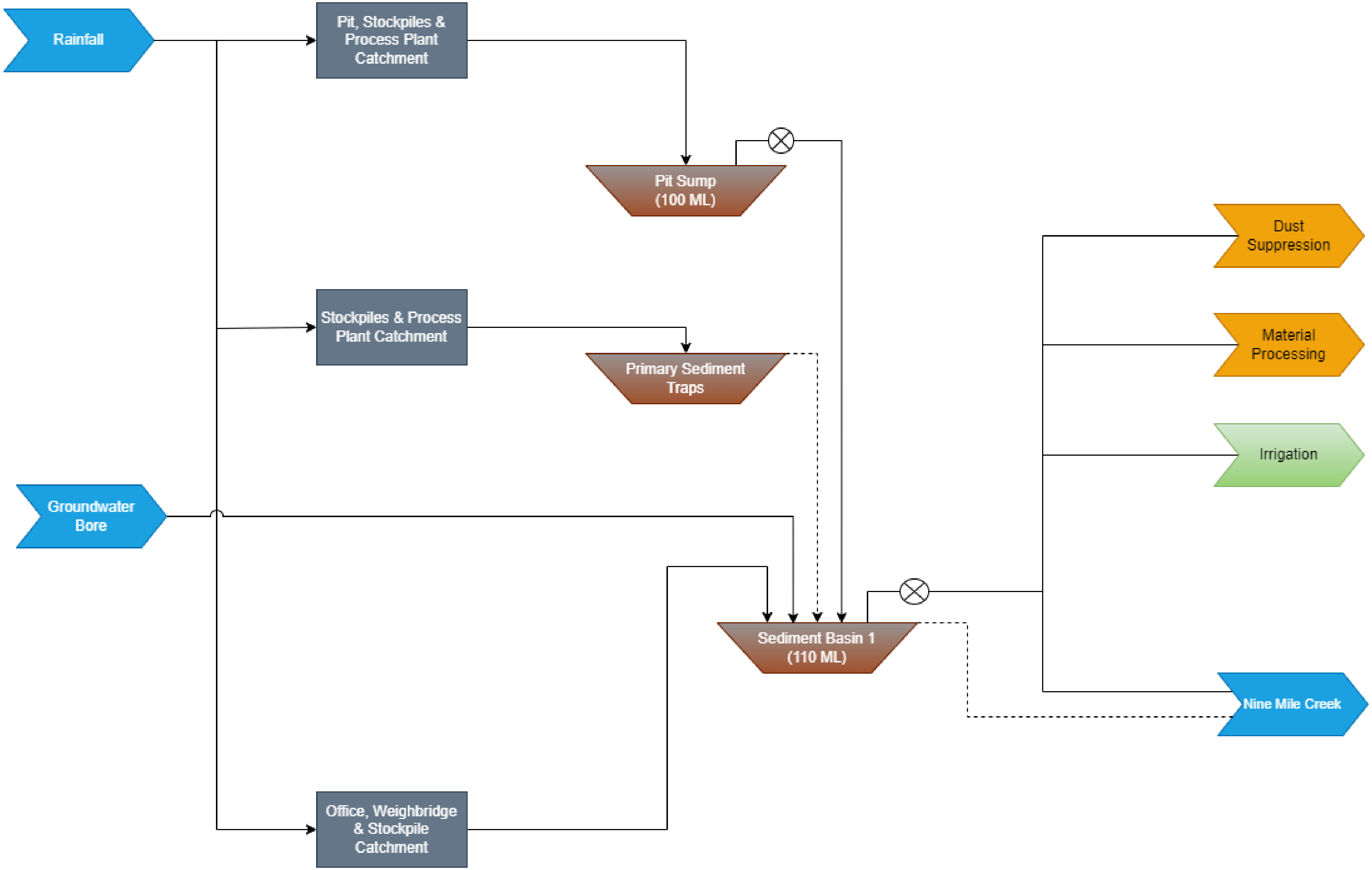

FIGURE 3.4:STAGE 9 CONCEPTUAL WATER MANAGEMENT SYSTEM SCHEMATIC

3.3 Sediment Basin 1 Location

In a submission regarding the location of SB1 as presented in the original EIS and SWIA, DPE's BCD indicated that it is not best practice to locate sediment basins on a watercourse and recommended that SB1 should be relocated to an off-line location. It is acknowledged that the location of SB1 is located on a second order stream. However, it is considered that the location of SB1 on the ephemeral second order stream is justified for the following reasons:

- the basin is located at the top of the catchment and runoff from disturbed areas will in general, naturally drain to this location as the quarry footprint expands with minimal undisturbed catchment upslope of the basin;
- the natural landform provides for the construction of a large capacity dam with limited excavation and the total disturbance footprint associated with SB1 would likely be greater at a location with less favourable topography;
- the basin capacity is large due to containment requirements (0.2% AEP as specified by Hunter Water) limiting potential locations within the proposed disturbance boundary;
- given the large capacity of SB1, the likelihood of uncontrolled releases to the downstream watercourse are considered very low (refer to Section 4.4.4.2 (the primary reason for the preference to avoid the use of higher order streams for sediment basins).

4. OPERATIONAL WATER BALANCE

4.1 Model Overview

The daily time step GoldSim water balance model (the Model) developed for the SWIA submitted with the Project EIS (Umwelt, 2023) has been updated to simulate the performance of the conceptual Stage 1 WMS and conceptual Stage 9 WMS as described in Section 3. Quarry water sources and demands, model input data, assumptions and results are detailed in the following sections.

The reason for modelling the Stage 1 and Stage 9 operating scenarios to assess Project impacts is outlined below:

- Stage 1 represents a period where there is limited available in-pit storage other than the Pit Sump to accommodate surplus rainfall runoff during wet periods and while the WMS catchment area is smaller than in latter stages, the limited in-pit storage capacity results in an increased likelihood of uncontrolled discharges from the WMS. Further, with the limited WMS catchment area and depth of extraction being above the groundwater table, Stage 1 will have the highest demand for external imports during dry periods.
- Stage 9 represents the maximum WMS catchment area and therefore the stage in which the largest volumes of rainfall runoff will require management through reuse and controlled discharges.

Discharge volume predictions from water balance modelling results for Stage 1 and Stage 9 were used to inform the NorBE on water quality assessment (refer to Section 6.1).

4.2 Water Sources and Demands

4.2.1 Water Sources

The modelled quarry water sources are:

- WMS catchment runoff and direct rainfall on water storages; and
- Groundwater sourced from a licensed bore as a supplementary supply.

4.2.2 Water Demands

The modelled quarry water demands are:

- haul road, exposed area and stockpile dust suppression;
- material processing;
- evaporation from water storage surfaces; and
- irrigation of Amended Project Area undisturbed catchment (as a means of disposal of surplus rainfall runoff captured in the WMS and contribute to downstream catchments of higher probability GDE communities).

4.3 Underlying Data and Assumptions

4.3.1 Runoff Model

The Australian Water Balance Model (AWBM) has been applied to estimate catchment runoff using daily rainfall and evaporation records sourced from the SILO Climate Database for the Project Area location (grid point -32.65° latitude, 151.80° longitude) for the period 1 January 1900 to 31 December 2022. Table 4.1 presents the catchment types and AWBM parameters used in the rainfall runoff model contained within the GoldSim water balance model. The AWBM parameters presented in Table 4.1 are unchanged from those applied in the water balance model prepared for the Project SWIA (Umwelt, 2023).

TABLE 4.1: CATCHMENT TYPES AND AWBM PARAMETERS

Catchment	Surface Store Area Split			Surface Store Capacities			BFI[1]	Kb[2]	Ks[3]	Evap %[4]
	A1	A2	A3	C1	C2	C3				
Undisturbed	0.134	0.433	0.433	25.56	261.03	522.06	0.22	0.991	0.5	100
Disturbed	0.185	0.430	0.385	8.11	115.12	257.14	0.05	0.985	0.0	85
Pit	0.185	0.430	0.385	4.05	57.56	128.57	0.05	0.985	0.0	85

[1] Base flow index
[2] Baseflow recession constant
[3] Surface runoff recession constant
[4] Pan factor to potential evapotranspiration

4.3.2 Groundwater Inflows

Groundwater inflows to the Pit are not predicted for Stage 1 as groundwater levels in the quarry area are below the floor level of the quarry during this stage of the Project (groundwater interception is not predicted until Stage 5). A groundwater inflow of 14.3 ML/year (0.04 ML/day) has been applied for Stage 9 of the Amended Project and corresponds to the inflow estimated as part of the Stone Ridge Quarry Groundwater Impact Assessment (GHD, 2023) assuming a 20% fractured rhyodacite resource for Stage 8. It has been assumed that only 50% of the groundwater inflow seepage reports as pumpable flow due to evaporative losses which is consistent with the approach used in the water balance for the SWIA submitted with the Project EIS (Umwelt, 2023).

4.3.3 Site Demands

Site water demands were estimated as follows:

- Evaporation from water storage surfaces has been estimated based on daily evaporation sourced from the SILO Climate Database for the Project Area location (grid point -32.65º latitude, 151.80º longitude) and a pan factor of 0.75.
- Water demands for haul road dust suppression and irrigation have been estimated based on an evaporation – rainfall deficit, that is:
  - if rainfall exceeds pan evaporation, then there is no dust suppression/irrigation demand; or
  - if evaporation exceeds rainfall, the dust suppression demand is equal to pan evaporation minus rainfall with an upper limit of 10 mm/day.
- Process plant water demands for Stage 1 of 1.73 ML/year and for Stage 9 of 2.70 ML/year as provided by ARDG.

4.3.4 Water Storage Operating Levels

The water balance model operating set points were updated with a view to optimising the water storage inventories on site with respect to both:

- minimising imports from the groundwater bore; and
- limiting the volumes and frequency of controlled discharges while ensuring no uncontrolled discharges in storm events less than the 24 hour, 0.2% AEP.

With the reduced WMS catchment areas associated with the conceptual revised Project layout, lesser volumes of water are captured in the WMS and with water storage capacities similar in magnitude to the proposed Project water storage capacities, the WMS water storage inventories can be maintained at higher levels without increased risk of uncontrolled discharges.

4.4 Water Balance Results

4.4.1 Gross Water Balance

Table 4.2 presents the statistical 10th, 50th and 90th percentile gross water balance results (excludes controlled discharges, irrigation and groundwater imports) for the Stage 1 and Stage 9 operating scenarios.

TABLE 4.2: GROSS WATER BALANCE RESULTS (ML/YEAR)

Stage	Minimum	10th Percentile	50th Percentile	90th Percentile	Maximum
Stage 1	-86.4	-38.5	9.5	63.0	179.9
Stage 9	-72.9	9.9	50.1	256.7	465.1

Gross water balance results indicate that the quarry is likely to:

- have a water deficit and a requirement for imports to meet operational demands in dry years for both modelled stages but in particularly Stage 1;
- have limited requirements for discharge in Stage 1 during median rainfall years
- have surplus water and a requirement for discharges for Stage 1 during wet rainfall years
- have surplus water and a requirement for discharges for Stage 9 during median and wet rainfall years.

Table 4.3 presents the average annual volumes of surface runoff captured in the quarry WMS for the Stage 1 and Stage 10 operating scenarios as well as the volume of runoff from equivalent areas (i.e., the Stage 1 and Stage 10 WMS areas) of undisturbed catchment (i.e., the average pre-development runoff).

TABLE 4.3: AVERAGE ANNUAL CATCHMENT RUNOFF CAPTURED IN WMS (ML/YEAR)

Stage	Captured Runoff Volume	Runoff from Equivalent Area of Undisturbed Catchment
Stage 1	91.7	30.0
Stage 9	239.2	62.2

The results presented in Table 4.3 demonstrate the increased runoff potential associated with the disturbed (approximately 2.5 ML/ha/year) and pit (approximately 3.3 ML/ha/year) areas compared to the undisturbed catchment (1.0 ML/ha/year as estimated using the NSW Farm Dams Calculator (WaterNSW, 2022)).

4.4.2 Median Year Net Water Balance

Table 4.4 presents the net water balance results for the modelled rainfall year closest to the gross water balance 50th percentile prediction for the Stage 1 and Stage 9 operational scenarios.

TABLE 4.4: MEDIAN YEAR NET WATER BALANCE RESULTS (ML/YEAR)

Parameter	Stage 1	Stage 9
INFLOWS		
Catchment Runoff	81.0	144.5
Pit Groundwater Seepage	0.0	7.2
Bore Import	21.1	0.0
Total Inflows	***102.1***	***151.7***
OUTFLOWS		
Evaporation	8.1	77.8
Operational Demands	65.3	96.4
Irrigation	17.4	38.1
Controlled Discharges	10.3	0.0
Uncontrolled Discharges	0.0	0.0
Total Outflows	***101.1***	***212.3***
Change in Storage	1.0	-60.6
Net Water Balance	**0.0**	**0.0**

4.4.3 Groundwater Bore Import

Table 4.5 presents the minimum, average and maximum groundwater bore imports required for the Stage 1 and Stage 9 operating scenarios.

TABLE 4.5: PREDICTED GROUNDWATER BORE IMPORTS (ML/YEAR)

Stage	Minimum	10^{th} Percentile	50^{th} Percentile	90^{th} Percentile	Maximum
Stage 1	0.0	0.0	12.8	39.0	86.4
Stage 9	0.0	0.0	0.0	4.8	74.7

While the gross water balance results (refer to Section 4.4.1) indicate that there would likely be years with no requirement to import water from the groundwater bore (i.e. results show surplus water balance in average years for both stages), imports are predicted in all but the driest years for both stages. Given the quarry WMS will operate with a view to minimising water inventories to minimise the risk of uncontrolled discharges, there will be short term dry periods within an overall wet year where demands draw down the minimised stored WMS water inventory. In practise, WMS water inventory may be managed to maintain greater water volumes when short to medium term dry periods are forecast to minimise imports from the groundwater bore.

Notwithstanding the above, ARDG will source sufficient entitlement in the groundwater source to cover the maximum take of groundwater.

4.4.4 Discharges

4.4.4.1 Controlled Discharges

Table 4.6 presents the predicted minimum, average and maximum annual controlled discharge volumes for the Stage 1 and Stage 9 operating scenarios. Table 4.7 presents the predicted average annual number of days that controlled discharges will occur.

TABLE 4.6:PREDICTED CONTROLLED DISCHARGES (ML/YEAR)

Stage	Minimum	Average	Maximum
Stage 1	0.0	3.4	64.5
Stage 9	0.0	40.4	286.1

TABLE 4.7: PREDICTED AVERAGE NUMBER OF DISCHARGE DAYS

Stage	Modelled Average Controlled Discharge Days
Stage 1	2
Stage 9	9

The results presented in Table 4.6 and Table 4.7 indicate that controlled discharges will be required in median and wet years to manage surplus rainfall runoff captured in the WMS. Higher discharge volumes and frequencies are predicted for Stage 9 due to the larger quarry catchment capturing greater volumes of water when compared to Stage 1.

4.4.4.2 Uncontrolled Discharges

The water storages within the conceptual WMS have been sized to minimise the risk of uncontrolled discharge and therefore, no uncontrolled discharges were predicted for either Stage 1 or Stage 9 for the modelled historical climate data set.

As indicated in Section 3, SB1 will be sized to minimise the risk of uncontrolled discharge during storm events not exceeding the 24 hour duration, 0.2% AEP storm event. The 24 hour duration, 0.2% AEP storm event rainfall depth for the Project site is 402 mm. Table 4.8 presents the estimated runoff volume from the 24 hour duration, 0.2% AEP storm event for the SB1 and SB2 catchments with an assumed conservative runoff coefficient of 0.9 (i.e. 90% of rainfall reports as runoff).

TABLE 4.8: SEDIMENT BASIN 1, 24-HOUR DURATION, 0.2% AEP RUNOFF VOLUMES

Stage	Catchment Area	Runoff Volume (ML)
Stage 1	25.07	91
Stage 9	20.57	74

5. FINAL LANDFORM AND FINAL VOID WATER RECOVERY

5.1 Final Landform

The final landform design will include a final void, however it is anticipated that SB1 and all other sediment traps/basins will be decommissioned with the landform outside of the Pit final void to be free draining.

5.2 Final Void Recovery

The final void water balance developed for the SWIA submitted with the Project EIS (Umwelt, 2023) was updated to estimate the equilibrium water level in the Pit final void for the conceptual revised Project layout. Rainfall inflows to the Pit final void will predominantly be associated with direct rainfall on void surfaces as there will be negligible external runoff due to the location of the void on a ridgeline. Inflow contributions from groundwater seepage are also expected. A groundwater inflow rate to the Pit final void of 14.3 ML/year (i.e. the groundwater inflow rate applied for the Stage 9 operational water balance scenario) has been used in the final void recovery water balance model and varied linearly from the maximum inflow rate (i.e. 14.3 ML/year) when the pit is empty down to 0 ML/year when the water surface elevation in the pits reach 23.4 mAHD (the pre-mining water table level of 23.4 mAHD (GHD, 2023)). Pit final void outflows to the groundwater aquifer have not been accounted for in the final void water balance model.

Figure 5.1 presents the final void recovery water level for the Pit and indicate that the final voids will fill and spill off-site over time. The Pit is not predicted to spill until approximately 135 years after quarry closure due to its very large capacity. However, it is important to note that at this stage it is unknown whether there will be any outflow seepage from the Pit final void to regional groundwater which may increase the time before the Pit final void spills or whether the water level even reaches spill elevation. The time at which the Pit final void water level is expected to reach the pre-mining water table level of 23.4 mAHD (GHD, 2023) is approximately 53 years.

The Project SWIA (Umwelt, 2023) indicated that groundwater monitoring EC results ranged from 198 µS/cm to 5,820 µS/cm and that while the upper range of EC for groundwater significantly exceeds receiving surface water quality, groundwater inflows to the pit are expected to cease as the Pit final void water level increase beyond 23.4 mAHD. With the cessation of groundwater inflows, Pit final void water quality characteristics will be dominated by surface water inflows and any spills that may occur from the Pit final void are expected to have ECs comparable to local catchment surface flows. Any recharge to groundwater from the Pit final void is expected to have a lower EC than the pre-mining conditions and as such, no adverse changes to groundwater quality are anticipated as a result of groundwater recharge.

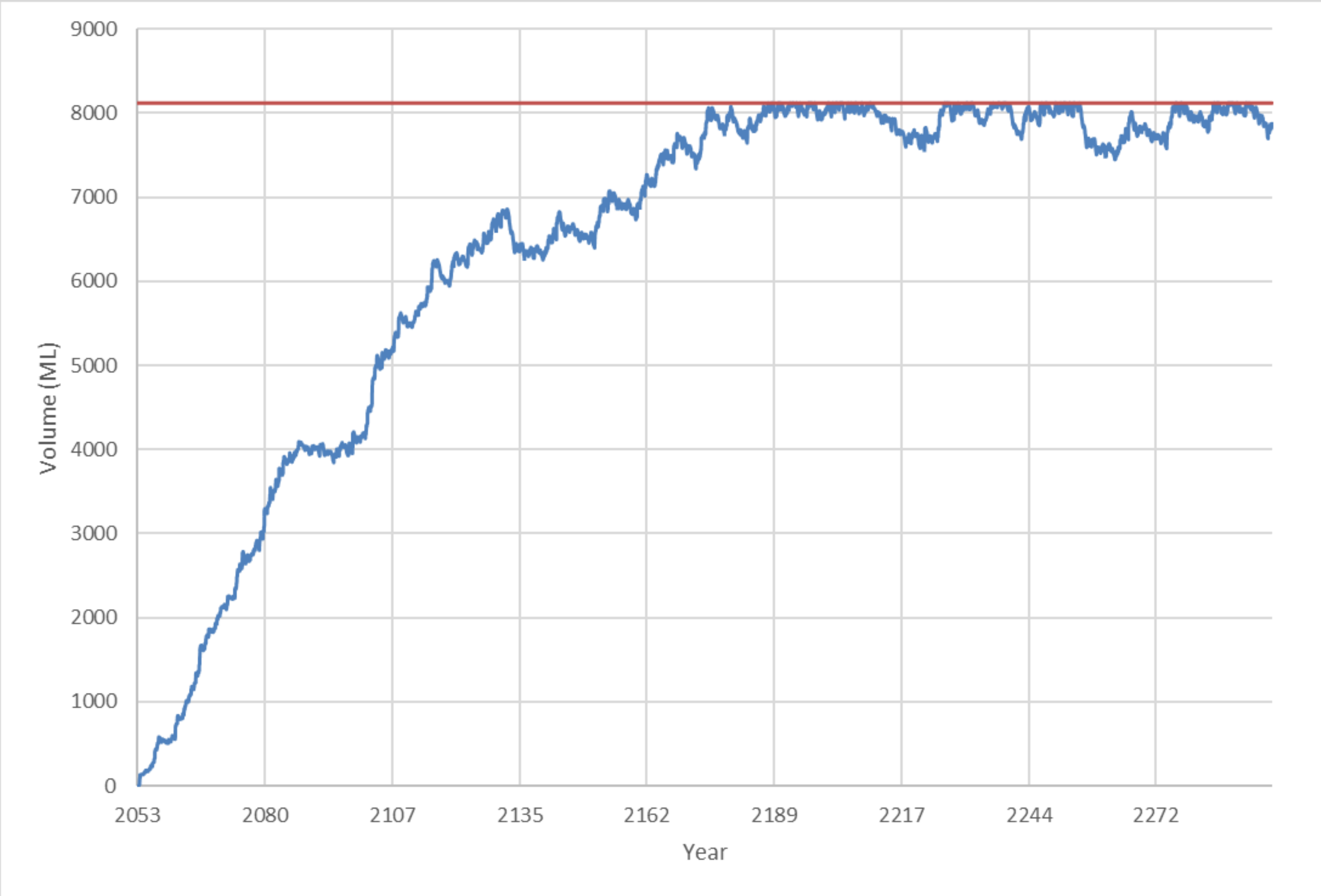

FIGURE 5.1: PIT FINAL VOID RECOVERY

6. IMPACT ASSESSMENT

6.1 Water Quality

As the Project is located within the Hunter Water's drinking water catchment, a Neutral or Beneficial Effects (NorBE) on water quality analysis must be undertaken to estimate whether the post-development pollutant loads discharged from the amended Project are greater than, equal to or less than the pollutant loads discharging from the pre-developed site. The pollutants of concern associated with the Project are considered to be total suspended solids and nutrients (Total Nitrogen and Total Phosphorus).

The average pre-development pollutant loads discharged from the Project Area have been determined based on the pre-development pollutant concentrations that were applied in the SWIA submitted with the Project EIS (Umwelt, 2023) and the average annual catchment runoff from undisturbed catchment areas equivalent to the quarry WMS areas. Table 6.1 presents the pre-development pollutant concentrations applied to the NorBE assessment.

TABLE 6.1: PRE-DEVELOPMENT POLLUTANT CONCENTRATIONS APPLIED TO NORBE ASSESSMENT

Pollutant	Concentration (mg/L)
Total Suspended Solids	15.8
Total Nitrogen	0.8
Total Phosphorus	0.05

With the reduced WMS catchment areas and modified operating rules applied in the Amended Project Water balance, the average annual volume of controlled discharges in has been reduced by approximately 38% and 45% for Stage 1 and Stage 9 respectively when compared to the original Project water balance predictions. As such the controlled discharge pollutant concentrations required to achieve a NorBE on water quality may be marginally higher than those proposed in the SWIA submitted with the Project EIS (Umwelt, 2023). Therefore, the proposed treatment measures detailed in the SWIA are considered to be adequate to meet the treatment requirements for the likely lower concentrations of pollutants under the amended project design. Water treatment measures will be implemented as required to reduce pollutant concentrations in controlled discharges to levels where a NorBE on water quality can be achieved.

The Project WMS will be designed and managed to minimise the likelihood of uncontrolled discharges for storm events up to the 24 hour duration, 0.2% AEP as specified by Hunter Water to manage the potential pollution risk within the drinking water catchment (refer to Sections 3.1, 3.2 and 4.4.4.2) and historical climatic conditions modelled in the water balance (refer to Section 3.3) and as such, uncontrolled discharges have not been considered on the NorBE assessment. The operational discharge pollutant concentrations applied to controlled discharges from the Stage 1 and Stage 9 quarry operating scenarios are presented in Table 6.2. A preliminary assessment indicates that available water treatment technologies are capable of treating the water captured in the quarry WMS to the concentrations presented in Table 6.2.

TABLE 6.2: OPERATIONAL DISCHARGE POLLUTANT CONCENTRATIONS APPLIED TO NORBE ASSESSMENT

Pollutant	Controlled Discharge Concentration (mg/L)
Total Suspended Solids	22
Total Nitrogen	1.1
Total Phosphorus	0.050

Table 6.3 presents a comparison of the pre-development and post-development pollutant loads for the Stage 1 and Stage 9 WMS catchment areas.

TABLE 6.3: COMPARISON OF AVERAGE PRE-DEVELOPMENT AND POST-DEVELOPMENT POLLUTANT LOADS

Pollutant	Stage 1 WMS Catchment Area – 30 ha			Stage 9 WMS Catchment Area – 62 ha		
	Pre-development (kg/year)	Post-development (kg/year	% Change Relative to Pre-development	Pre-development (kg/year)	Post-development (kg/year	% Change Relative to Pre-development
Total Suspended Solids	474.0	129.4	-73%	979.6	885.8	-10%
Total Nitrogen	24.0	6.5	-73%	49.6	44.5	-10%
Total Phosphorus	1.5	0.3	-78%	3.1	2.0	-35%

The results presented in Table 6.3 indicate that on average pollutant loads are lower than pre-development conditions and a NorBE on water quality can be achieved for the Project for both the conceptual Stage 1 WMS and conceptual Stage 9 WMS designs:

- the Stage 1 operating scenario represents a period where there is no available in-pit storage other than the Pit Sump to accommodate surplus rainfall runoff during wet periods and, while the WMS catchment area is smaller than in latter stages, the limited in-pit storage capacity results in an increased likelihood of uncontrolled discharges from the WMS and as such, a need to ensure water inventories can be appropriately managed;
- the Stage 9 operating scenario represents the maximum WMS catchment area and therefore the stage in which the largest volumes of rainfall runoff will require management through reuse and controlled discharges.

It is considered that intermediate stages (i.e., Stages 2 to 8) will also on average achieve a NorBE on water quality by ensuring:

- adequate water storage capacity is constructed for each stage
- the water treatment system (if required) is operating to design specifications, and
- operational water management practises to minimise site water inventories prior to wet conditions are implemented to minimise the likelihood of uncontrolled discharges for storm events up to the 24 hour duration, 0.2% AEP (refer to Sections 3.1, 3.2 and 4.4.4.2) and historical climatic conditions modelled in the water balance (refer to Section 4).

6.2 Water Quantity

6.2.1 Catchment Yield

Water balance modelling predicts that for the Stage 1 scenario there will be a reduction in catchment yield during all years (an average reduction of approximately 23.5 ML/year). Reductions in catchment yield are predicted for Stage 9 for all but the wettest years (an average reduction of 17.0 ML/year for Stage 9). There is no reduction in catchment yield for the wettest years in Stage 9 as the higher runoff rates associated with disturbed and hardstand surfaces within the quarry WMS result in the requirement to discharge volumes of water that exceed natural catchment runoff for an area equivalent to that of the WMS.

Table 6.4 presents the reductions in waterway catchments impacted by the Project for the original Quarry design and the revised quarry design. The data presented in Table 6.4 shows that the revised quarry design results in smaller catchment reductions when compared to the original quarry design for all waterways. It is considered that the loss in catchment yield for Grahamstown Dam and the Williams River during dry years will be negligible. The percentage reduction in Nine Mile Creek and Caswells Creek catchments is higher, however, still minor and less than the reductions associated with the original quarry design.

TABLE 6.4: WATERWAY CATCHMENT REDUCTION COMPARISON

Waterway	Total Catchment (ha)	Maximum WMS Catchment – Original Quarry Design (ha)	Catchment Reduction - Original Quarry Design	Maximum WMS Catchment – Revised Quarry Design (ha)	Catchment Reduction – Revised Quarry Design
Grahamstown Dam (inc. Balickera Canal downstream of Balickera pump station)	11,500	52.0	0.45%	50.7	0.44%
Williams River (inc. Balickera Canal upstream of Balickera pump station)	97,400	23.0	0.02%	11.5	0.01%
Nine Mile Creek (part of Grahamstown Dam catchment)	1,970	44.4	2.26%	40.5	2.06
Caswells Creek (part of Williams River catchment)	1,075	18.3	1.70%	11.7	1.09

6.2.2 Water Security

Water balance modelling of the Project WMS indicates that rainfall runoff and groundwater bore imports will provide an adequate and reliable supply of water to meet operational water demands for all stages of the Project (refer to Section 4). Section 7.1.3 of the SWIA submitted with the Project EIS (Umwelt, 2023) included an assessment of the availability of groundwater source entitlement in the New England Fold Belt Coast Groundwater Source that indicated that sufficient shares should be obtainable. Given the Project groundwater import demand for the conceptual revised Project layout is lower than the estimated groundwater import demand for the original quarry layout presented in the EIS, it is considered that the assessment of groundwater entitlement availability remains valid.

Should any temporary restrictions for access to the groundwater entitlements be imposed, the quarry will scale Project operations to an appropriate level to reduce operational water demands to meet the available supply while, as far as practicable, ensuring environmental controls are maintained (i.e., dust suppression).

6.2.3 Flow Regimes and Stream Stability

Given the Project will capture rainfall runoff and discharge water (controlled and uncontrolled discharges), flow regimes will be altered and impacts to stream stability are possible in the watercourses downstream of the Project.

As indicated in and consistent with the SWIA submitted with the Project EIS (Umwelt, 2023), ARDG will engage a suitably qualified and experienced specialist to undertake a baseline riparian corridor assessment of the streams (which will include an assessment of baseline stream stability) that will receive controlled and uncontrolled discharge prior to Project construction. ARDG will also commission a detailed hydrological and hydraulic assessment will be undertaken to assess the potential for scouring in downstream watercourses and inform maximum discharge flow rates (for controlled discharges) and the requirement for scour protection as committed to in the SWIA submitted with the Project EIS (Umwelt, 2023). Given the loss of catchment associated with the Project, it is considered that scouring in the downstream watercourses is less likely during rainfall events that do not result in uncontrolled discharges from the quarry WMS.

6.2.4 Flooding

As outlined in the SWIA submitted with the Project EIS (Umwelt, 2023), *Port Stephens Local Environmental Plan 2013* flood mapping indicates that the Project Area, including the quarry access off Italia Road, was not located in a flood planning area. The Project Area is in the same location on a ridgeline with no upslope catchment and as such, no local flooding issues are expected on-site nor are any impacts on local flood regimes expected downstream of the Project.

6.3 Riparian Corridor

The Project will include a number of works that are located on waterfront land (i.e. works within 40 m of the top of bank of a defined watercourse). To minimise the risk of impacts on watercourses and the associated riparian corridor, all works on waterfront will be designed and constructed in accordance with the *Guidelines for Controlled Activities on Waterfront Land* found at https://water.dpie.nsw.gov.au/licensing-and-trade/controlled-activity-approvals/guidelines.

7. LICENSING, MONITORING & REPORTING

7.1 Licensing

7.1.1 Environment Protection Licence

The quarry will be required to hold an Environment Protection Licence (EPL) as it will be carrying out a premises-based activity listed in Schedule 1 of the Protection of the Environment Operations Act 1997 (POEO Act), i.e., Activity 19 Extractive activities, >30,000 tonnes/year. ARDG will include a request for at least one licensed discharge point in the EPL application to allow controlled discharges of surplus water from the quarry WMS.

The EPL application will also include proposed pollutant concentration limits and controlled discharge volume limits that have been informed by the NorBE assessment (refer to Section 6.1) and the hydrological and hydraulic assessment (refer to Section 6.2.3).

7.1.2 Surface Water

7.1.2.1 Exemptions

Surface water runoff capture within the Quarry WMS, including SB1, occurs to prevent the contamination of a water source and therefore all Project water storages are considered as excluded works under Schedule 1 of the Water Management (General) Regulation 2018 and therefore exempt from requiring a Water Access Licence under Schedule 4 Clause 12 of the Water Management (General) Regulation 2018.

DPE Water noted in a submission regarding the original Project EIS that SB1 exceeds the typical design requirements for sediment basins as provided in "the Managing Urban Stormwater guide". Given the Project is located in the Grahamstown Dam drinking water catchment (refer to Section 2 above), pollution prevention standards beyond those recommended in relation to sediment basins in *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Volume 2e: Mines and quarries* (Department of Environment and Climate Change, 2008) are being proposed. Further, Hunter Water has specified that the Project WMS should be designed to contain a 0.2% AEP storm event (refer to Sections 3). As far as practicable, undisturbed catchments upslope of SB1 will be diverted around SB1 and it is noted that only minimal areas of undisturbed catchment will drain to SB1. As such, it is considered that rainfall runoff captured in SB1 is exempt from licensing.

7.1.2.2 Harvestable Rights

The Maximum Harvestable Rights Dam Capacity (MHRDC) (for dams that are not exempt from licensing, refer to Section 7.1.2.1) for the licence area held by ARDG (391 ha) has been estimated using the NSW MHRDC calculator to be 39.1 ML (i.e. 10% of the average regional runoff). However, as indicated in Section 7.1.2.1, all quarry dams/water storages during the operational phase of the Project are considered excluded works and exempt from water access licensing.

7.1.2.3 Final Landform

As indicated in Section 5.1, the final landform will include a final void (the Pit) while all other water storages (SB1 and any other sediment traps/basins) will be decommissioned and the landform outside of the Pit will be free draining.

While the Pit void will have negligible external catchment areas draining into the void, the direct rainfall runoff to the pit surfaces will require licensing. Water balance modelling indicates that the maximum surface water take based on runoff from an undisturbed catchment of equivalent size to the final void catchment area (approximately 43 ha) is 235 ML/year. Following completion of extractive activities and at the time that the final landform is established (i.e. after all rehabilitation activities are complete), ARDG will purchase and hold sufficient entitlement in the Newcastle Water Source and the Williams River Water Source to comply with contemporary surface water licensing legislation with consideration of harvestable rights provisions (and any applicable water returns policy at the time to account for spill volumes) associated with rainfall into the voids.

7.1.3 Groundwater

ARDG plans to source groundwater via a bore from the New England Fold Belt Coast Groundwater Source to supplement surface water runoff captured in the WMS as required (i.e., during dry conditions) to meet operational water demands. Water balance modelling indicates that the maximum groundwater import demand could be up to approximately 87 ML/year (approximately 5.5 L/s based on pumping 12 hours/day, seven days/week).

Pump testing of a bore within the Project Area undertaken by ARDG indicates that continuous pumping at 1.25 L/s or discontinuous pumping at 2.5 L/s (assuming complete recovery following each 12-hour pumping period), is likely to be sustainable for at least a year in the fractured rock aquifer (GHD, 2024). Pumping at a rate of 2.5 L/s for 12 hours a day equates to approximately 39 ML/year which is the predicted 90th percentile bore import demand for Stage 1 of the Project. The higher predicted bore import demands associated with the Project are limited to dry climatic conditions in the early stages of operation when the quarry WMS catchment is relatively small and WMS catchment runoff alone is not sufficient to meet operational demands. Should the early stages of operation coincide with forecast dry climatic conditions that are anticipated to result in bore import demands in excess of 39 ML/year, ARDG will:

- source additional entitlement in the New England Fold Belt Coast Groundwater Source construct and additional bore (or bores) at a location an adequate distance from the bore subject to the pump test but within the area licensed to ARDG by the NSW Forestry Corporation; and/or
- restrict production rates if required to ensure water is available to satisfy environmental controls (e.g. dust suppression) as a priority.

Elders Rural Services Australia was engaged to undertake an assessment of the availability of surface water entitlement in the New England Fold Belt Groundwater Source (refer to Appendix A). As of March 2023, there were 630 WALs with share entitlement ranging from 0 to 1,000 ML in the New England Fold Belt Groundwater Source. During the 2022/2023 water year there have been one permanent share assignment one temporary trade to date within the groundwater source and while no controlled allocations are presently available, there may be one similar in the future to that made available (1,739 ML) by the NSW Government in 2021.

Throughout the 2021/2022 water year the NSW Water Register indicates that 15,121 ML of water was made available in the New England Fold Belt Groundwater Source with only 133.1 ML of that water used. Based on the above assessment of water trades, controlled allocations and usage within the New England Fold Belt Coast Groundwater Source it is expected that ARDG will be able to secure sufficient groundwater entitlement to supplement operational demands.

7.2 Monitoring and Reporting

No changes to the monitoring and reporting proposed in the SWIA submitted with EIS (Umwelt, 2023) are proposed. All monitoring and reporting requirements will be detailed in a water management plan (WMP) should the Project be approved.

8. CONCLUSIONS

An assessment of the potential impacts on surface water resources associated with the Amended Project was undertaken and the following conclusions have been drawn based on the assessment outcomes:

- The Project can on average achieve a NorBE on water quality (as required for developments within the Grahamstown Dam catchment) provided adequate site storage capacity is available for all stages of the quarry operation, an appropriate water treatment system is installed and maintained to ensure controlled discharge water quality targets are achieved and appropriate water inventory management is implemented to minimise the volume and frequency uncontrolled discharges.
- The Project will have an adequate and reliable water source (i.e., captured rainfall runoff and groundwater bore) for all stages of the Project.
- There is a predicted overall loss of catchment yield during Stage 1 of the Project and for all climate scenarios (i.e. dry through to wet years) and in Stage 9 for all but the wettest years. There is no reduction in catchment yield for the wettest years in Stage 9 as the higher runoff rates associated with disturbed and hardstand surfaces within the quarry WMS result in the requirement to discharge volumes of water that exceed natural catchment runoff for an area equivalent to that of the WMS.
- Loss of catchment yield will have a negligible impact on overall Grahamstown Dam catchment yields as the Project WMS will occupy less than 0.50% of the Grahamstown Dam catchment and less than 0.03% of the Williams River catchment.
- Potential stream stability issues associated with discharges are expected to be manageable and any required mitigation measures (e.g., scour protection, discharge flow rate limits) will be informed by the hydrologic and hydraulic assessment.
- The Project will have no impact on local or broader catchment flood regimes.

9. REFERENCES

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GHD (2024). Stone Ridge Quarry, Groundwater Impact Assessment Version 2

10. QUALIFICATIONS

(a) In preparing this document, including all relevant calculation and modelling, Engeny Australia Pty Ltd (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

(b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

(c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:

   (i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or

   (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.

(d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

(e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.

(f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.

(g) This Report does not provide legal advice.

APPENDIX A: GROUNDWATER SHARES AVAILABILITY REVIEW

Elders

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PO Box 37, Forbes NSW 2871
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23 March 2023

Australian Resource Development Group Pty Ltd

Mr Justin Meleo

69 Ross St

Belmont

NSW 2280

Dear Mr Meleo

Re New England Fold Belt Coast Groundwater Source:

There are 629 registered licences in the New England Fold Belt Coast Ground water source with a range of 0-1000ML.

Number of licences by volume

287	0-10ML
271	10-50 ML
30	50-100 ML
35	100-400 Ml
6	400-1000 ML
Toal 629	15639 ML

- 2022 – 2023 1 Permanent Share assignment of 5ML @ $650.00 / ML to current date.
- 2022-2023 18 Licence were transferred with no price recorded on 15 transfers indicating that these may have been part of a property sale. The remaining 3 transfers had a spread of $740 to $800 / ML.
- There has been 1 temporary trade in the current year 2022-2023 @ $80/ ML and 3 trades in the previous year 2021 – 2022 to $75 / ML indicating little activity in this area.
- There may be a similar Controlled allocation for the New England Fold Belt Coast in the future as was available in 2021 that could be considered as the project progresses.
- See following data from Water NSW.

Yours faithfully

Warwick Judge

Real Estate Sales Specialist & Water Broker

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Information about a water source

Use this tool to search for information about a particular water source in relation to water access licences, approvals and water usage.

Search for:

○ Water access licences (including conditions) for a water source

◉ **Total number of water access licences and water usage for a water source**

Water Source New England Fold Belt Coast Groundwater

Licence Category All

Period (Financial Year) 2022/2023

Notes:

The calculation of all information in the search results - including the Water Access Licence (WAL) numbers, may be affected by the licences that were created and/or cancelled during the selected period (financial year).

Information on licences issued under the *Water Act 1912* is not available via this search.

○ Status of approvals (including conditions) for a water source or region

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Search Results

Access Licence Category	No. of WAL(s)	Total Share Component	Total IDEC (Daily flow shares)	Cumulative AWD	Cumulative AWD Unit	Share Component Unit	Water made Available (ML)	Usage YTD (ML)
AQUIFER	629	16509	N/A	1	1	ML per share	15639	5.2
LOCAL WATER UTILITY	2	240	N/A	1	100	% of Share Component	240	0

Share assignment trading statistics

The whole or part of the share component of a water access licence can be sold or traded from one water access licence to another under section 71Q of the *Water Management Act 2000* . This water dealing is otherwise known as an 'assignment of share component' or 'share assignment'. See assigning a share component.

Use the tool below to search for information on the trading of water access licence share components.

Search for the s71Q share assignment dealings for a particular water source. Alternatively, search for the s71Q share assignment dealings for a particular water access licence.

Note: The accuracy of pricing data is not guaranteed by WaterNSW; this search tool does not include transfers of water access licences pursuant to section 71 M of the *Water Management Act 2000* . For transfer dealings, go to Transfer trading statistics

Search by either:

◉ **Water Source**

Water Source New England Fold Belt Coast Groundwater

Period (Water Year) This water year 01-Jul-2022 to 30-Jun-2023

○ Water Access Licence (WAL)

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Search Results

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Intra Water Source

	Assign From			Assign To					
WAL No.	Water Source	Category	WAL No.	Water Source	Category	Application Number	Transferred	Share (units or ML)	Price Paid '$ per Unit'
40195	New England Fold Belt Coast Groundwater Source	Aquifer	43259	New England Fold Belt Coast Groundwater Source	Aquifer	1022558	23-SEP-2022	5	650

Licence transfer statistics

A water access licence or a holding in a water access licence can be sold or transferred from one holder to another under section 71M of the *Water Management Act 2000* . See transfer of water access licences.

If a security interest (mortgage or charge) is recorded on a water access licence and there is a default of mortgage payments, the security interest holder may take action to transfer the water access licence (or holding in the water access licence) by default under section 71X of the *Water Management Act 2000* . This is otherwise known as a dealing on default.

Use the tool below to search for information on water access licence transfers.

Search for information on types of transfers for a particular water source. In addition to s71M transfer dealings and s71X dealings on default, other forms of transfers such as transmissions and orders by the court are also available.

Alternatively, search for the transfer dealings for a particular water access licence.

Note: Some transfers may not involve the sale or purchase of the water access licence and therefore will not show a dollar ($) value for the price per unit.

Search by either:

Water Source

Water Source	New England Fold Belt Coast Groundwater
Transfer Type	All
Period (Water Year)	This water year 01-Jul-2022 to 30-Jun-2023

Water Access Licence (WAL)

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Search Results

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Transfers

WAL No.	Water Source	Category	Transferred	Share (units or ML)	Price Paid ($ per Unit)
38376	New England Fold Belt Coast Groundwater Source	Aquifer	27-JUL-2022	5	0.00
38411	New England Fold Belt Coast Groundwater Source	Aquifer	01-SEP-2022	8	0.00
43607	New England Fold Belt Coast Groundwater Source	Aquifer	01-SEP-2022	12	0.00
40796	New England Fold Belt Coast Groundwater Source	Aquifer	12-SEP-2022	10	0.00
38358	New England Fold Belt Coast Groundwater Source	Aquifer	23-SEP-2022	27	0.00
38358	New England Fold Belt Coast Groundwater Source	Aquifer	23-SEP-2022	27	0.00
43785	New England Fold Belt Coast Groundwater Source	Aquifer	29-SEP-2022	7	0.00

43606	New England Fold Belt Coast Groundwater Source	Aquifer	29-SEP-2022	20	0.00
40235	New England Fold Belt Coast Groundwater Source	Aquifer	04-OCT-2022	10	0.00
40133	New England Fold Belt Coast Groundwater Source	Aquifer	24-NOV-2022	10	0.00
40089	New England Fold Belt Coast Groundwater Source	Aquifer	29-NOV-2022	5	0.00
44501	New England Fold Belt Coast Groundwater Source	Aquifer	10-JAN-2023	41	0.00
43349	New England Fold Belt Coast Groundwater Source	Aquifer	24-JAN-2023	30	800.00
38358	New England Fold Belt Coast Groundwater Source	Aquifer	31-JAN-2023	27	740.74
40060	New England Fold Belt Coast Groundwater Source	Aquifer	09-FEB-2023	6	0.00
44483	New England Fold Belt Coast Groundwater Source	Aquifer	01-MAR-2023	20	800.00
40078	New England Fold Belt Coast Groundwater Source	Aquifer	14-MAR-2023	25	0.00
40367	New England Fold Belt Coast Groundwater Source	Aquifer	16-MAR-2023	5	0.00

Exporting and printing: Search results show a maximum of 50 rows per page. Search results can only be printed page by page.

More information: Should you require further information or technical assistance, please submit your request to water.enquiries@waternsw.com.au or contact 1300 662 077

Water allocation assignment trading statistics

The water allocation available under a water access licence can be sold or traded to another water access licence.

This dealing is otherwise known as a 'water allocation assignment', or an 'assignment of water allocations between water access licences' (and previously 'a temporary trade').

Use the tool below to search for information on the trading of water allocations.

Search for either:

◉ **Water allocation assignments for a particular water source**

Water Source New England Fold Belt Coast Groundwater
Licence Category All
Period ◉ **Water Year** 2022/2023
○ **Month of Allocation** **Year**

○ Water allocation assignments for a particular water access licence

○ Total number of water allocation assignments and volume of water traded **within** a water source

○ Total number of water allocation assignments and volume of water traded **between** water sources ('intervalley' and interstate)

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Search Results

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Assign From				Assign To				Details					
Water Access Licence	Water Source	Water Management Zone	Category	Water Access Licence	Water Source	Water Management Zone	Category	Application Number	Assigned	Trade Purpose	Volume (ML)	Price Paid '$ per ML'
40195	New England Fold Belt Coast Groundwater Source		Aquifer	43259	New England Fold Belt Coast Groundwater Source		Aquifer	SWC828501	13-JUL-2022	Other	5	1
43713	New England Fold Belt Coast Groundwater Source		Aquifer	43896	New England Fold Belt Coast Groundwater Source		Aquifer	SWC828164	05-JUL-2022	Other	10	80

Disclaimer: WaterNSW is making the information available on the understanding that it does not warrant that the information is suitable for any intended use. In using the information supplied, the user acknowledges that they are responsible for any deductions or conclusions arrived at from interpretation of the data.

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Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Water Sharing Plan	**Groundwater Source**	**Management zone in the water source (column 2)**	**Quantity of unit shares made available**	**Quantity of unit shares issued**	**Price paid per unit share $**	**Total price paid $**
	Groundwater Source					
	Lorne Basin Groundwater Source		446	0	$0.00	$0.00
	New England Fold Belt Coast Groundwater Source		1739	15	$1,200.00	$18,000.00
				20	$950.00	$19,000.00
				20	$800.00	$16,000.00
				20	$800.00	$16,000.00
				20	$800.00	$16,000.00
				20	$700.00	$14,000.00
				20	$700.00	$14,000.00
				20	$700.00	$14,000.00
				25	$650.00	$16,250.00
				25	$621.00	$15,525.00
				20	$600.00	$12,000.00
				4	$600.00	$2,400.00
				60	$600.00	$36,000.00
				25	$570.00	$14,250.00
				70	$559.00	$39,130.00
				20	$555.00	$11,100.00
				21	$526.00	$11,046.00
				30	$525.00	$15,750.00
				10	$520.00	$5,200.00
				100	$520.00	$52,000.00
				40	$511.00	$20,440.00
				20	$501.00	$10,020.00
				232	$500.00	$116,000.00
				20	$500.00	$10,000.00
				7	$500.00	$3,500.00
	North Coast Volcanics Groundwater Source		299	40	$550.00	$22,000.00
				30	$550.00	$16,500.00
				20	$501.00	$10,020.00
				35	$501.00	$17,535.00