DARKWATER CONSULTING

Lucky Bay Sand Tailings Stockpile Groundwater Assessment

July 2024
Rev B

[redacted]

[redacted]

Table of Contents

Figures

Tables

1. Executive Summary

Australian Garnet Pty Ltd (AGPL) operates the Lucky Bay Garnet Project (the Project), a heavy mineral sands deposit located at the southern margin of the Carnarvon Basin, approximately 40 kilometres (km) south of Kalbarri and 540 km north of Perth, in the Shire of Northampton.

Tailings produced as a byproduct are currently temporarily stockpiled in a designated sand tailings stockpile area. The sand tailings are wet stacked (20 to 30% moisture content). The existing Works Approval conditions and Mining Proposal commitments permit temporary stockpiling of sand tails until there is sufficient footprint within the mining void to facilitate in-pit deposition of tails. The temporary sand tails stockpile contains an estimated 2.4 million cubic metres of material, or 9% of projected sand tails associated with the Project (Australian Garnet, 2022b).

AGPL is seeking to revise existing approvals to instead allow for the sand tailings stockpile to remain in place as a permanent stable landform upon closure. To support this revision, Mineral Resources Limited (MRL, the Client) has engaged BG&E Resources (BGER) to perform a surface and groundwater assessment of the proposed permanent stable landform as input to regulatory approvals. BGER have subsequently engaged Darkwater Consulting Pty Ltd (Darkwater) to perform the groundwater component of this assessment.

A desktop study was performed using reporting, approvals documentation, and associated data provided by the Client, to assess any changes to groundwater levels and quality resulting from the proposed sand tailings stockpile changes. Review of existing works suggests that a permanent ex-pit stockpile will not significantly change any impacts to groundwater levels or quality when compared to the previously approved depositional scenario.

It is recommended that a geochemical assessment of tailings seepage is performed. While, with the exception of pH, the individual signatures of leachate and groundwater do not significantly exceed any applied water quality standards, there is the potential for water quality changes resulting from mixing. Characterisation of water quality resultant from groundwater-leachate mixing, and any potential associated geochemical processes, would require assessment by a suitably qualified geochemist.

2. Introduction

2.1 Background

Australian Garnet Pty Ltd (AGPL) operates the Lucky Bay Garnet Project (the Project), a heavy mineral sands deposit located at the southern margin of the Carnarvon Basin, approximately 40 kilometres (km) south of Kalbarri and 540 km north of Perth, in the Shire of Northampton. The location of the Project is shown in Figure 1.

The Project is a heavy mineral sands (primarily alluvial garnet) mining and processing operation. The project consists of an above water table (AWT) open pit mine, with any below water table (BWT) sections of the resource being excluded from the pit shell.

Mined material is fed to a mobile Mining Unit Plant (MUP) that feeds to a Central Processing Area (CPA) containing a Wet Concentrator Plant (WCP), dryer and Mineral Separation Plant (MSP), Screening and Bagging Plant (SBP), and associated plant infrastructure and utilities to produce a heavy mineral concentrate, including garnet and ilmenite final products.

Tailings produced as a byproduct are currently temporarily stockpiled in a designated sand tailings stockpile area. The sand tailings are wet stacked (20 to 30% moisture content). The existing Works Approval conditions and Mining Proposal commitments permit temporary stockpiling of sand tails until there is sufficient footprint within the mining void to facilitate in-pit deposition of tails. The temporary sand tails stockpile contains an estimated 2.4 million cubic metres of material, or 9% of projected sand tails associated with the Project (Australian Garnet, 2022b).

The initial dimensions for the sand tailings stockpile (post completion of remedial height reduction activities) will be 250 m wide, 800 m long and 10 m high relative to ground level (25 m RL) in accordance with the Works Approval conditions. The stockpile area includes perimeter bunds and drains to capture runoff and minimise washouts. The surface of the stockpile is proposed to be used for the creation of solar drying cells to accommodate clay fraction slimes; a waste product produced from the wet concentrator plant. The proposed location of the permanent sand tailings stockpile is shown in Figure 2.

AGPL is seeking to revise existing approvals to instead allow for the sand tailings stockpile to remain in place as a permanent stable landform upon closure. The remainder of tails volumes will still be used to progressively backfill the mining void. To support this revision, Mineral Resources Limited (MRL, the Client) has engaged BG&E Resources (BGER) to perform a surface and groundwater assessment of the proposed permanent stable landform as input to regulatory approvals. BGER have subsequently engaged Darkwater Consulting Pty Ltd (Darkwater) to perform the groundwater component of this assessment.

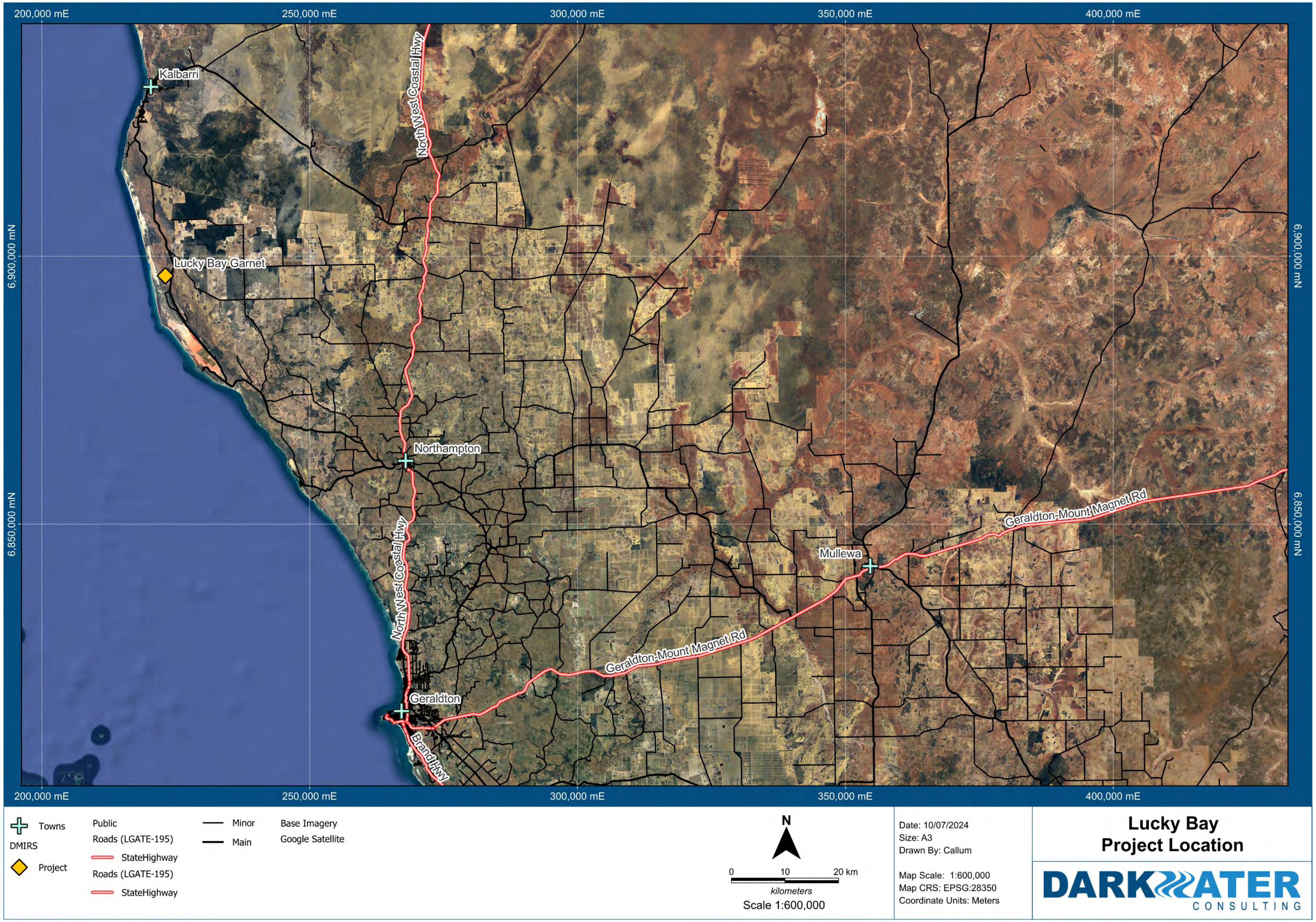


Figure 1: Lucky Bay Project Location

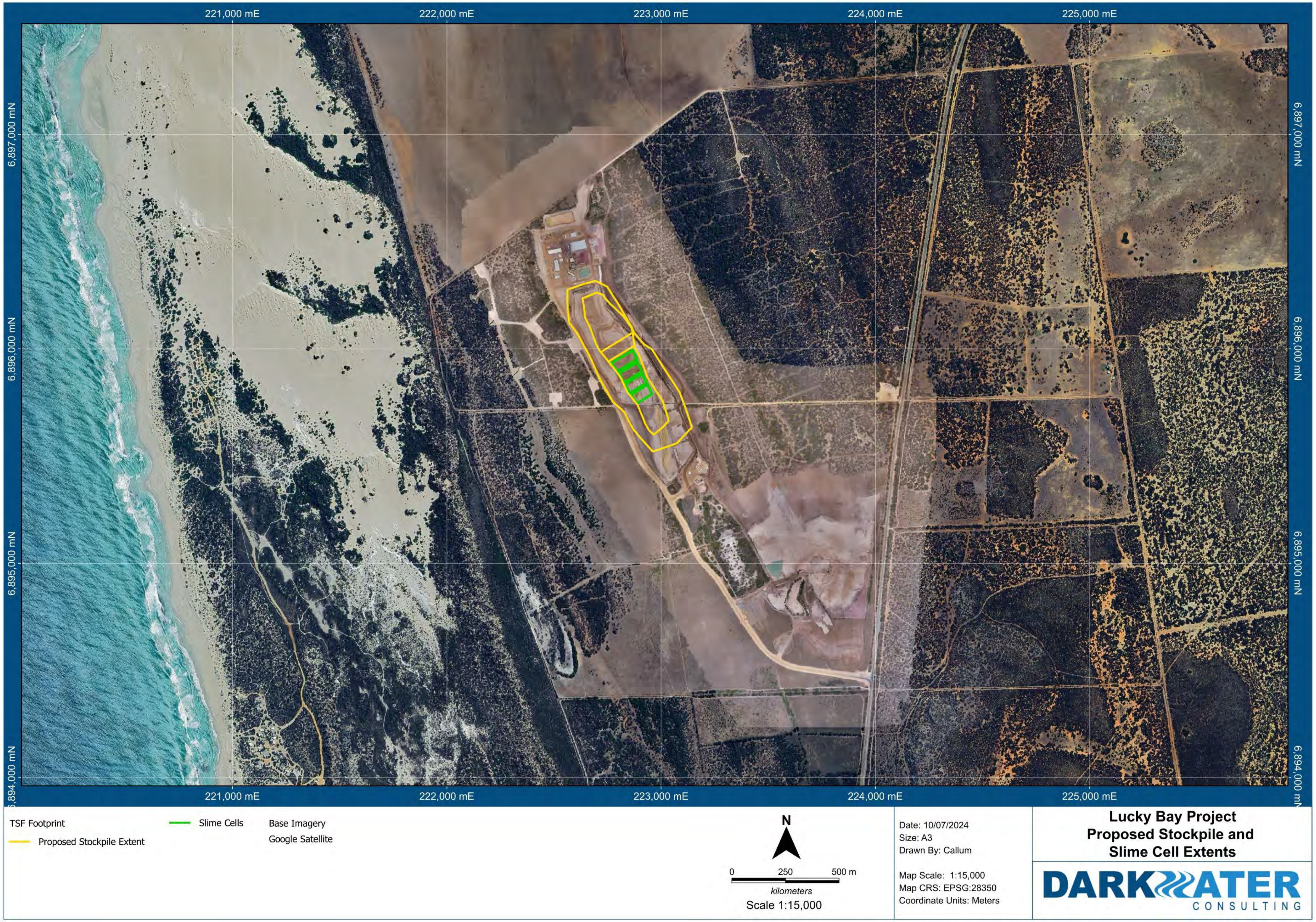


Figure 2: Lucky Bay Proposed Stockpile and Slime Cell Extents

2.2 Objectives

The objective of this assessment is to assess any changes to groundwater levels and quality that could potentially arise from the permanent sand tailings stockpile landform, and any associated impact to environmental and social values in the area surrounding the Project. This assessment is proposed to take place in two phases:

- Phase 1 (this Report) comprises a:
    - Desktop review of existing information relating to the Project;
    - Impact assessment of groundwater levels and quality resulting from the proposed changes;
    - Gap and risk analysis; and
    - Forward work plan to address any highlighted gaps.
- Phase 2 is contingent on the findings of this report and would include any additional works deemed necessary by this report to satisfy environmental approval requirements.

3. Document Review

The following documents, shown in Table 1, were provided by the Client and have been reviewed during this assessment phase to develop an understanding of the Project.

Table 1: Documents Reviewed.

Document	Author	Date Issued
Groundwater Supplies - Water Bore Installation and Aquifer Testing Phase	URS Australia Pty Ltd	Jan-10
Final Report, Groundwater Supply, Aircore Drilling Program	URS Australia Pty Ltd	Jul-09
Balline Garnet Project, Groundwater Assessment for Increased Abstraction to 1.70 GL/year	Geowater Consulting Pty Ltd	Jul-14
H2 Level Hydrogeological Assessment - Tumblagooda Sandstone Aquifer	Water Direct Pty Ltd	Jul-21
Groundwater Operating Strategy – Lucky Bay Garnet Mine	Australian Garnet Pty Ltd	Dec-21
Balline Garnet Project, Kalbarri, Western Australia: Subterranean Fauna Pilot Survey	Goater, S and Knott, B	Dec-09
Lucky Bay Garnet Project Detailed Flora and Vegetation Survey	Onshore Environmental Consultants Pty Ltd	Jan-22
Long-Term Erosional Stability of the Proposed Rehabilitation Design for the Sand Tailings Landform: Lucky Bay Garnet Project	Landloch Pty Ltd	Jun-24
Mining Proposal - Lucky Bay Garnet Project - Revision 2, Version 1	Australian Garnet Pty Ltd	Aug-22
Mine Closure Plan - Lucky Bay Garnet Project - Phase 1	Australian Garnet Pty Ltd	Feb-22
Lucky Bay Garnet Project - Application for a Licence - Part V Environmental Protection Act 1986	Australian Garnet Pty Ltd	Feb-24

4. Project Setting

Tenure associated with the Project is shown in Figure 4. Information provided herein is derived from documents listed in Table 1.

4.1 Physiography

The Project area is located on undulating land adjacent to the coast, approximately 1.8 km inland from the ocean. There is a primary vegetated dune running generally parallel with the coast in a north to south direction. The highest point of the dune is approximately 75 mAHD and the lowest point being approximately 15 mAHD.

The land systems of the study area were described as part of the Geraldton Land Resource Survey (Rogers 1996). Two land systems are described within the vicinity of the study area; the Quindalup system, which occurs along the coastal fringe, and the Tamala system, which extends approximately 5 km inland. The land systems are described as:

- Quindalup (Qu): Coastal dune system of unconsolidated calcareous sand forming a thin sequence of dune formations along the coast. Uniform calcareous sands with some accumulation of organic matter in the surface under native vegetation on older dunes and swales; and
- Tamala (Ta): Series of low hills parallel to the coast immediately behind Quindalup System. Well drained calcareous black sands, neutral reddish-brown sands and neutral yellow sands.

The Project area is further defined within the Port Gregory Zone, located within the Carnarvon Province (Tille, 2006). This is described as coastal plains, sand plains, alluvial plains and sea cliffs. The zone consists of limestone and sand with Cretaceous sedimentary rocks of the Carnarvon basin covered by red shallow sands, deep sands, stony soils and calcareous deep sands. Some yellow deep sands and yellow/brown shallow sands also occur.

4.2 Climate

The Project region experiences a typically Mediterranean climate with mild wet winters and hot dry summers (BGER, 2024). The nearest (active) Bureau of Meteorology (BOM) climate stations are located at Kalbarri (about 40 km north), Nabawa (about 80km southeast) and Geraldton Town (about 90 km south). Average daily temperatures recorded at Kalbarri (BOM site 8251) range between a minimum of 9.7ºC in July and a maximum of 34.1ºC in February, as shown in Table 2.

Table 2: Lucky Bay Climate Statistics (BGER, 2024).

	Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Kalbarri	Mean Maximum Temperature (ºC)	33.2	34.1	32.6	29.5	26.1	23	21.9	22.6	24.1	26.2	28.4	31.2	27.7
	Mean Minimum Temperature (ºC)	46.4	48.1	47.2	39.5	36.2	30.9	30.5	33	38.5	41.2	42.4	46.5	48.1
	Mean Rainfall 1970-2024 (mm)	4.9	8.3	11.6	19.2	52.9	75.6	69.2	48.0	23.3	13.8	6.8	3.6	334.3
Balline	Mean Rainfall 1930-2024 (mm)	5.0	9.7	15.4	25.3	65.9	95.8	84.2	57.0	28.9	16.4	8.9	3.6	417.1

For the period of available record (1970 – 2024), Kalbarri recorded an annual average rainfall of 334 mm. Rainfall is winter-dominant, with over 70% of rainfall occurring between May and August. A rainfall monitoring site located at Balline (8004), immediately to the east of the Project, is monitored by the farm owner, and has a partially complete record since 1930 (Water Direct, 2021). The long-term average annual rainfall at Balline is approximately 417 mm and monthly averages are higher than those recorded at Kalbarri. Annual rainfall totals are demonstrating a general declining trend, as shown in Figure 3.

It has not been possible to obtain recent evaporation data from BOM weather stations. URS (2010) reported that the annual average evaporation measured at Geraldton was 2,450 mm, and that average monthly evaporation exceeded average rainfall in all months of the year. Extrapolation of evaporation data from all Western Australian climate stations with over 10 years of measurements by the BoM indicated that the Project area has an annual evaporation rate of about 2,550 – 2,600 mm.

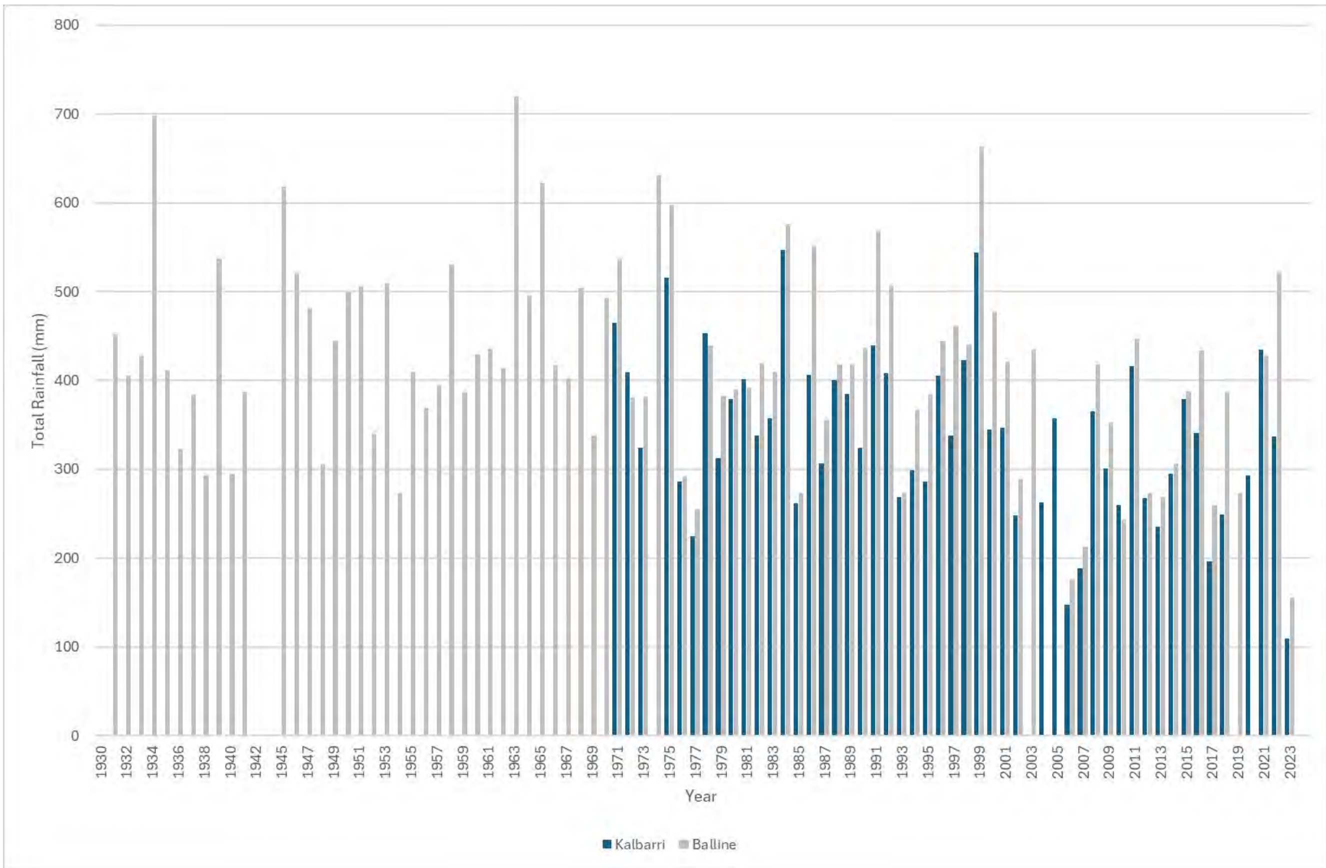


Figure 3: Total Annual Rainfall at Kalbarri and Balline (BGER, 2024).

4.3 Vegetation

The majority of vegetation types recorded within the study area occur on undulating low hills and ridges comprising limestone and sand and are dominated by xerophytic plant taxa that have no reliance on groundwater to survive. There are three localised vegetation types surrounding claypans in the south-western corner of the study area where seasonal interaction between groundwater and vegetation was previously identified (Onshore, 2013).

The other two vegetation types mapped around the claypans, FL Co and CP Tib, were dominated by the tree *Casuarina obesa* and low samphire shrub *Tecticornia indica* subsp. *bidens*. *Casuaria obesa* is a shallow rooted species with root exploration restricted to the upper 0.9 m of the soil profile and likely to be reliant on soil moisture supplemented by summer rainfall, rather than groundwater (Onshore, 2022). The low shrub *Tecticornia indica* subsp. *bidens* is also not considered to be groundwater dependent (Onshore, 2022). Hence, neither of the vegetation types are considered to be groundwater dependant.

This finding was also supported by the groundwater study undertaken by URS (2010) which concluded, based on the groundwater and vegetation assessments completed, that there were no wetlands or native phreatic vegetation present in the study area that could be considered as groundwater dependant.

The occurrences of the three vegetation types within the Project area have been heavily impacted by pastoral activities and high stocking rates, and vegetation condition was rated as being completely degraded to degraded (Onshore, 2013). Death and decline of *Casuarina obesa* trees was also noted at the time of the September 2021 field survey (Onshore, 2022), possibly related to elevated salinity.

Groundwater modelling completed by Geowater Consulting (2014) predicted a maximum of 0.5 m drawdown in areas where vegetation may seasonally interact with groundwater. This drawdown was deemed unlikely to cause any significant impacts to these vegetation types (Onshore, 2022), and is addressed in objectives associated with the Groundwater Operating Strategy (GWOS) (Australian Garnet, 2021).

4.4 Geology

The project is situated within the southern margin of the Carnarvon Basin, where relatively thin Quaternary alluvial, aeolian, and shoreline deposits (referred to as Superficial Formations) unconformably overlay the Silurian-aged Tumblagooda Sandstone (URS, 2010). Regionally, the oldest rocks are Proterozoic igneous, sedimentary, and volcanic rocks associated with the Northampton Block, which occurs east of the Project area.

The Tumblagooda Sandstone forms the bedrock sequence in the Project region and consists largely of red and yellow, consolidated, feldspathic sandstone and conglomerate, with minor interbeds of siltstone. Rocks of the Tumblagooda Sandstone are generally absent at surface in the Project region, although it does outcrop close to Lucky Bay Well, and is also prominent further north in the Murchison River Gorge and the coastal cliffs of Kalbarri. A small outcrop of Tumblagooda Sandstone occurs close to Lucky Bay Station, which indicates that the formation is relatively shallow in the Project area. To the south near the Hose and Lynton mines (GMA Garnet), the Tumblagooda Sandstone typically occurs about 20 m below ground level (Brandes de Roos, 2006).

The Tumblagooda Sandstone is unconformably overlain in the Gascoyne coastal domain by sedimentary facies associated with a belt of coastal (Tamala) limestone (calcarenite) and sand dunes that extend along the coastline north from Geraldton to Kalbarri. The Lucky Bay deposit itself consists of superficial heavy mineral bearing sands, with a 5.7% heavy mineral fraction comprising garnet, ilmenite, zircon, and leucoxene. These originated from Garnet Granulite facies of the inland Precambrian Northampton Block and are hosted in the Lucky Bay area in a relict Late Pleistocene shoreline environment setting.

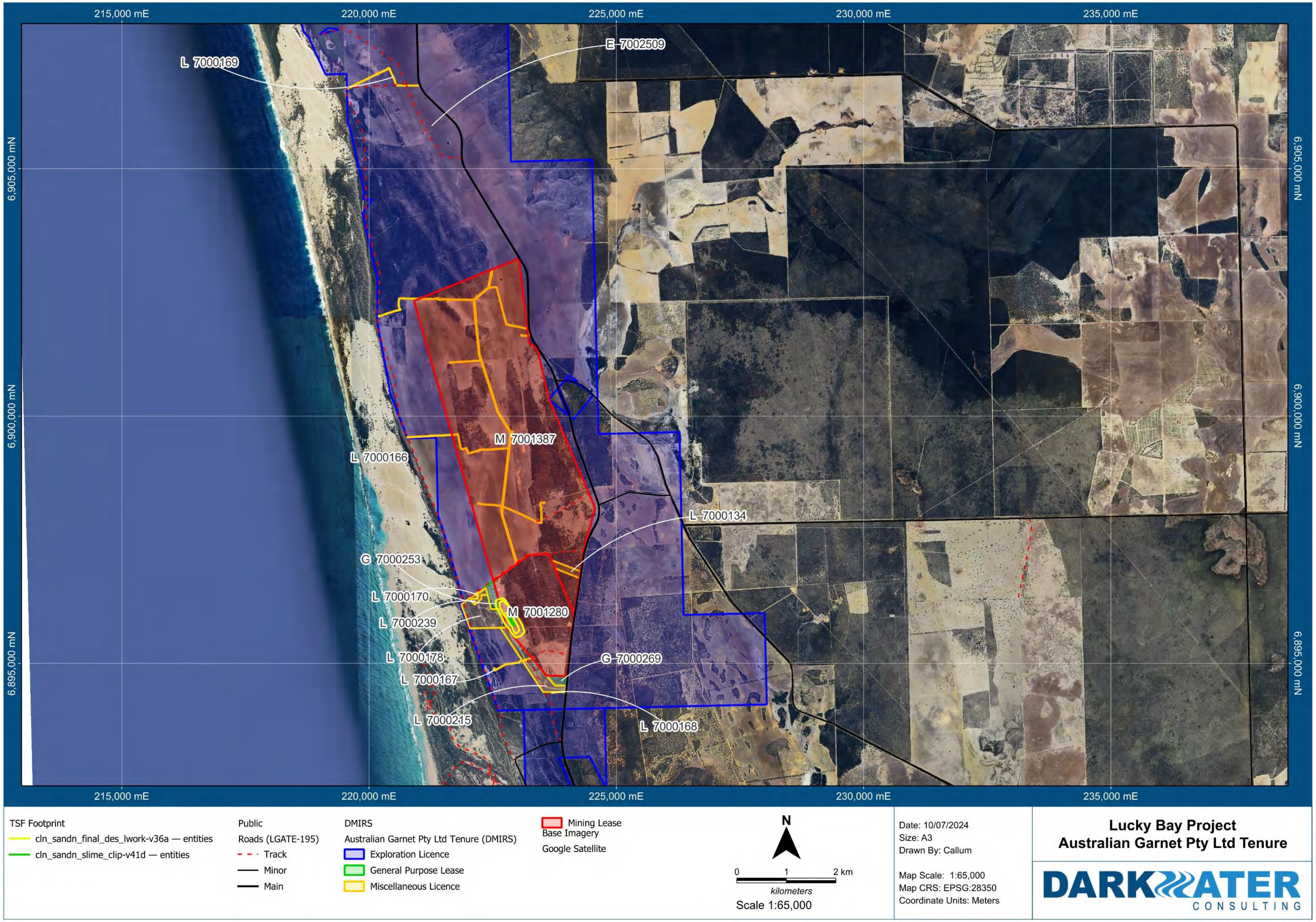


Figure 4: Australian Garnet Pty Ltd Tenure

5. Hydrogeology

5.1 Regional Setting

The Project is located within the Kalbarri/Eurady Subarea of the Gascoyne Groundwater Area. Existing local groundwater licenses as of July 2024 are shown in Figure 5 and Table 3.

Table 3: Existing Groundwater Licenses within the Project area.

User	GWL ID	Allocation (GL/a)	Aquifer	Date Issued
Australian Garnet Pty Ltd	170860	2.015	Carnarvon - Tumblagooda	21/09/2020
GMA Garnet Pty Ltd	62130	1.000	Carnarvon - Tumblagooda	9/07/2013
N.D Nachev & A.T Nolis	177700	0.095	Carnarvon - Tumblagooda	7/10/2015
Shire of Northampton	158575	0.060	Carnarvon - Sandstone	29/05/2018
Gregory Springs Trust	206605	0.015	Carnarvon - Surficial	16/11/2021
Main Roads	177137	0.001	Carnarvon - Tumblagooda	21/09/2020

5.2 Local Hydrogeology

5.3 Aquifers

5.3.0 Superficial

The Superficial aquifer, directly underlying the Project, is a west-dipping wedge-shaped unconfined aquifer, bound to the east by outcropping Tumblagooda sandstone. This aquifer is approximately 10 to 20 m thick in the pit area, increasing to at least 35 m thick towards the coastline west of the Project. The aquifer unconformably overlies the Tumblagooda sandstone.

The Superficial aquifer is a highly permeable unit. Testing indicates that hydraulic conductivities are in the range of 40 to 80 m/day, and specific yields are approximately 0.1 to 0.2.

5.3.1 Tumblagooda Sandstone

The Tumblagooda Sandstone aquifer underlies the Superficial aquifer in the Project region. The aquifer is a granular to fractured rock aquifer, generally containing brackish to saline groundwater, but may contain fresh water locally (DoW, 2017). While the stratigraphic unit is approximately 1,000 m in thickness, the aquifer is understood to be limited to the upper 150 m of Tumblagooda sandstone within the project area.

The Tumblagooda Sandstone is of lower permeability than the overlying superficial aquifer. Testing indicates that transmissivity values are approximately 30 m^2/day, corresponding to a hydraulic conductivity of less than 1 m/day. Specific yields are also expected to be lower than the overlying superficial formations.

Hydraulic connectivity between the Tumblagooda Sandstone aquifer and overlying Superficial aquifer is understood to be low, given the contrast in hydraulic conductivity (URS, 2010). The Tumblagooda sandstone is inferred to behave as a semi-confined unit and exhibit a low vertical hydraulic conductivity due to the presence of siltstone interbeds.

5.4 Groundwater Recharge and Discharge

Direct rainfall recharge to the Superficial aquifer occurs within the immediate project area. Rainfall recharge to the Tumblagooda Sandstone is inferred to occur inland of the project area, where outcropping, or where overlain by unsaturated Superficial Formations (URS, 2010). Vertical head gradients between the Superficial and Tumblagooda Sandstone aquifers are not well understood (URS, 2010), but some additional recharge to the Tumblagooda Sandstone may occur through vertical leakage from the overlying Superficial aquifer.

Previous rainfall recharge studies, alongside chloride mass balance estimates performed by URS (2010) indicate that rainfall recharge within the project area is likely to be relatively low. Recharge is estimated to be 1 to 5% of rainfall. Influence of seawater interactions on groundwater chemistry may skew the results of chloride mass balance assessment.

Historical recharge rate estimates applied to the Superficial aquifer across the Northern Perth Basin were around 7% of rainfall (DoW, 2017). Higher recharge rates may be associated with land clearing, which is present within the Project area. Reductions in average annual rainfall, as observed in the local rainfall dataset, will likely reduce the effective rainfall recharge rates (DoW, 2017)

Groundwater discharge is inferred to primarily occur where the Superficial and Tumblagooda aquifers are hydraulically connected to the ocean near and underneath the coastline. Seawater interactions are supported by observed groundwater quality gradients indicative of a seawater interface within the Superficial Formations.

Groundwater is also removed from the system via abstraction, and potentially through evapotranspiration where groundwater is sufficiently close to the ground surface.

5.5 Groundwater Levels and Throughflow

Pre-development groundwater contouring, derived from URS (2010), is shown in Figure 6. Contouring of the most recent groundwater level measurements, taken in June 2024, is shown in Figure 7.

Groundwater levels within the mining area are generally 10 to 20 m below ground level, or between 1 and 2 mAHD. Groundwater flow generally occurs in a westerly direction, indicative of groundwater discharge occurring along the coastline. Pre-development contours were relatively flat, likely due to a combination of high transmissivity and limited groundwater recharge. Hydraulic gradients increase towards the east, as the superficial aquifer reduces in thickness.

Groundwater level changes relating to project activity are observed in the most recent groundwater contouring. Reductions in groundwater levels in the order of 1 m are observed proximal to active production bores, while water levels proximal to the existing stockpile have not significantly changed. Reductions in groundwater levels within the pit area may also be attributable to a reduction in depth to groundwater levels and resultant increased evaporation. Within the stockpile footprint, the water table is approximately 9 metres below ground level.

Groundwater throughflow was previously estimated by URS (2010) using Darcy’s Law, with observed hydraulic gradients, aquifer geometry and hydraulic parameters as input. An estimated 400 kL/day/km of groundwater throughflow occurs within the superficial aquifer, which would equate to approximately 1,600 kL/day, or 20 L/sec of throughflow within the active pit and stockpile area.

5.6 Groundwater Quality

Groundwater sampling has been performed during previous investigations, and subsequently during operations to meet licensing requirements. The results are summarised below.

Results of groundwater quality lab analysis are shown in Table 4.

Groundwater salinity within the area is brackish to saline (1,500 to 7,000 mg/L TDS), generally increasing in salinity laterally towards the coastline. Regular salinity profiling of monitoring bores shows generally uniform distributions of EC within most monitoring bores. Some sites, such as MB2, MB9, MB14, and MB16 display significant increases in salinity with depth (up to 20,000 mg/L). This is attributable to intersection of the seawater interface within the Superficial Formations aquifer. No freshwater lenses at the top of the water table were identified during salinity profiling.

Salinity within the underlying Tumblagooda Sandstone in generally lower, with TDS values from lab analysis ranging from 840 to 1,700 mg/L.

Groundwater pH within the Superficial Formations is circumneutral, with an average value of 7.3 and ranging from 6.7 to 7.9. Groundwater pH within the Tumblagooda Sandstone is slightly acidic, averaging 6.5 and ranging from 6.0 to 7.1.

The chemical composition of groundwater is shown in a Piper diagram in Figure 8, and an Expanded Durov diagram in Figure 9. Groundwater in both the Superficial Formations and Tumblagooda Sandstone aquifers is of a sodium chloride type, likely a result of proximity to the coast, and the occurrence of associated seawater interactions. Samples from PB2 exhibit slightly elevated calcium, magnesium, and bicarbonate concentrations, attributable to potential carbonate dissolution within the superficial aquifer.

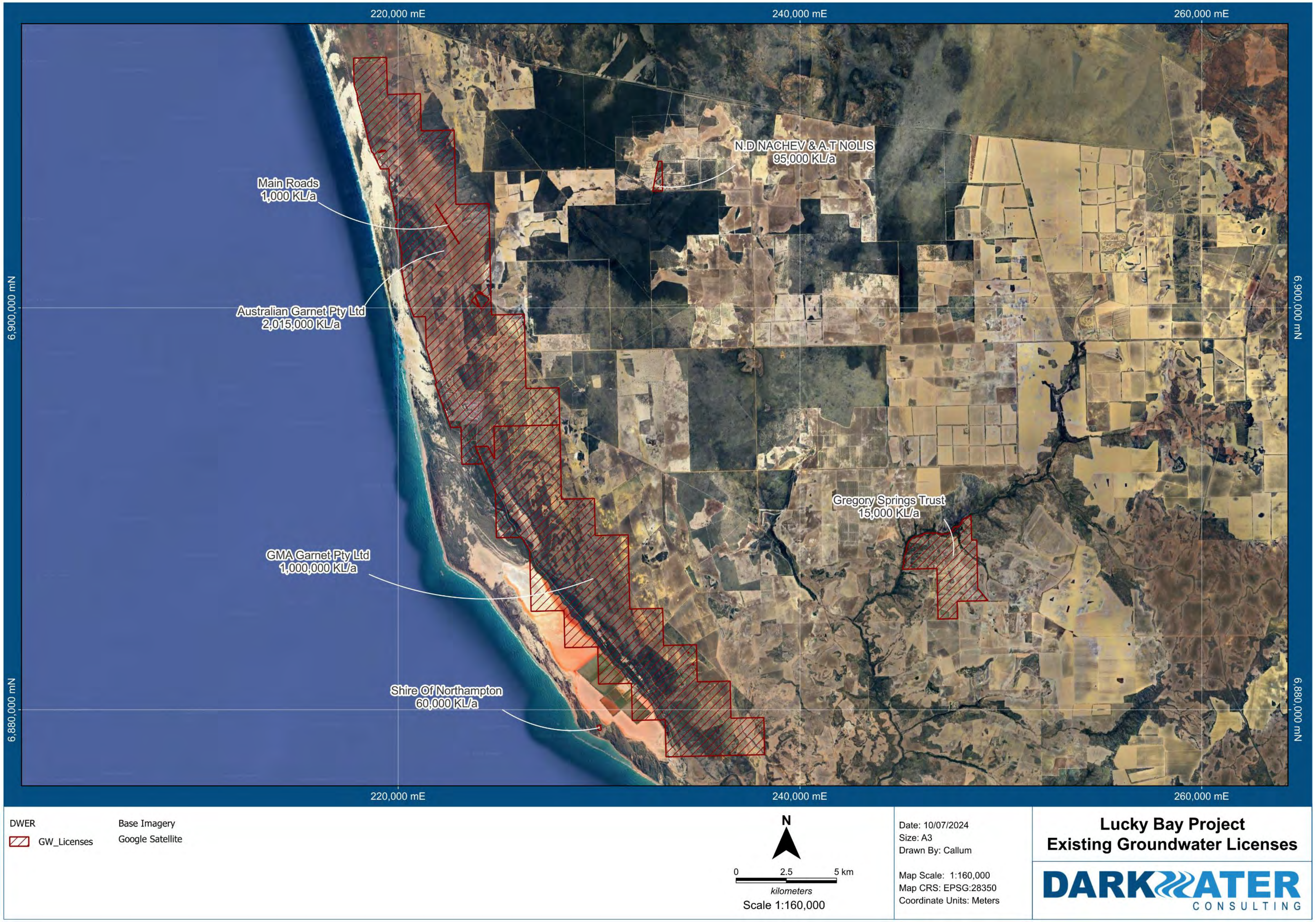


Figure 5: Existing Groundwater Licenses

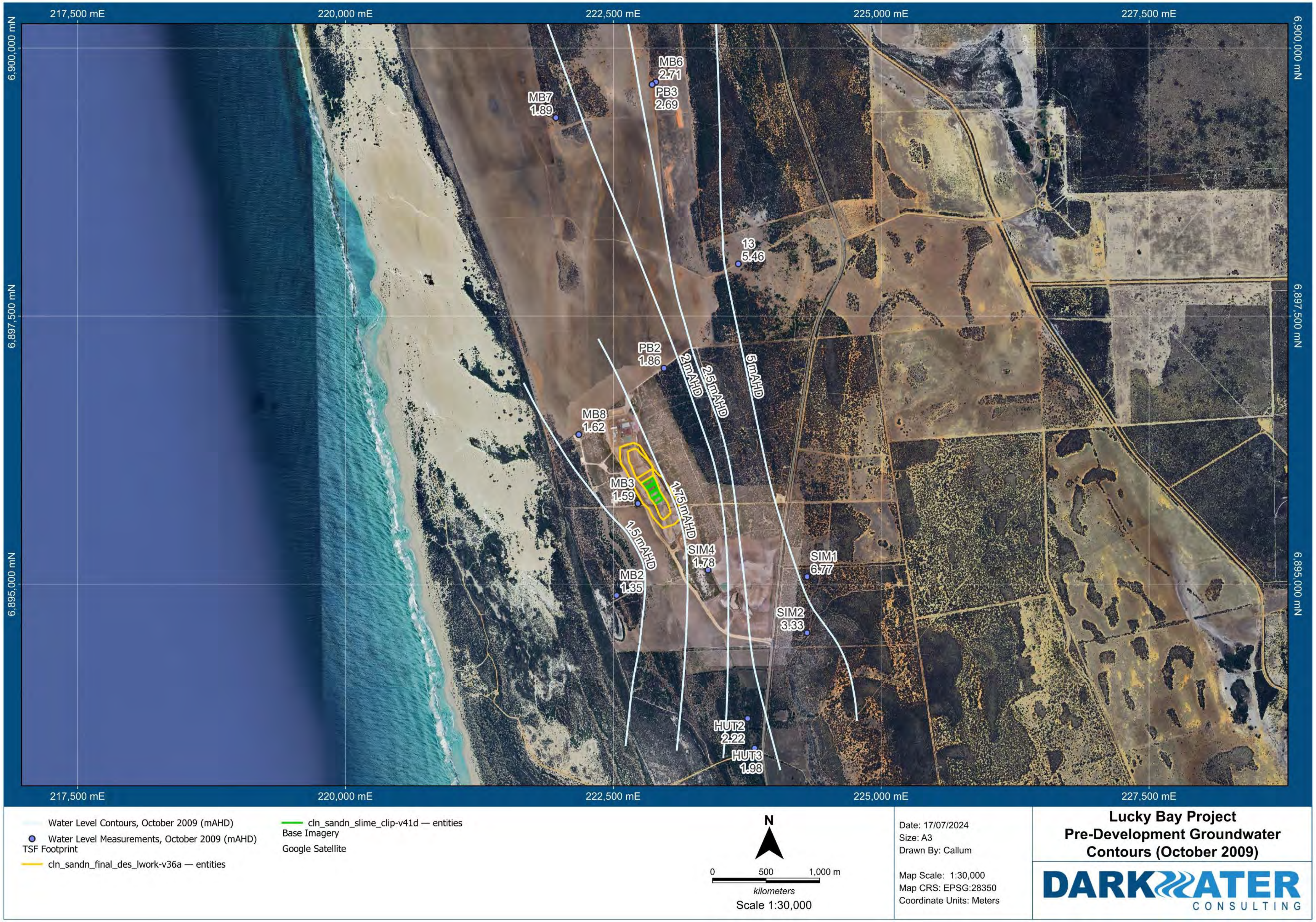


Figure 6: Pre-Development Groundwater Contours (October, 2009)

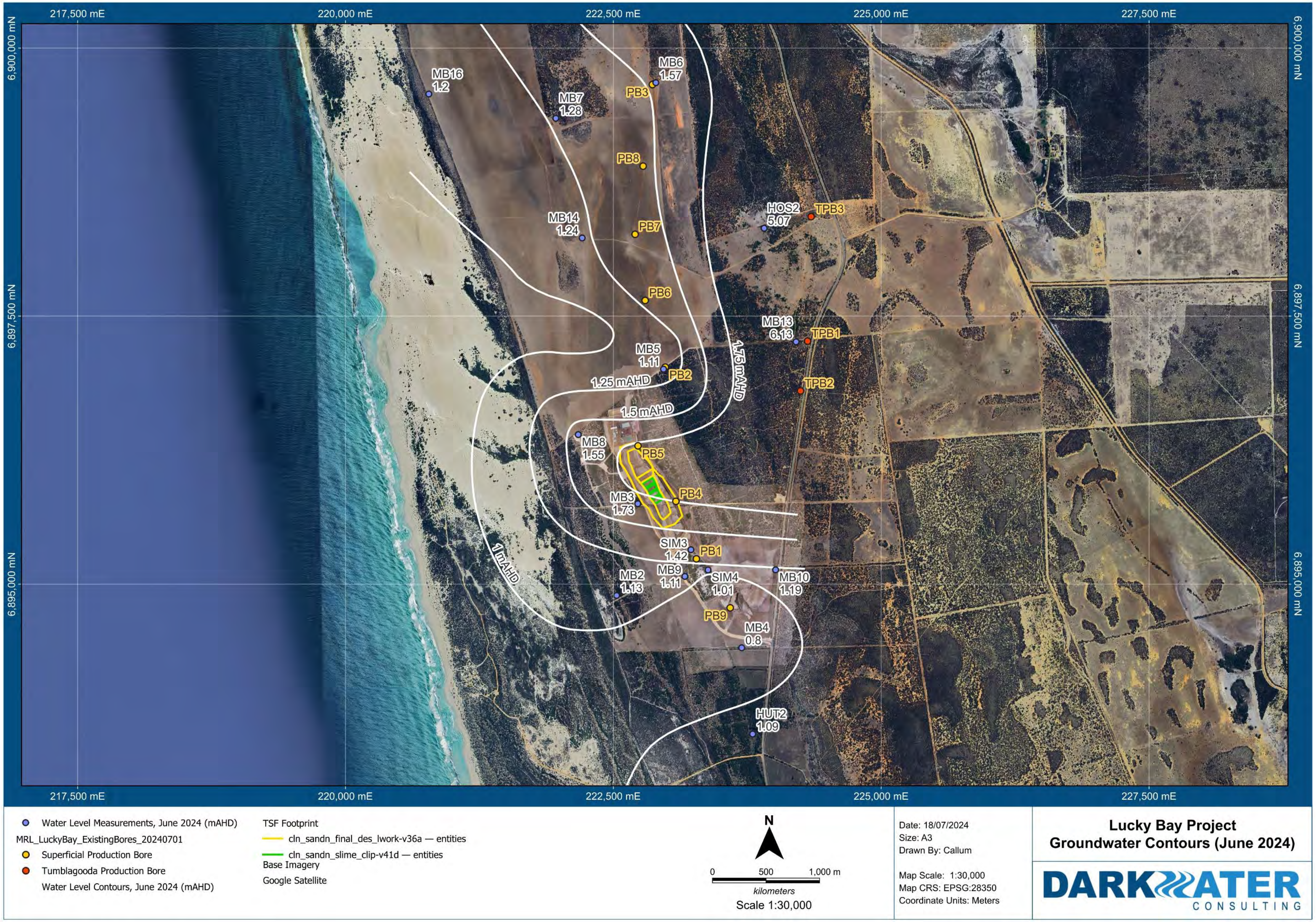


Figure 7: Groundwater Contours (June, 2024)

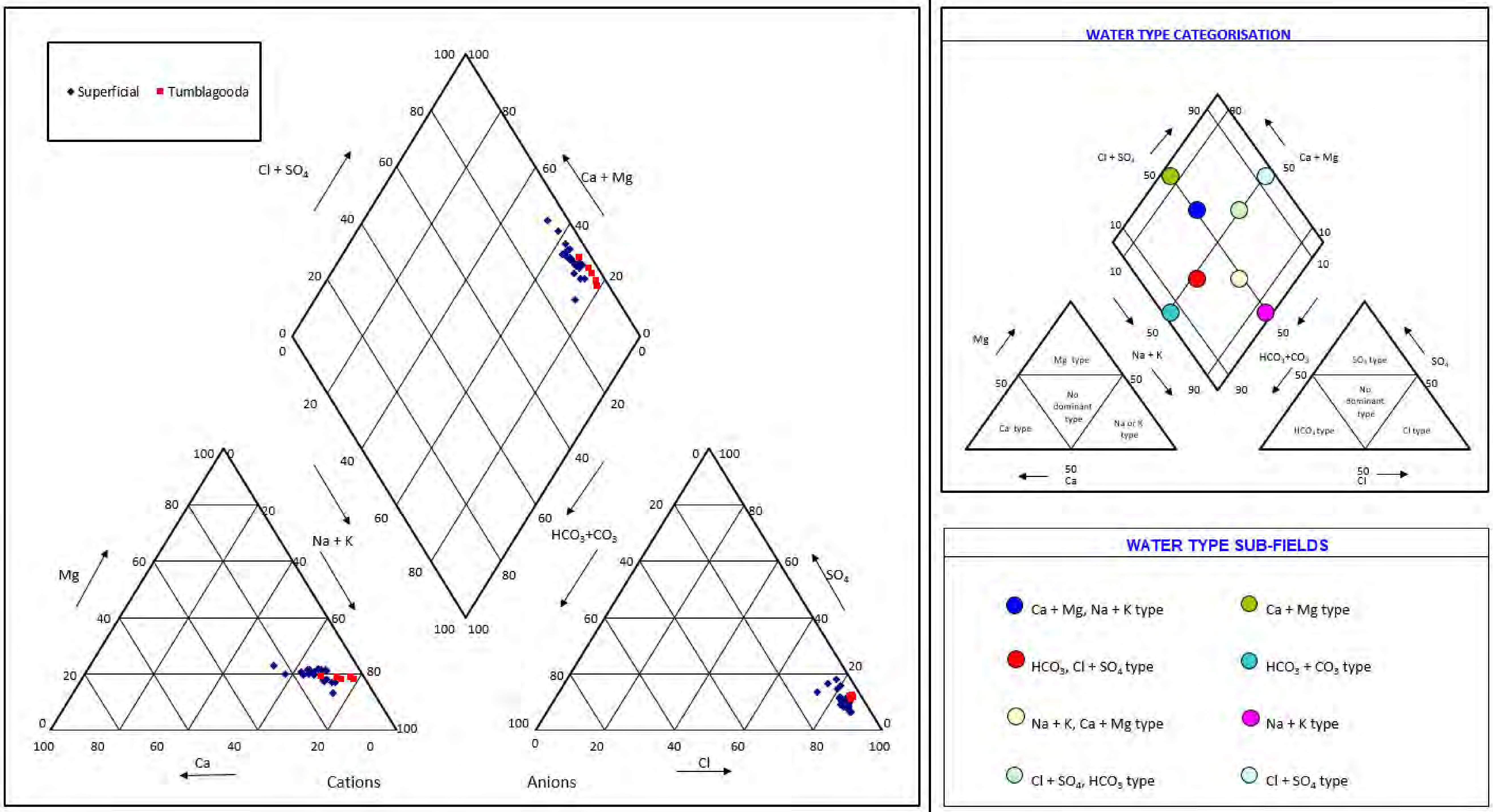
Table 4: Lucky Bay Project Groundwater Quality Lab Results

Site		PB1					PB2				PB3	
Sample Date		26/10/2009	30/10/2021	13/04/2022	6/04/2023	17/03/2024	26/10/2009	30/10/2021	6/04/2023	18/03/2024	1/11/2009	18/03/2024
pH (Field)	-	7.9	-	7.2	6.7	7.2	8.1	-	6.8	7.0	7.9	7.1
EC (Field)	µS/cm	5430	5068	5265	6046	7054	6170	7305	8041	9485	12270	7799
pH (Lab)	-	8.1	7.7	7.7	8.2	7.7	8.1	7.8	8.1	7.7	7.9	7.9
TDS (Lab)	mg/L	3230	3200	3100	3300	4200	4960	5500	5100	5500	6240	4600
Ca	mg/L	130	130	150	180	200	335	330	270	320	168	150
K	mg/L	30	34	37	33	33	23	31	28	29	44	37
Mg	mg/L	115	110	130	170	180	195	180	220	230	190	150
Na	mg/L	837	680	710	1000	1000	836	970	1300	1300	1530	1200
Sulfate	mg/L	360	320	310	360	280	327	470	480	440	569	400
Fluoride	mg/L	0.4	0.9	0.6	0.7	0.7	0.4	0.6	0.9	0.8	0.3	0.8
Chloride	mg/L	1210	1700	1600	1900	2200	1900	2600	3100	3000	2310	2400
Hydroxide (mg CaCO3/L)	OH-	<1		< 5	< 5	<5	<1		< 5	<5	<1	<5
Bicarbonate (mg CaCO3/L)	HCO3-	209		220	250	240	233		300	300	282	340
Carbonate (mg CaCO3/L)	CO32-	<1		< 5	< 5	<5	<1		< 5	<5	<1	<5
Total Alkalinity (mg CaCO3/L)	Total	209	240	220	250	240	233	260	300	300	282	340
Ag	µg/L	-	< 0.001				-	< 0.001			-	
Al	mg/L	-	0.16	< 0.01	< 0.05	<0.05	-	0.12	< 0.05	<0.05	-	<0.05
As	µg/L	<0.01	0.003		0.002	<0.001	<0.01	0.002	0.003	0.002	0.01	0.002
Ba	µg/L	<0.1	0.06				0.2	0.11			0.2	
Cd	µg/L	<0.05	< 0.0001				<0.005	< 0.0001			<0.005	
Cr	mg/L	-	0.002	< 0.002	< 0.002	0.004	-	0.004	0.003	0.003	-	<0.002
Cu	mg/L	<0.01	< 0.001		< 0.001	<0.001	<0.01	< 0.001	< 0.001	<0.001	<0.01	<0.001
Fe	mg/L	<0.05	0.21	0.07	0.02	<0.01	<0.05	< 0.01	< 0.01	<0.01	0.11	0.7
Mn	mg/L	0.06	0.03	0.05	0.032	0.018	0.06	< 0.01	0.008		0.34	0.23
Ni	mg/L	<0.01	0.001		0.005	0.007	<0.01	0.002	0.001	0.001	<0.01	0.002
Pb	µg/L	<0.01	< 0.001				<0.01	< 0.001			<0.01	
Sb	µg/L	-	< 0.001				-	< 0.001			-	
Si	mg/L	67.3	62	56	71	72	75.3	66	83	83	92.5	71
Sn	µg/L	-	< 0.01				-	< 0.01			-	
Sr	µg/L	-	2				-	2.2			-	
U	mg/L	-	0.003	0.005	0.004	0.002	-	0.005	0.006	0.004	-	<0.001
Zn	mg/L	<0.01	< 0.005		< 0.005	<0.005	0.01	0.14	< 0.005	0.025	0.02	1.2

Site		PB4			PB5			PB6			PB7	PB8		
Sample Date		23/08/2022	6/04/2023	18/03/2024	18/10/2022	6/04/2023	18/03/2024	18/10/2022	6/04/2023	18/03/2024	18/03/2024	18/10/2022	6/04/2023	18/03/2024
pH (Field)	-	7.2	6.9	7.2	7.4	7.0	7.2	7.6	7.0	7.2	7.5			7.7
EC (Field)	µS/cm		9016	8499	8650	7070	8252	8730	7041	9044	8132			4103
pH (Lab)	-		8.2	7.9		8.2	7.9		8.2	8.0	8.1		8.3	8.3
TDS (Lab)	mg/L		5100	5000		4700	4800		5200	5300	4800		2200	2400
Ca	mg/L	230	210	190	210	190	190	220	240	230	200	170	150	93
K	mg/L		40	34		37	38		39	38	35		20	16
Mg	mg/L		280	210		250	220		230	210	170		120	62
Na	mg/L		1700	1200		1500	1300		1700	1500	1300		720	660
Sulfate	mg/L		330	270		330	280		810	840	440		200	250
Fluoride	mg/L		1	1		1.2	1.1		1	0.9	1		0.6	0.6
Chloride	mg/L		3300	2800		2900	2600		3000	2700	2600		1500	1000
Hydroxide (mg CaCO3/L)	OH-		< 5	<5		< 5	<5		< 5	<5			< 5	<5
Bicarbonate (mg CaCO3/L)	HCO3-		380	340		350	310		260	260	290		210	280
Carbonate (mg CaCO3/L)	CO32-		< 5	<5		< 5	<5		< 5	<5	<5		< 5	<5
Total Alkalinity (mg CaCO3/L)	Total		380	340		350	310		260	260	290		210	280
Ag	µg/L	< 0.001			< 0.001			< 0.001				< 0.001		
Al	mg/L		< 0.05	<0.05		< 0.05	<0.05		< 0.05	<0.05	<0.05		< 0.05	<0.05
As	µg/L	0.005	0.005	0.003	0.006	0.007	0.005	0.003	0.004	0.003	0.001	< 0.001	< 0.001	0.001
Ba	µg/L													
Cd	µg/L													
Cr	mg/L		0.004	<0.002		< 0.002	0.004		< 0.002	<0.002	<0.002		< 0.002	<0.002
Cu	mg/L		< 0.001	<0.001		< 0.001	<0.001		< 0.001	<0.001	<0.001		< 0.001	<0.001
Fe	mg/L		< 0.01	<0.01		< 0.01	<0.01		< 0.01	<0.01	<0.01		< 0.01	<0.01
Mn	mg/L		< 0.005	<0.005		< 0.005	<0.005		0.063	0.05	0.43		0.01	0.04
Ni	mg/L		0.004	0.004		< 0.001	<0.001		0.003	0.002	0.004		0.002	<0.001
Pb	µg/L													
Sb	µg/L													
Si	mg/L	79	90	87	87	89	86	76	77	79	78	61	63	80
Sn	µg/L	< 5			< 5			< 5				< 5		
Sr	µg/L	6.3			4.8			2.1				1.8		
U	mg/L	0.007	0.008	0.004	0.006	0.007	0.004	0.004	0.004	0.002	<0.001	0.001	0.001	<0.001
Zn	mg/L		< 0.005	0.13		< 0.005	<0.005		< 0.005	<0.005	<0.005		< 0.005	<0.005

Site		PB9			TPB1			TPB2			
Sample Date		18/10/2022	6/04/2023	18/03/2024	18/10/2022	6/04/2023	18/03/2024	30/10/2021	13/04/2022	6/04/2023	18/03/2024
pH (Field)	-	7.8	7.1	7.4	6.5	6.4	6.0			6.7	6.7
EC (Field)	µS/cm	4820	4034	4176	2437	2066	2965		2373	2079	3106
pH (Lab)	-		8.3	8.1		7.8	7.3	6.5	6.6		7.6
TDS (Lab)	mg/L		2200	2500		1300	1700	840	1300		1700
Ca	mg/L	170	150	130	31	42	43	4.7	48		61
K	mg/L		20	18		18	16	20	16		13
Mg	mg/L		120	90		69	62	18	48		59
Na	mg/L		720	540		530	450	170	210		390
Sulfate	mg/L		200	180		160	160	72	110		140
Fluoride	mg/L		0.6	0.5		0.2	0.3	0.3	0.4		0.3
Chloride	mg/L		1500	1200		860	810	430	660		810
Hydroxide (mg CaCO3/L)	OH-		< 5	<5		< 5	<5		< 5		<5
Bicarbonate (mg CaCO3/L)	HCO3-		210	190		47	42		50		58
Carbonate (mg CaCO3/L)	CO32-		< 5	<5		< 5	<5		< 5		<5
Total Alkalinity (mg CaCO3/L)	Total		210	190		47	42	43	50		58
Ag	µg/L	< 0.001			< 0.001			< 0.001			
Al	mg/L		< 0.05	<0.05		< 0.05	<0.05	0.19	< 0.01		<0.05
As	µg/L	< 0.001	< 0.001	<0.001	< 0.001	< 0.001	<0.001	< 0.001			<0.001
Ba	µg/L							0.08			
Cd	µg/L							< 0.0001			
Cr	mg/L		< 0.002	<0.002		< 0.002	<0.002	< 0.001	< 0.002		<0.002
Cu	mg/L		< 0.001	<0.001		< 0.001	<0.001	< 0.001			<0.001
Fe	mg/L		< 0.01	<0.01		0.02	<0.01	20	0.02		<0.01
Mn	mg/L		0.01	0.01		0.055	0.04	0.19	0.05		
Ni	mg/L		0.002	0.003		0.004	0.002	0.004			0.002
Pb	µg/L							< 0.001			
Sb	µg/L							< 0.001			
Si	mg/L	61	63	62	25	31	31	20	35		46
Sn	µg/L	< 5			< 5			< 0.01			
Sr	µg/L	1.8			0.39			0.07			
U	mg/L	0.001	0.001	<0.001	< 0.001	< 0.001	<0.001	< 0.001	< 0.001		<0.001
Zn	mg/L		< 0.005	<0.005		0.006	0.006	0.006			0.026

Site		TPB3			Percentile			Livestock Drinking Water DGV (ANZECC 2000/ANZG 2018)	NPUG (DER 2014)	Freshwater Ecosystem Protection 95% DGV (ANZECC 2000/ANZG 2018)
Sample Date		23/08/2022	6/04/2023	18/03/2024	P20	P50	P80			
pH (Field)	-	7.1	6.5	6.4	6.7	7.1	7.4	6.5-8.5	N/G	6.5-8.5
EC (Field)	µS/cm	1113	2069	2754	2796	6108	8450	6250	N/G	N/G
pH (Lab)	-		7.7	7.5	7.7	7.9	8.2	6.5-8.5	N/G	6.5-8.5
TDS (Lab)	mg/L		1500	1600	1700	3750	5100	4000	N/G	N/G
Ca	mg/L	5	19	18	47	170	222	1000	N/G	N/G
K	mg/L		13	13	16.8	30	37	N/G	N/G	N/G
Mg	mg/L		66	56	63.6	160	216	No limit	N/G	N/G
Na	mg/L		540	430	534	903	1300	N/G	N/G	N/G
Sulfate	mg/L		170	150	164	295	440	1000	1000	N/G
Fluoride	mg/L		0.4	0.3	0.34	0.6	0.96	2	15	N/G
Chloride	mg/L		880	760	868	1900	2760	N/G	250	N/G
Hydroxide (mg CaCO3/L)	OH-		< 5	<5				N/G	N/G	N/G
Bicarbonate (mg CaCO3/L)	HCO3-		58	42	58	250	302	N/G	N/G	N/G
Carbonate (mg CaCO3/L)	CO32-		< 5	<5				N/G	N/G	N/G
Total Alkalinity (mg CaCO3/L)	Total		58	42	58	245	300	N/G	N/G	N/G
Ag	µg/L	< 0.001						N/G	1000	0.05
Al	mg/L		< 0.05	<0.05	0.136	0.16	0.178	5	0.2	0.055
As	µg/L	< 0.001	< 0.001	<0.001	0.002	0.003	0.005	500	100	13
Ba	µg/L				0.076	0.11	0.2	N/G	20000	N/G
Cd	µg/L							10	20	0.2
Cr	mg/L		< 0.002	<0.002	0.003	0.004	0.004	1	0.5	0.0033
Cu	mg/L		< 0.001	<0.001				1	20	0.0014
Fe	mg/L		< 0.01	<0.01	0.02	0.09	0.504	No limit	0.3	0.3
Mn	mg/L		0.017	0.02	0.017	0.04	0.063	N/G	5	1.9
Ni	mg/L		0.003	0.002	0.002	0.002	0.004	1	0.2	0.011
Pb	µg/L							100	100	3.4
Sb	µg/L							N/G	30	9
Si	mg/L	13	25	25	34.2	71	83	N/G	N/G	N/G
Sn	µg/L	< 5						N/G	N/G	N/G
Sr	mg/L	0.099			0.3318	1.9	2.72	N/G	N/G	N/G
U	mg/L	< 0.001	< 0.001	<0.001	0.0018	0.004	0.006	0.2	0.17	N/G
Zn	mg/L		< 0.005	<0.005	0.006	0.0225	0.132	20	3	0.008



Lucky Bay Garnet Project

Piper Diagram

Date: 10/07/24

https://darkwatercloud.sharepoint.com/Shared Documents/MinRes/Lucky Bay/Study/Documents/Tables/[MRL_Typing.xlsm]Project Information

Project: Lucky Bay Garnet

Project No:

Description: Groundwater Typing

Client: Mineral Resources Ltd

Figure 8: Lucky Bay Piper Diagram

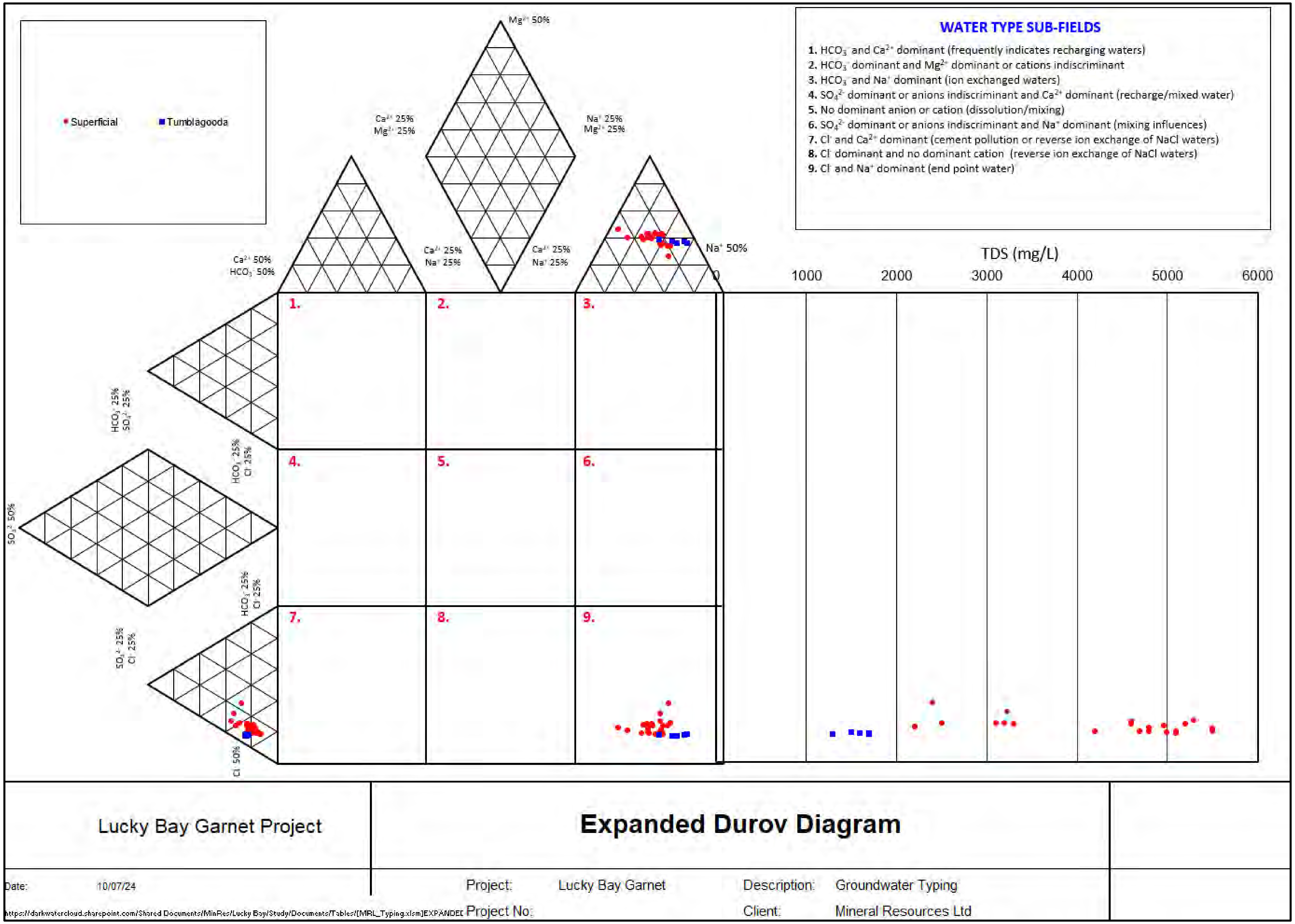
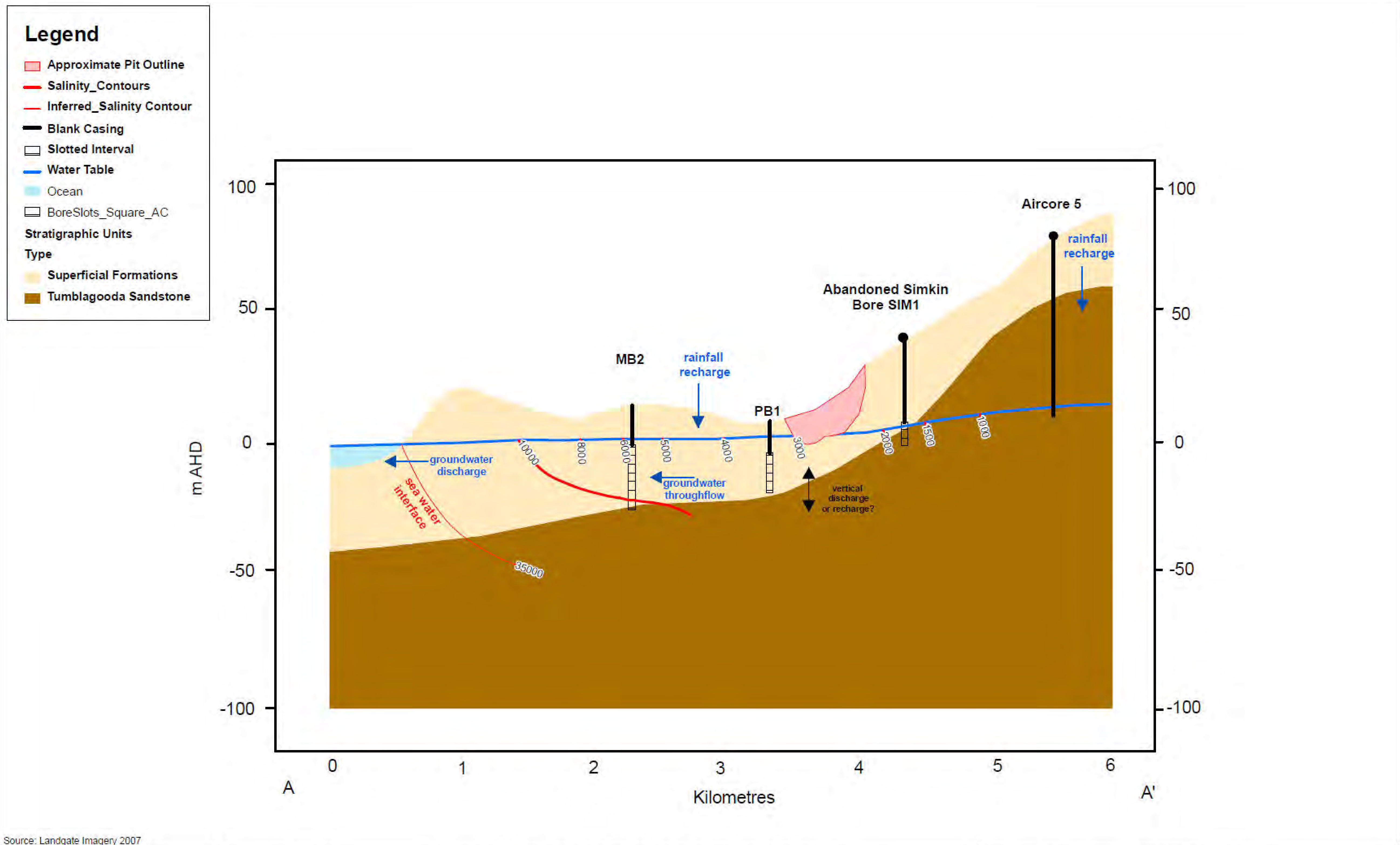


Figure 9: Lucky Bay Expanded Durov Diagram

5.7 Conceptual Hydrogeological Model

The conceptual hydrogeological model developed by URS (2010) has been maintained in subsequent studies and regulatory submissions. This model is shown in Figure 10, and is described below.

- The project area is underlain by a highly permeable unconfined aquifer within the unconsolidated calc-arenite sediments of the Superficial Formations.
- The Superficial Formation aquifer is regionally wedge-shaped; and is bounded to the east by the contact with the underlying Tumblagooda Sandstone. To the west of the proposed pits, The Superficial Formations are at least 35 m thick.
- Groundwater flow is in a westerly to south-westerly direction, with discharge from the Superficial Formations to the ocean near the coastline.
- The Superficial Formations aquifer is highly permeable with hydraulic conductivities in the range of 40 – 80 m /day. The coarse clean sand and gravel sequences intersected by drilling throughout the project area supports the K values derived from aquifer testing.
- Aquifer testing indicates unconfined aquifer responses but with variable specific yield values. Specific yield values of 0.1 – 0.2 were adopted for impact assessments based on the Aircore sampling as well as aquifer testing.
- Direct rainfall recharge to the Superficial Formations is considered to be relatively low; in the order of 1 – 5% in the project area, although it is noted that this could be underestimated.



Source: Landgate Imagery 2007

Client	Project	Title
ALTURA MINING	BALLINE GARNET PROJECT, GROUNDWATER SUPPLY - BORE INSTALLATION AND TESTING PHASE	CONCEPTUAL HYDROGEOLOGY
URS	Drawn: RM Job No.: 42907332	Approved: TH File No.: Conceptual Diagram.mxd
	Date: 05/01/2010	Figure: 17
	Rev. A	A4

Figure 10: Lucky Bay Conceptual Hydrogeological Model (URS, 2010)

6. Groundwater Impact Assessment

6.1 Stockpile Characterisation

The stockpile, shown previously in Figure 2, consists primarily of clean sand tailings, or subsoil, from the pit. The surface of the stockpile is proposed to be used for the creation of solar drying cells in which clay fraction slimes, a waste product produced by the wet concentrator plant, will be deposited.

Ten subsoil samples and one slime sample were subject to a water leach to assess the water quality of any associated seepage. These results are shown in Table 6. The filtered leachate solutions were analysed for a range of elements including major ions (calcium, magnesium, potassium, sodium, sulfate and chloride) and other environmentally significant metals and metalloids. Leachates were simultaneously tested for electrical conductivity (EC), pH, fluoride and alkalinity (bicarbonate, carbonate and hydroxide forms).

The results of the subsoil water leachate were compared to non-potable use guidelines (NPUG) (DER 2021) and livestock drinking water guidelines (ANZECC 2000/ANZG 2018). All samples, except a single sample from North Menari North, reported concentrations below guideline values. The reported aluminium concentration in this sample exceeded the NPUG of 0.2 mg/L with a concentration of 0.23 mg/L. This single exceedance is deemed to be low risk.

The results of the slime water leachate were also compared to livestock drinking water guidelines (ANZECC 2000/ANZG 2018) and non-potable use guidelines (NPUG) (DER 2014). The concentrations of metals and metalloids were all below guideline values indicating the decant liquid presents a low risk to the environment. All tested subsoil and slime samples were classified as non-acid forming.

6.2 Groundwater Levels

Sand tailings are wet stacked and will be 20 to 30% saturated by volume upon deposition. Previous analytical estimates of seepage by URS (2010) estimated 0.1 m of mounding beneath the tailings stockpile. As tailings were proposed to be returned to the pit with the introduction of associated seepage, the scale of seepage associated mounding is not expected to significantly differ to previously approved scenarios. Continued operation of production bores proximal to the stockpile will capture seepage and produce drawdown that will offset any seepage associated mounding.

Slime cells placed on top of the stockpile are expected to self-seal, intercepting potential direct rainfall recharge to the underlying Superficial Formations aquifer, which will instead evaporate. Previous studies indicate that direct rainfall recharge makes up a small portion of the overall water balance. Based upon the proposed stockpile dimensions (0.2 km^2 footprint) and previous rainfall recharge estimates by URS (2010), the footprint may potentially intercept 700 to 3,500 kL per annum. This volume is a small portion of total aquifer throughflow and rainfall recharge across the Project area. Previously approved scenarios included burial of slime cells, which would also act as a barrier to recharge.

Given the majority of sand tails will still be returned to the pit shell, bringing the pit base to well above the groundwater table, there is no anticipated impact to groundwater levels via any changes to evaporation rates.

6.3 Groundwater Quality

Piper and Expanded Durov diagrams showing water quality characteristics of subsoil and slime leachate samples compared to groundwater quality are shown in Figure 11 and Figure 12, respectively. Comparison of P20, P50, and P80 concentrations for groundwater and tested leachate is shown in Table 5.

Material characterisation of subsoil and slime leachate indicates that any seepage will exhibit low salinity, low concentrations of metals, and will be non-acid forming. Leachate water chemistry reported below drinking water and livestock guideline values, with the exception of one sample slightly exceeding NPUG aluminium concentrations.

Previous investigations, and ongoing salinity profiling of monitoring bores completed as part of Groundwater Operating Strategy monitoring requirements, indicate that there is no freshwater lens present within the Superficial Formations aquifer.

The volume and quality of seepage in a permanent stockpile scenario does not differ from the previously approved in-pit deposition scenario. Both scenarios include seepage of water content within clean sand tails and slime tails, with subsequent interactions between tails materials and direct rainfall recharge.

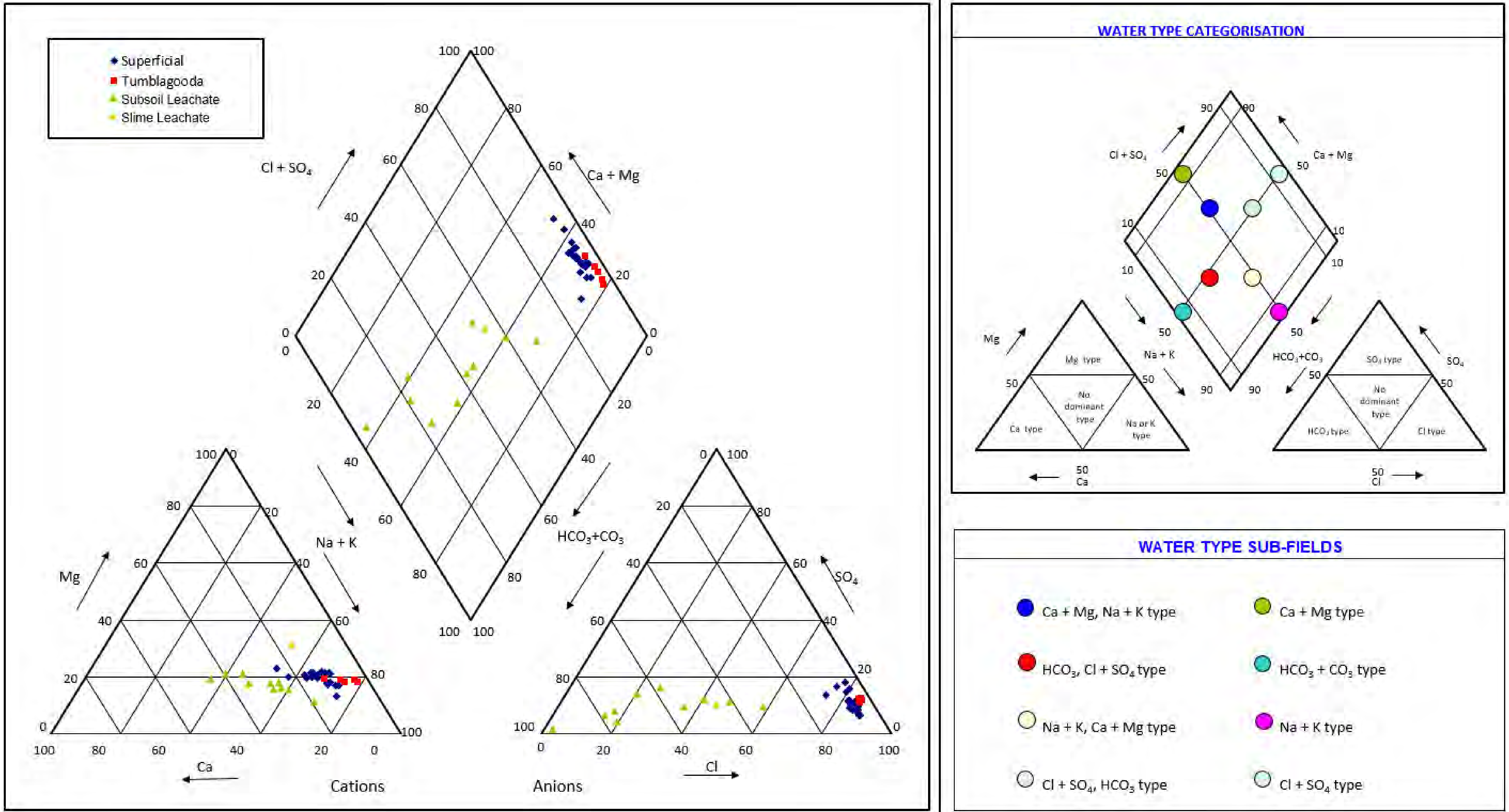
While, with the exception of pH, the individual signatures of leachate and groundwater do not significantly exceed any applied water quality standards, there is the potential for water quality changes resulting from mixing, geochemical reactions generated as a result of mixing between waters of different chemical characteristics. Characterisation of water quality resultant from groundwater-leachate mixing, and any potential associated geochemical processes, would require assessment by a suitably qualified geochemist.

Table 5: Comparison between Groundwater and Leachate Water Quality

Site		Groundwater Percentile			Leachate Percentile			Difference (%)		
Sample Date		P20	P50	P80	P20	P50	P80	P20	P50	P80
pH (Lab)	-	7.7	7.9	8.2	9.3	9.4	9.5	121%	119%	116%
TDS (Lab)	mg/L	1700	3750	5100	106.752	124.16	156.032	6%	3%	3%
Ca	mg/L	47	170	222	10.8	11.8	13.8	23%	7%	6%
K	mg/L	16.8	30	37	2	3.4	4.2	12%	11%	11%
Mg	mg/L	63.6	160	216	3.52	3.99	5.36	6%	2%	2%
Na	mg/L	534	903	1300	14.7	21.2	36.9	3%	2%	3%
Sulfate	mg/L	164	295	440	9.7	14.1	20.4	6%	5%	5%
Fluoride	mg/L	0.34	0.6	0.96	0.6	0.8	0.91	176%	133%	95%
Chloride	mg/L	868	1900	2760	19	29	58	2%	2%	2%
Hydroxide (mg CaCO3/L)	mg/L	-	-	-	-	-	-	-	-	-
Bicarbonate (mg CaCO3/L)	mg/L	58	250	302	37	54	126	64%	22%	42%
Carbonate (mg CaCO3/L)	mg/L	-	-	-	23	27	38.6	-	-	-
Total Alkalinity (mg CaCO3/L)	mg/L	58	245	300	63.6	78	164.2	110%	32%	55%
Al	mg/L	0.136	0.16	0.178	0.038	0.08	0.102	28%	50%	57%
As	mg/L	0.002	0.003	0.005	0.0015	0.0018	0.0022	75%	60%	44%
Ba	mg/L	0.076	0.11	0.2	0.0033	0.0058	0.0155	4%	5%	8%
Fe	mg/L	0.02	0.09	0.504	0.1	0.1	0.1	500%	111%	20%
Mn	mg/L	0.017	0.04	0.063	0.001	0.001	0.001	6%	3%	2%
Si	mg/L	34.2	71	83	-	-	-	-	-	-
Sn	µg/L	-	-	-	0.22	0.45	0.92	-	-	-
Sr	mg/L	0.3318	1.9	2.72	0.5179	0.6112	1.6797	156%	32%	62%

Table 6: Subsoil and Slime Leachate Water Quality Analysis.

Category		Subsoil (North Menari)								Subsoil (Menari)		Slime Decant	Percentile			Livestock Drinking Water DGV (ANZECC 2000/ANZG 2018)	NPUG (DER 2014)	Freshwater Ecosystem Protection 95% DGV (ANZECC 2000/ANZG 2018)
Sample ID		MNNcomp 2	MNNcomp 4	MNNcomp 5	MNNcomp 7	MNScomp 2	MNScomp 6	MNScomp 7	MNScomp 9	MAScomp 2	MAScomp 4	DC_01	P20	P50	P80			
pH	-	9.3	9.5	9.3	9.5	9.6	9.4	9.3	9.3	9.4	9.5	8.8	9.3	9.4	9.5	6.5-8.5	N/G	6.5-8.5
EC	µS/cm	202	186	417	228	146	172	307	223	134	181	970	172	202	307	6250	N/G	N/G
TDS	mg/L	129.28	119.04	266.88	145.92	93.44	110.08	196.48	142.72	85.76	115.84		106.752	124.16	156.032	4000	N/G	N/G
Ca	mg/L	10.4	11.9	15.2	10.8	10.8	10.9	13.8	12	11.8	8.3	31.4	10.8	11.8	13.8	1000	N/G	N/G
K	mg/L	2.4	1.9	4.2	2.5	1.6	2	4.1	5.6	3.4	3.9	9.6	2	3.4	4.2	N/G	N/G	N/G
Mg	mg/L	3.89	3.67	5.36	4.54	3.52	3.99	5.38	4.06	3.07	3.12	37.35	3.52	3.99	5.36	No limit	N/G	N/G
Na	mg/L	21.2	17.8	60.9	25.3	11.4	14.7	36.9	23.6	8.9	18.8	115.6	14.7	21.2	36.9	N/G	N/G	N/G
Sulfate	mg/L	9.1	11.8	20.4	14.1	9.7	13.1	18.1	21.1	9.3	17.3	41.8	9.7	14.1	20.4	1000	1000	N/G
Fluoride	mg/L	0.69	0.47	0.26	0.91	0.71	0.8	0.6	1.47	0.8	1.1	0.9	0.6	0.8	0.91	2	15	N/G
Chloride	mg/L	31	29	95	39	15	22	58	25	12	19	142	19	29	58	N/G	250	N/G
Hydroxide (mg CaCO3/L)	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-	-	N/G	N/G	N/G
Bicarbonate (mg CaCO3/L)	mg/L	121	34	41	54	55	126	37	49	359	34	243	37	54	126	N/G	N/G	N/G
Carbonate (mg CaCO3/L)	mg/L	45	12	24	24	30	37	23	23	206	35	<1	23	27	38.6	N/G	N/G	N/G
Total Alkalinity (mg CaCO3/L)	mg/L	166	46	66	78	85	163	60	72	565	69	243	63.6	78	164.2	N/G	N/G	N/G
Ag	µg/L	0.04	0.01	0.02	<0.01	<0.01	<0.01	0.01	<0.01	0.02	0.02	<0.01	0.01	0.02	0.02	N/G	1000	0.05
Al	mg/L	0.11	0.23	0.03	0.07	0.1	0.09	0.06	0.04	0.09	0.01	<0.01	0.038	0.08	0.102	5	0.2	0.055
As	µg/L	1.9	1.7	0.8	2.2	1.7	1.8	2	1.5	0.9	3	3	1.5	1.8	2.2	500	100	13
Ba	µg/L	1.9	5.8	21.6	2.3	7.6	3.3	14.9	4.8	15.5	5.67	54.1	3.3	5.8	15.5	N/G	20000	N/G
Bi	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	N/G	N/G	N/G
Cd	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	-	10	20	0.2
Ce	µg/L	0.011	<0.002	0.004	<0.002	<0.002	<0.002	<0.002	0.003	0.071	<0.002	<0.002	0.0036	0.0075	0.035	N/G	N/G	N/G
Co	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	1000	N/G	1.4
Cr	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<10	<10	<0.01	-	-	-	1	0.5	0.0033
Cu	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<1	<1	0.002	0.002	0.002	0.002	1	20	0.0014
Fe	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.1	<0.01	<0.05	0.1	0.1	0.1	No limit	0.3	0.3
Hg	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	2	10	0.6
La	µg/L	0.008	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	0.047	<0.002	<0.002	0.005	0.008	0.0314	N/G	N/G	N/G
Hf	µg/L	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	0.018	<0.005	<0.005	<0.005	0.0092	0.0125	0.0158	N/G	N/G	N/G
Mn	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.1	0.001	0.001	0.001	N/G	5	1.9
Mo	µg/L	0.36	0.39	0.52	0.28	0.17	0.28	0.6	0.92	0.48	0.75	17.58	0.28	0.48	0.75	150	500	34
Ni	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	1	0.2	0.011
Pb	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	100	100	3.4
Sb	µg/L	1.95	1.83	1.58	3.9	1.48	2	1.79	1.22	1.8	1.59	0.12	1.48	1.79	1.95	N/G	30	9
Sc	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<10	-	-	-	N/G	N/G	N/G
Sn	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	1.4	0.3	0.6	0.22	0.45	0.92	N/G	N/G	N/G
Sr	µg/L	533.6	2291.6	289.3	611.2	828.1	976.4	517.9	1679.7	539.7	481.72	2195	517.9	611.2	1679.7	N/G	N/G	N/G
Te	µg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	N/G	N/G	N/G
Ti	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	-	-	-	N/G	N/G	N/G
Tl	µg/L	<0.01	<0.01	0.02	0.01	<0.01	<0.01	0.02	0.02	0.01	0.02	<0.01	0.01	0.02	0.02	N/G	N/G	0.03
W	µg/L	0.36	0.49	2.02	0.51	0.29	0.41	1.21	1.18	0.35	0.59	4.38	0.36	0.51	1.21	N/G	N/G	N/G
Zn	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<10	-	-	-	20	3	0.008



Lucky Bay Garnet Project	**Piper Diagram**			
Date: 10/07/24	Project:	Lucky Bay Garnet	Description:	Groundwater Typing
https://darkwatercloud.sharepoint.com/Shared Documents/MinRes/Lucky Bay/Study/Documents/Tables/[MRL_Typing.xlsm]PIPER	Project No:		Client:	Mineral Resources Ltd

Figure 11: Lucky Bay Piper Diagram Including Leachate Samples

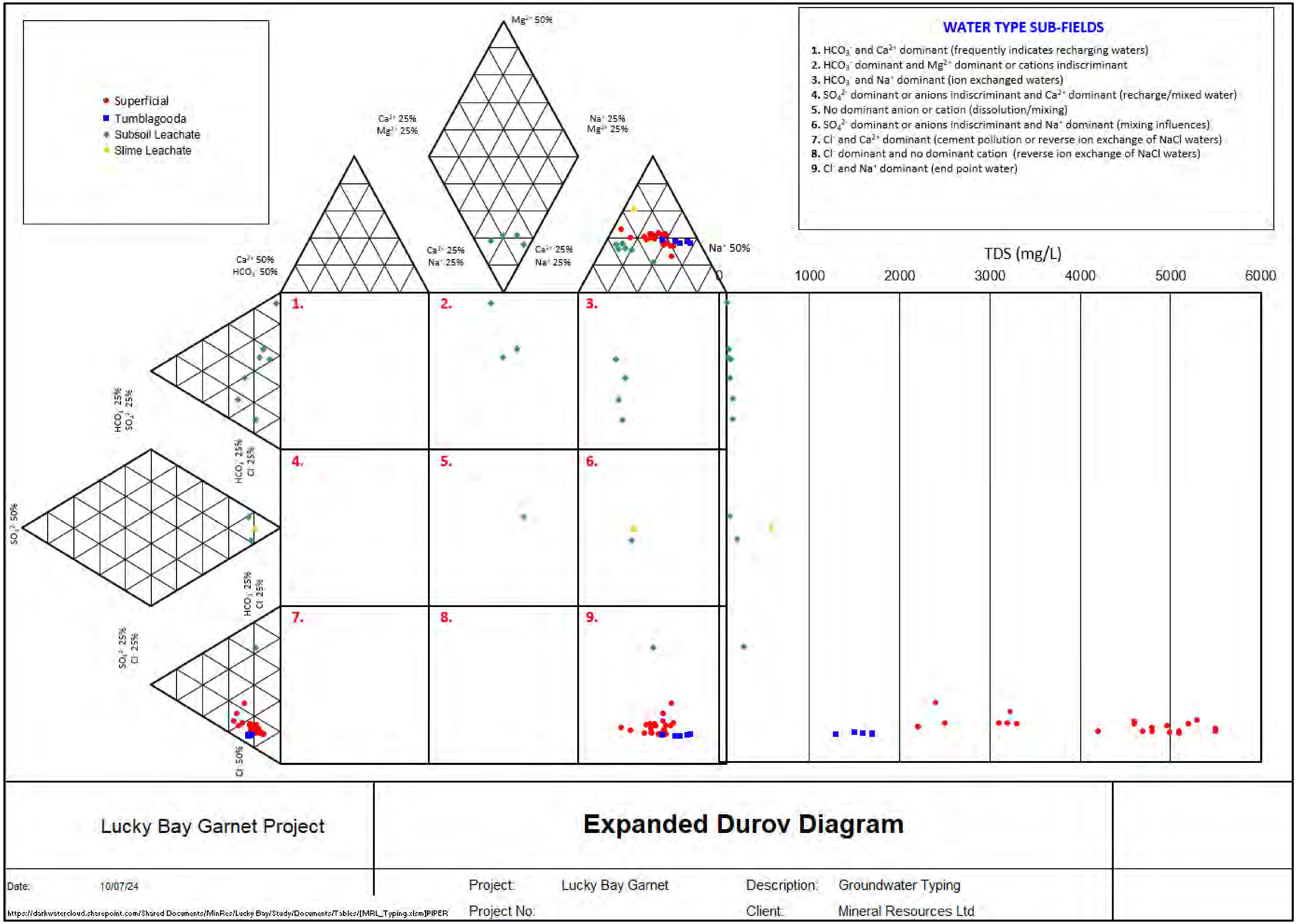


Figure 12: Lucky Bay Expanded Durov Diagram Including Leachate Samples

7. Conclusion

This assessment has consisted of a desktop assessment of previous works and approvals documentation, with additional context provided by the most recent monitoring data. Review of existing works suggests that a permanent ex-pit stockpile, comprising around 9% of the total tails generated, will not significantly change any impacts to groundwater levels or quality when compared to the previous complete in-pit depositional scenario.

7.1 Uncertainties

While, with the exception of pH, the individual signatures of leachate and groundwater do not significantly exceed any applied water quality standards, there is the potential for water quality changes resulting from mixing. Characterisation of water quality resultant from groundwater-leachate mixing, and any potential associated geochemical processes, would require assessment by a suitably qualified geochemist.

8. References

Australian Garnet Pty Ltd, 2021. *Groundwater Operating Strategy, Lucky Bay Garnet Mine: E70/2509, G70/253, L70/134, L70/166, L70/167, L70/168, L70/169, L70/170, M70/1280, M70/1387*. Submission to Department of Water and Environmental Regulation, dated 20th December 2021.

Australian Garnet Pty Ltd, 2022a. *Mine Closure Plan, Lucky Bay Garnet Project - Phase 1: M 70/1280, M70/1387, G 70/253, L 70/134, L 70/166, L70/167, L 70/168, L 70/170, L 70/178, L 70/215*. Submission to Department of Mines, Industry Regulation and Safety, dated 4 February 2022.

Australian Garnet Pty Ltd, 2022b. *Mining Proposal, Lucky Bay Garnet Project, Revision 2, Version 1 - M 70/1280, M70/1387, G 70/253, L 70/134, L 70/166, L70/167, L 70/168, L70/170, L70/178, L70/215*. Submission to Department of Mines, Industry Regulation and Safety, dated 29 August 2022.

BG&E Resources, 2024. *Lucky Bay Garnet Project Sand Tailings Stockpile Surface Water Assessment*. Report prepared for Australian Garnet Pty Ltd.

Brandes De Roos, I., 2006. *Examples of Groundwater Sustainability Issues in Mining*. In Water in Mining Conference Proceedings, Brisbane, Qld, 14 – 16 November 2006, pp 211 -214.

Department of Water, 2017. *Northern Perth Basin: Geology, hydrogeology and groundwater resources*, Hydrogeological bulletin series, report no. HB1, Department of Water, Government of Western Australia, Perth.

Geowater Consulting, 2014. *Balline Garnet Project Groundwater Assessment for Increased Abstraction to 1.70 GL/year*. Report prepared for Australian Garnet Pty Ltd.

Onshore Environmental, 2013. *Level 2 Flora and Vegetation Survey Balline Garnet Project*. Prepared for Australian Garnet Pty Ltd.

Onshore Environmental, 2012. *Level 2 Flora and Vegetation Survey Balline Garnet Project*. Prepared for Australian Garnet Pty Ltd.

Rogers, L G, 1996. *Geraldton region land resources survey*. Department of Primary Industries and Regional Development, Western Australia, Perth. Report 13.

Tille, P, 2006. *Soil-landscapes of Western Australia's rangelands and arid interior*. Resource management technical report 313. Department of Agriculture and Food WA.

URS, 2010. *Balline Garnet Project, Groundwater Supplies - Water Bore Installation and Aquifer Testing Phase*. Prepared for Altura Mining Limited, 42907332, 28 January 2010.

Water Direct, 2021. *H2 Level Hydrogeological Assessment: Tumblagooda Sandstone Aquifer, Lucky Bay Garnet Mine, Yallabatharra*, For Australian Garnet Pty Ltd. July 2021.