Appendix A

Aquifer Interference Assessment Framework

AQUIFER INTERFERENCE ASSESSMENT FRAMEWORK

Assessing a proposal against the NSW Aquifer Interference Policy – step by step guide

Note for proponents

This is the basic framework which the NSW Office of Water uses to assess project proposals against the **NSW Aquifer Interference Policy (AIP).**

The NSW Aquifer Interference Policy can be downloaded from the NSW Office of Water website (www.water.nsw.gov.au under Water management > Law and policy > Key policies > Aquifer interference).

While you are not required to use this framework, you may find it a useful tool to aid the development of a proposal or an **Environmental Impact Statement (EIS).**

We suggest that you summarise your response to each AIP requirement in the tables following and provide a reference to the section of your EIS that addresses that particular requirement. Using this tool can help to ensure that all necessary factors are considered, and will help you understand the requirements of the AIP.

Table 1. Does the activity require detailed assessment under the AIP?

	Consideration	Response
1	Is the activity defined as an aquifer interference activity?	Yes
2	Is the activity a defined minimal impact aquifer interference activity according to section 3.3 of the AIP?	No

Note for proponents

Section 3.2 of the AIP defines the framework for assessing impacts. These are addressed here under the following headings:

1. Accounting for or preventing the take of water
2. Addressing the minimal impact considerations
3. Proposed remedial actions where impacts are greater than predicted.

1. Accounting for, or preventing the take of water

Where a proposed activity will take water, adequate arrangements must be in place to account for this water. It is the proponent's responsibility to ensure that the necessary licences are held. These requirements are detailed in Section 2 of the AIP, with the specific considerations in Section 2.1 addressed systematically below.

Where a proponent is unable to demonstrate that they will be able to meet the requirements for the licensing of the take of water, consideration should be given to modification of the proposal to prevent the take of water.

Table 2. Has the proponent:

	AIP requirement	Proponent response	NSW Office of Water comment
1	Described the water source(s) the activity will take water from?	Lachlan Fold Belt (LFB) Murray Darling Basin (MDB) Groundwater Source (refer Section 3.2.1).	
2	Predicted the total amount of water that will be taken from each connected groundwater or surface water source on an annual basis as a result of the activity?	Peak predicted take of 854 ML/yr from the LFB MDB Groundwater Source in 2026 (refer Section 11.2).	
3	Predicted the total amount of water that will be taken from each connected groundwater or surface water source after the closure of the activity?	Ongoing take relates to the new Cobar open cut. Predicted take ranges from 11 ML/yr at 100 years post mining to 18 ML/yr at 1000 years post mining from the LFB MDB Groundwater Source (refer Section 9.6).	
4	Made these predictions in accordance with Section 3.2.3 of the AIP? (refer to Table 3, below)	Yes. Baseline groundwater conditions established (refer Sections 4 and 5). Licensing conditions/rules followed (refer Sections 3.2.1 and 11). Minimal predicted impacts to landholders, licensed water users, GDEs or the environment (refer Section 9).	
5	Described how and in what proportions this take will be assigned to the affected aquifers and connected surface water sources?	Refer Section 11.	
6	Described how any licence exemptions might apply?	None apply.	
7	Described the characteristics of the water requirements?	Refer Section 2 and New Cobar Complex Project: surface water assessment (EMM 2020a).	

	AIP requirement	Proponent response	NSW Office of Water comment
8	Determined if there are sufficient water entitlements and water allocations that are able to be obtained for the activity?	There are enough groundwater entitlements available for purchase within the LFB MDB Groundwater Source. PGM has secured 880 unit shares.	
9	Considered the rules of the relevant water sharing plan and if it can meet these rules?	Project meets the rules of relevant water sharing plans.	
10	Determined how it will obtain the required water?	Mine inflows and water supply pipeline (refer to the New Cobar Complex Project: surface water assessment (EMM 2020a) and EIS).	
11	Considered the effect that activation of existing entitlement may have on future available water determinations?	The LFB MDB Groundwater Source is under-allocated, activation of existing entitlements should not have and effect on future available water determinations (refer Section 3.2.1).	
12	Considered actions required both during and post-closure to minimize the risk of inflows to a mine void as a result of flooding?	Not applicable as proposed backfill method will be to fill stope voids with waste rock, with cemented aggregate fill (CAF) used where necessary.	
13	Developed a strategy to account for any water taken beyond the life of the operation of the project?	PGM will adopt a water balance approach to monitor water take throughout the life of project (refer New Cobar Complex Project: surface water assessment (EMM 2020a).	
Will uncertainty in the predicted inflows have a significant impact on the environment or other authorised water users? No, uncertainty analysis shows potential impacts on the environment and water receptors are not significantly different from the base case and suggests that the adopted model parameter values are conservative with regards to the impact assessment, notably the predicted drawdown contours (refer Section 8.7.4). If **YES,** items 14-16 must be addressed.			
14	Considered any potential for causing or enhancing hydraulic connections, and quantified the risk?	Not applicable.	
15	Quantified any other uncertainties in the groundwater or surface water impact modelling conducted for the activity?	Not applicable.	

	AIP requirement	Proponent response	NSW Office of Water comment
16	Considered strategies for monitoring actual and reassessing any predicted take of water throughout the life of the project, and how these requirements will be accounted for?	Not applicable.	

Table 3. Determining water predictions in accordance with Section 3.2.3
(complete one row only – consider both during and following completion of activity)

	AIP requirement	Proponent response	NSW Office of Water comment
1	**For the Gateway process**, is the estimate based on a simple modelling platform, using suitable baseline data, that is, fit-for-purpose?	Not applicable.	
2	**For State Significant Development or mining or coal seam gas production**, is the estimate based on a complex modelling platform that is: • Calibrated against suitable baseline data, and in the case of a **reliable water source,** over at least two years? • Consistent with the Australian Modelling Guidelines? • Independently reviewed, robust and reliable, and deemed fit-for-purpose?	**Yes** Modelling platform uses the MODFLOW-USG code operated under the Groundwater Vistas 7 GUI (Section 8.232.2). Suitably complex model developed in accordance with the Australian Modelling Guidelines (refer Section 5.4) Calibrated against over two years of reliable baseline data (refer Section 4) The independent review by HydroGeoLogic Pty Ltd deemed the flow model fit-for-purpose (refer Appendix H).	
3	In all other processes, estimate based on a desk-top analysis that is: • Developed using the available baseline data that has been collected at an appropriate frequency and scale; and • Fit-for-purpose?	Not applicable.	

Other requirements to be reported on under Section 3.2.3

Table 4. Has the proponent provided details on:

	AIP requirement	Proponent response	NSW Office of Water comment
1	Establishment of baseline groundwater conditions?	Refer to section 5. Section 6 details the formed conceptual hydrogeological model.	
2	A strategy for complying with any water access rules?	Refer to section 11.	
3	Potential water level, quality or pressure drawdown impacts on nearby basic landholder rights water users?	None identified.	
4	Potential water level, quality or pressure drawdown impacts on nearby licensed water users in connected groundwater and surface water sources?	Refer to section 9.1, 9.2 and 9.4.	
5	Potential water level, quality or pressure drawdown impacts on groundwater dependent ecosystems?	Refer to section 9.1, 9.2 and 9.4.	
6	Potential for increased saline or contaminated water inflows to aquifers and highly connected river systems?	Refer to section 9.4.	
7	Potential to cause or enhance hydraulic connection between aquifers?	There is no potential to connect aquifer and no productive aquifers within the local area.	
8	Potential for river bank instability, or high wall instability or failure to occur?	Not applicable.	
9	Details of the method for disposing of extracted activities (for coal seam gas activities)?	Not applicable.	

2. Addressing the minimal impact considerations

Note for proponents

Section 3.2.1 of the AIP describes how aquifer impact assessment should be undertaken.

1. Identify all water sources that will be impacted, referring to the water sources defined in the relevant water sharing plan(s). Assessment against the minimal impact considerations of the AIP should be undertaken for each ground water source.
2. Determine if each water source is defined as 'highly productive' or 'less productive'. If the water source is named in then it is defined as highly productive, all other water sources are defined as less productive.
3. With reference to pages 13-14 of the Aquifer Interference Policy, determine the sub-grouping of each water source (eg alluvial, porous rock, fractured rock, coastal sands).
4. Determine whether the predicted impacts fall within Level 1 or Level 2 of the minimal impact considerations defined in Table 1 of the AIP, for each water source, for each of water table, water pressure, and water quality attributes. The tables below may assist with the assessment. There is a separate table for each sub-grouping of water source – only use the tables that apply to the water source(s) you are assessing, and delete the others.
5. If unable to determine any of these impacts, identify what further information will be required to make this assessment.
6. Where the assessment determines that the impacts fall within the Level 1 impacts, the assessment should be 'Level 1 – Acceptable'
7. Where the assessment falls outside the Level 1 impacts, the assessment should be 'Level 2'. The assessment should further note the reasons the assessment is Level 2, and any additional requirements that are triggered by falling into Level 2.
8. If water table or water pressure assessment is not applicable due to the nature of the water source, the assessment should be recorded as 'N/A – reason for N/A'.

Table 5. Minimal impact considerations

Aquifer	Fractured rock
Category	Less productive
Level 1 Minimal Impact Consideration	**Assessment**
Water table Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 metres from any: • high priority groundwater dependent ecosystem or • high priority culturally significant site listed in the schedule of the relevant water sharing plan. **OR** A maximum of a 2 metre water table decline cumulatively at any water supply work.	Sections 9.1 and 9.2
Water pressure A cumulative pressure head decline of not more than a 2 metre decline, at any water supply work.	Section 9.1
Water quality Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 metres from the activity.	Sections 9.1 and 9.4

3. Proposed remedial actions where impacts are greater than predicted.

Note for proponents

Point 3 of section 3.2 of the AIP provides a basic framework for considerations to consider when assessing a proponent's proposed remedial actions.

Table 6. Has the proponent:

AIP requirement		Proponent response	NSW Office of Water comment
1	Considered types, scale, and likelihood of unforeseen impacts *during operation*?	Sections 7.1 and 9.7	
2	Considered types, scale, and likelihood of unforeseen impacts *post closure*?	Sections 7.1 and 9.7	
3	Proposed mitigation, prevention or avoidance strategies for each of these potential impacts?	Section 9.7	
4	Proposed remedial actions should the risk minimization strategies fail?	Refer to the PGM Water Management Plan (EMM 2020b).	
5	Considered what further mitigation, prevention, avoidance or remedial actions might be required?	Section 9	
6	Considered what conditions might be appropriate?	Section 9	

4. Other considerations

Note for proponents

These considerations are not included in the assessment framework outlined within the AIP, however are discussed elsewhere in the document and are useful considerations when assessing a proposal.

Table 7: Has the proponent:

AIP requirement		Proponent response	NSW Office of Water comment
1	Addressed how it will measure and monitor volumetric take? (page 4 of the AIP)	Section 10 and the New Cobar Complex Project: surface water assessment (EMM 2020a).	
2	Outlined a reporting framework for volumetric take? (page 4 of the AIP)	Section 10 and the PGM Water Management Plan (EMM 2020b).	

More information

www.water.nsw.gov.au

Disclaimer:

This is a draft document produced as a guide for discussion, and to aid interpretation and application of the NSW Aquifer Interference Policy (2012). All information in this document is drawn from that policy, and where there is any inconsistency, the policy prevails over anything contained in this document.
Any omissions from this framework do not remove the need to meet any other requirements listed under the Policy.

The information contained in this publication is based on knowledge and understanding at the time of writing (October 2020). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the Department of Primary Industries or the users independent adviser.

Published by the NSW Department of Primary Industries.

Reference 12279.1

Appendix B

New Cobar Complex monitoring bore network borelogs

Ncmw01-5

Form A Particulars of completed work

WaterNSW

1

Driller's Licence No:	DL2494
Class of Licence:	4
Driller's Name:	Alan Broad
Assistant Driller:	mitch Hoffman
Contractor:	Budd exploration Drilling
New bore	X
Replacement bore	
Deepened	
Enlarged	
Reconditioned	
Other (specify)	
Final Depth	52 m

2

Work Licence No:	
Name of Licensee:	Aurelia metals
Intended Use:	monitoring Bore
Completion Date:	7/4/20

DRILLING DETAILS **3**

From (m)	To (m)	Hole Diameter (mm)	Drilling Method (See Code 3)
0	52	150	9

WATER BEARING ZONES **4**

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Cumulative	Test method (See Code 4)	D D L at end of test (m)	Duration Hrs	min	Salinity (Conductivity or TDS) Cond (µS/cm)	TDS (mg/L)
21	22	1			0.13	1 H			30		
41	42	1			•25				30		
45	46	1	13.4		4			1			

CASING / LINER DETAILS **5**

Material (Code 5)	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method Fixing (Code 5)
8	60	5	+1	52	5

Casing support method (See Code 5): 2

Type of casing bottom (See Code 5): 2

Centralisers installed (Yes/No): Yes (indicate on sketch)

Sump installed (Yes/No): No From m To m

Pressure cemented (Yes/No): Yes From 0 m To 19 m

Casing Protector cemented in place

WATER ENTRY DESIGN **6**

General: Material (Code 5)	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Opening type (See Code 6)	Fixing (See Code 5)	Screen Aperture (mm)	Slot Details: Length (mm)	Width (mm)	Alignment (See Code 6)
8	60	5	46	52	5	5	1	30	8	H

GRAVEL PACK **7**

Type		Grade		Grain size (mm) From	To	Depth (m) From	To	Quantity Litres	m^3
Rounded	X	Graded		4	6	21	52	460	·46
Crushed		Ungraded							
Bentonite/Grout seal (Yes/No)		Yes				18	21	40	·04

Method of placement of Gravel Pack (See Code 7): 1

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Please submit forms to groundwater@waternsw.com.au or send to WaterNSW, PO Box 398, Parramatta 2124

Form A Particulars of completed work

WaterNSW

BORE DEVELOPMENT 8

Chemical used for breaking down drilling mud	(Yes/No)	NO	Name:									
Method	Bailing/Surging		Jetting		Airlifting		Backwashing		Pumping		Other:	
Duration		hrs		hrs		hrs		hrs		hrs		hrs

DISINFECTION ON COMPLETION 9

Chemical(s) used	Quantity applied (Litres)	Method of application

PUMPING TESTS ON COMPLETION 10

Test type		Date	Pump intake depth (m)	Initial Water Level (SWL) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery Water level (m)	Recovery Time taken (hrs)	Recovery Time taken (mins)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
	Stage 4									
Single stage (constant rate)										

Height of measuring point above ground level ___ m Test Method ___ See Code 4

WORK PARTLY BACKFILLED OR ABANDONED 11

Original depth of work: ___ m Is work partly backfilled: (Yes/No) ___

Is work abandoned: (Yes/No) ___ Method of abandonment: Backfilled ___ Plugged ___ Capped ___

Has any casing been left in the work (Yes/No) ___ From ___ m To ___ m

Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	Sealing / fill type (See Code 11)	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist ___ Geologist ___ Driller ___ Diviner ___ Client ___ Other ___ 12

13

Lot No ___ DP No ___

Work Location Co ordinates Easting 389980 Northing 6513814 Zone 54

GPS: (Yes/No) NO >> AMG/AGD ___ or MGA/GDA ___ (See explanation)

Longitude ___ Latitude ___

Please mark the work site with "X" on the CLID provided map.

Indicate also the distances in metres from two (2) adjacent boundaries, and attach the map to this Form A package.

Signatures: [signature]

Driller: [signature]

Date: 7 4 20

Licensee: PEAK GOLD MINES PTY LTD

Date: 10 JUNE 2020.

Please submit forms to groundwater@waternsw.com.au or send to WaterNSW, PO Box 398, Parramatta 2124

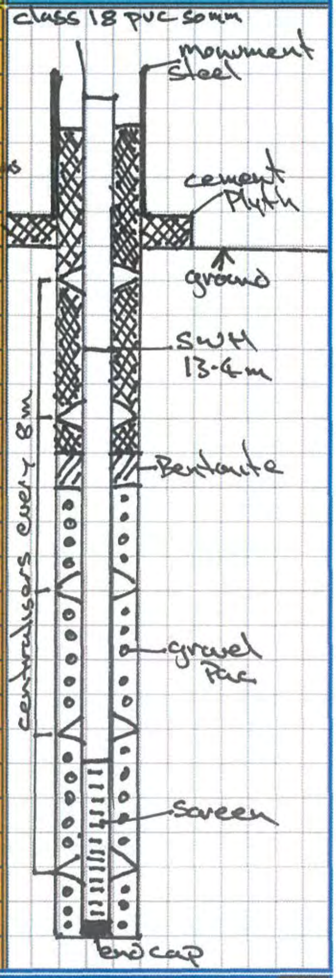
Form A Particulars of completed work

Work Licence No:

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY)

Depth From (m)	Depth To (m)	Description (See Code 15)
0	2	clay/gravel red Fg/cg Puggy
2	20	Siltstone Lt Brown Fg soft
21	26	siltstone Dk Brown/quartzveins weathered
27	33	siltstone white Fg weathered
34	52	siltstone Lt greay Fg Firm with Broken sections

15 WORK CONSTRUCTION SKETCH



16 WORK NOT CONSTRUCTED BY DRILLING RIG

Method of excavation: Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Other

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimentions of liner (m)	From Depth (m)	To Depth (m)

17 Please attach copies of the following if available

Geologist log (Yes/No) NO — Laboratory analysis of water Sample (Yes/No) NO — Pumping test(s) (Yes/No) NO

Geophysical log (Yes/No)		Sieve analysis of aquifer material (Yes/No)		Installed Pump details (Yes/No)	

CODE TABLES

DRILLING METHOD (3)

1	Auger - Hollow Flight	9	Rotary - Percussion - (Down Hole Hammer)
2	Auger - Solid Flight	10	Rotary - Percussion - Foam injection
3	Cable Tool - Drill and Drive Casing	11	Rotary - Reverse circulation - Air
4	Cable Tool - Mud stabilised	12	Rotary - Reverse circulation - Mud
5	Rotary Air	13	Rotary - Coring
6	Rotary - Air/foam	14	Jetted - Air
7	Rotary - Mud	15	Jetted - Water
8	Rotary - Water	16	Other - See page 2, N0 11

WATER BEARING ZONE (4)

TEST METHOD				FLOW MEASURING DEVICE			
1	Airlift	6	Pump - Helical Rot	A	Container of known volun	F	Weir - Rectangular
2	Bailer	7	Pump - Jet	B	Flow meter	G	Weir - V Notch - 60°
3	Pump - Centrifugal	8	Pump - Turbine	C	Flume	H	Weir - V Notch - 90°
4	Pump - Cylinder	9	Freeflow	D	Orifice, plate & manomete	I	Other
5	Pump - Electric submersil			E	Ultra sonic meter		

CASING / LINER DETAILS (5)

MATERIAL						METHOD OF FIXING			
1	A.B.S.	6	PVC - Class 12	11	Steel - Stainless	1	Glued	6	Welded - Butt
2	Aluminium	7	PVC - Class 15	12	Steel - Stainless 304	2	Kwik-lock	7	Welded - Colla
3	Concrete cylinder	8	PVC - Class 18	13	Steel - Stainless 316	3	Packer	8	Other
4	Fibre glass (FRP)	9	Steel - ERW	14	Other	4	Riveted		
5	PVC - Class 9	10	Steel - Galvanised			5	Screwed		

CASING SUPPORT METHOD				TYPE OF CASING BOTTOM			
1	Driven into small hole	5	Held in clamp	1	Open end	5	Casing shoe
2	Seated on bottom	6	Other	2	End cap	6	Wash down shoe
3	Seated on backfill			3	Plug - concrete	7	Cementing shoe
4	Cemented			4	Plug - wood	8	Other

WATER ENTRY DESIGN (6)

OPENING TYPE				SLOT ALIGNMENT	
1	Casing - Bridge slot	7	Casing - Plasma-cut slot	D	Diagonal
2	Casing - Drilled holes	8	Casing - Perforated in hole	H	Horizontal
3	Casing - Hand sawn slot	9	Screen - gauze / mesh	V	Vertical
4	Casing - Louvre slot	10	Screen - round wire		
5	Casing - Machine slotted	11	Screen - wedge wire		
6	Casing - Oxy cut slot				

For MATERIAL and FIXING Codes Please refer to CASING DETAILS code table

GRAVEL PACK - METHOD OF PLACEMENT (7)

1	Poured or shovelled into annul	2	Placed through tremie pipe	3	Reverse circulated

WORK PARTLY BACKFILLED OR ABANDONED - SEALING MATERIAL (11)

1	Cement grout	3	Bentonite	5	Clay	7	Gravel
2	Concrete	4	Drilled cuttings	6	Sand	8	Coarse stone

DRILLER'S ROCK STRATA DESCRIPTION (15)

Reporting sequence	1 Rock type	2 Colour	3 Grain size	4 Texture	To save confusion, write the *full name of colour and abbreviate*
					following: light = lt, dark = dk, fine grained = fg,
Example	Sandstone	Dk Grey	mg	Fractured	medium grained = mg, coarse grained = cg. *Texture can relate* weathered, fractured, broken, hard, soft etc.

Ncmw01-D

Form A Particulars of completed work

WaterNSW

1

Driller's Licence No:	DL2494
Class of Licence:	4
Driller's Name:	Alan Broad
Assistant Driller:	mitch Hoffman
Contractor:	Budd Drilling
New bore	X
Deepened	
Reconditioned	
Replacement bore	
Enlarged	
Other (specify)	
Final Depth	100 m

2

Work Licence No:	
Name of Licensee:	Aurelia metals
Intended Use:	monitoring Bore
Completion Date:	8 4 20

DRILLING DETAILS 3

From (m)	To (m)	Hole Diameter (mm)	Drilling Method See Code 3
0	52	200	9
52	100	150	9

WATER BEARING ZONES 4

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method See Code 4		D D L at end of test (m)	Duration Hrs	Duration min	Salinity (Conductivity or TDS) Cond (µS/cm)	TDS (mg/L)
88	94	6	14	1·8		1	H		1	30		
41	42	1		~~·25~~	·25							
45	46	1			4 cemented							

CASING / LINER DETAILS 5

Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method Fixing Code 5
6	164	8	0	52	1
8	60	5	0	88	5
8	60	5	94	100	5

Casing support method See Code 5: 2

Type of casing bottom See Code 5: 2

Centralisers installed (Yes/No): yes (indicate on sketch)

Sump installed (Yes/No): yes From 94 m To 100 m

Pressure cemented (Yes/No): yes From 0 m To 84 m

Casing Protector cemented in place

WATER ENTRY DESIGN 6

Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Opening type See Code 6	Fixing See Code 5	Screen Aperture (mm)	Slot Length (mm)	Slot Width (mm)	Alignment See Code 6
8	60	5	88	94	S	5	1	30	8	H

GRAVEL PACK 7

Type		Grade		Grain size (mm) From	Grain size (mm) To	Depth (m) From	Depth (m) To	Quantity Litres	Quantity m^3
Rounded	X	Graded		4	6	86	100	207	0·21
Crushed		Ungraded							
Bentonite/Grout seal (Yes/No)		yes				84	86	40	·04

Method of placement of Gravel Pack See Code 7: 1

For Departmental use only: GW

Form A Particulars of completed work

WaterNSW

BORE DEVELOPMENT 8

Chemical used for breaking down drilling mud	(Yes/No)	NO	Name:										
Method	Bailing/Surging		Jetting		Airlifting		Backwashing		Pumping		Other:		
Duration		hrs		hrs		hrs		hrs		hrs		hrs	

DISINFECTION ON COMPLETION 9

Chemical(s) used	Quantity applied (Litres)	Method of application

PUMPING TESTS ON COMPLETION 10

Test type		Date	Pump intake depth (m)	Initial Water Level (SWL) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery Water level (m)	Recovery Time taken (hrs)	Recovery Time taken (mins)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
	Stage 4									
Single stage (constant rate)										

Height of measuring point above ground level ______ m   Test Method ______ See Code 4

WORK PARTLY BACKFILLED OR ABANDONED 11

Original depth of work: ______ m   Is work partly backfilled: (Yes/No) ______

Is work abandoned: (Yes/No) ______   Method of abandonment: Backfilled ☐ Plugged ☐ Capped ☐

Has any casing been left in the work (Yes/No) ______   From ______ m To ______ m

Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	Sealing / fill type (See Code 11)	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist ☐ Geologist ☐ Driller ☐ Diviner ☐ Client ☒ Other ______ 12

Lot No ______ DP No ______ 13

Work Location Co ordinates Easting 389480 Northing 6513814 Zone 54

GPS: (Yes/No) NO >> AMG/AGD ☐ or MGA/GDA ☐ (See explanation)

Longitude ______ Latitude ______

Please mark the work site with "X" on the CLID provided map.
Indicate also the distances in metres from two (2) adjacent boundaries, and attach the map to this Form A package.

Signatures: [signature]

Driller: [signature]   **Licensee:** PEAK GOLD MINES PTY LTD

Date: 8.4.20   **Date:** 10 JUNE 2020.

Please submit forms to groundwater@waternsw.com.au or send to WaterNSW, PO Box 398, Parramatta 2124

Form A Particulars of completed work

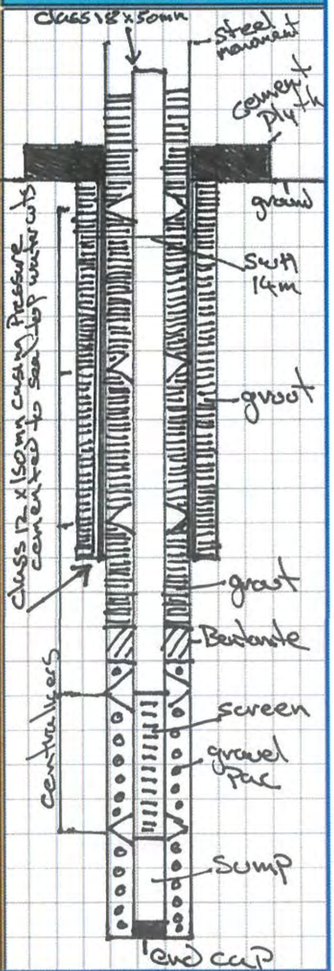
WaterNSW

Work Licence No:

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY) — 15

Depth From (m)	Depth To (m)	Description (See Code 15)
0	2	gravel clay red Puggy
3	20	Siltstone Lt Brown Fg Soft
21	26	Siltstone Dk Brown Fg Soft
27	32	Siltstone white Fg Soft
33	54	Siltstone Lt grey Fg Firm
55	88	Siltstone Dk grey Fg Hard
88	94	Siltstone/quartz white-Dk grey Broken
95	100	Siltstone Dk grey Fg Hard

WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG — 16

Method of excavation: Hand dug [ ] Back hoe [ ] Dragline [ ] Dozer [ ] Other [ ]

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimentions of liner (m)	From Depth (m)	To Depth (m)

Please attach copies of the following if available — 17

Geologist log (Yes/No) NO   Laboratory analysis of water Sample (Yes/No) NO   Pumping test(s) (Yes/No) NO

Geophysical log (Yes/No)	No	Sieve analysis of aquifer material (Yes/No)	No	Installed Pump details (Yes/No)	NO

CODE TABLES

DRILLING METHOD — 3

1	Auger - Hollow Flight	9	Rotary - Percussion - (Down Hole Hammer)
2	Auger - Solid Flight	10	Rotary - Percussion - Foam injection
3	Cable Tool - Drill and Drive Casing	11	Rotary - Reverse circulation - Air
4	Cable Tool - Mud stabilised	12	Rotary - Reverse circulation - Mud
5	Rotary Air	13	Rotary - Coring
6	Rotary - Air/foam	14	Jetted - Air
7	Rotary - Mud	15	Jetted - Water
8	Rotary - Water	16	Other - See page 2, N0 11

WATER BEARING ZONE — 4

TEST METHOD				FLOW MEASURING DEVICE			
1	Airlift	6	Pump - Helical Rot	A	Container of known volun	F	Weir - Rectangular
2	Bailer	7	Pump - Jet	B	Flow meter	G	Weir - V Notch - 60°
3	Pump - Centrifugal	8	Pump - Turbine	C	Flume	H	Weir - V Notch - 90°
4	Pump - Cylinder	9	Freeflow	D	Orifice, plate & manomete	I	Other
5	Pump - Electric submersi			E	Ultra sonic meter		

CASING / LINER DETAILS — 5

MATERIAL						METHOD OF FIXING			
1	A.B.S.	6	PVC - Class 12	11	Steel - Stainless	1	Glued	6	Welded - Butt
2	Aluminium	7	PVC - Class 15	12	Steel - Stainless 304	2	Kwik-lock	7	Welded - Coll
3	Concrete cylinder	8	PVC - Class 18	13	Steel - Stainless 316	3	Packer	8	Other
4	Fibre glass (FRP)	9	Steel - ERW	14	Other	4	Riveted		
5	PVC - Class 9	10	Steel - Galvanised			5	Screwed		

CASING SUPPORT METHOD				TYPE OF CASING BOTTOM			
1	Driven into small hole	5	Held in clamp	1	Open end	5	Casing shoe
2	Seated on bottom	6	Other	2	End cap	6	Wash down shoe
3	Seated on backfill			3	Plug - concrete	7	Cementing shoe
4	Cemented			4	Plug - wood	8	Other

WATER ENTRY DESIGN — 6

OPENING TYPE				SLOT ALIGNMENT	
1	Casing - Bridge slot	7	Casing - Plasma-cut slot	D	Diagonal
2	Casing - Drilled holes	8	Casing - Perforated in hole	H	Horizontal
3	Casing - Hand sawn slot	9	Screen - gauze / mesh	V	Vertical
4	Casing - Louvre slot	10	Screen - round wire		*For MATERIAL and FIXING Codes Please refer to CASING DETAILS code table*
5	Casing - Machine slotted	11	Screen - wedge wire		
6	Casing - Oxy cut slot				

GRAVEL PACK - METHOD OF PLACEMENT — 7

1	Poured or shovelled into annu	2	Placed through tremie pipe	3	Reverse circulated

WORK PARTLY BACKFILLED OR ABANDONED - SEALING MATERIAL — 11

1	Cement grout	3	Bentonite	5	Clay	7	Gravel
2	Concrete	4	Drilled cuttings	6	Sand	8	Coarse stone

DRILLER'S ROCK STRATA DESCRIPTION — 15

Reporting sequence	1 Rock type	2 Colour	3 Grain size	4 Texture	To save confusion, write the *full name of colour and abbreviate*
Example	Sandstone	Dk Grey	mg	Fractured	*following:* light = lt, dark = dk, fine grained = fg, medium grained = mg, coarse grained = cg. *Texture can relate* weathered, fractured, broken, hard, soft etc.

Ncmw03-D

Form A Particulars of completed work

WaterNSW

Driller's Licence No:	DL 2494	1
Class of Licence:	4	
Driller's Name:	Alan Broad	
Assistant Driller:	mitch Hoffman	
Contractor:	Budd drilling	

New bore	X	Replacement bore	
Deepened		Enlarged	
Reconditioned		Other (specify)	
Final Depth	120 m		

Work Licence No:		2
Name of Licensee:	Aurelia Metals	
Intended Use:	monitoring Beres	
Completion Date:	10 4 20	

DRILLING DETAILS 3

From (m)	To (m)	Hole Diameter (mm)	Drilling Method See Code 3
0	120	150	9

WATER BEARING ZONES 4

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Cumulative	Test method See Code 4	D D L at end of test (m)	Duration Hrs	min	Salinity (Conductivity or TDS) Cond (µS/cm)	TDS (mg/L)
60	62	2			0.025	1 H			30		
96	97	1			0.15	1 H			30		
116	117	1	21.9		0.65	1 H		1			

CASING / LINER DETAILS 5

Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method Fixing Code 5
8	60	5	0	95	5
8	60	5	98	115	5
			118	120	5

Casing support method See Code 5: 2

Type of casing bottom See Code 5: 2

Centralisers installed (Yes/No): Yes (indicate on sketch)

Sump installed (Yes/No): Yes From 118 m To 120 m

Pressure cemented (Yes/No): Yes From 0 m To 91 m

Casing Protector cemented in place

WATER ENTRY DESIGN 6

General: Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Opening type See Code 6	Fixing See Code 5	Screen Aperture (mm)	Slot Details: Length (mm)	Width (mm)	Alignment See Code 6
8	60	5	95	98	5	5	1	30	8	H
8	60	5	115	118	5	5	1	30	8	H

GRAVEL PACK 7

Type		Grade		Grain size (mm) From	To	Depth (m) From	To	Quantity Litres	m³
Rounded	X	Graded		4	6	93	120	400	0.40
Crushed		Ungraded							
Bentonite/Grout seal (Yes/No)	Yes					91	93	40	.04

Method of placement of Gravel Pack See Code 7: 1

For Departmental use only: GW

WaterNSW

Form A Particulars of completed work

BORE DEVELOPMENT							8
Chemical used for breaking down drilling mud (Yes/No) NO			Name:				
Method	Bailing/Surging	Jetting	Airlifting	Backwashing	Pumping	Other:	
Duration	hrs	hrs	hrs	hrs	hrs	hrs	

DISINFECTION ON COMPLETION		9
Chemical(s) used	Quantity applied (Litres)	Method of application

PUMPING TESTS ON COMPLETION											10
Test type		Date	Pump intake depth (m)	Initial Water Level (SWL) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery Water level (m)	Recovery Time taken (hrs)	Recovery Time taken (mins)	
Multi stage (stepped drawdown)	Stage 1										
	Stage 2										
	Stage 3										
	Stage 4										
Single stage (constant rate)											

Height of measuring point above ground level m Test Method See Code 4

WORK PARTLY BACKFILLED OR ABANDONED						11
Original depth of work: m			Is work partly backfilled: (Yes/No)			
Is work abandoned: (Yes/No)		Method of abandonment:	Backfilled	Plugged	Capped	
Has any casing been left in the work (Yes/No)			From m	To m		
Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	

Site chosen by: Hydrogeologist Geologist Driller Diviner Client Other **12**

						13
Lot No		DP No				
Work Location Co ordinates	Easting	390688	Northing	6514130	Zone	54
GPS: (Yes/No) NO	>>	AMG/AGD	or	MGA/GDA	(See explanation)	
	Longitude		Latitude			

Please mark the work site with "X" on the CLID provided map.
Indicate also the distances in metres from two (2) adjacent boundaries, and attach the map to this Form A package.

Signatures:

Driller: [signature] **Licensee:**

Date: 10 4 20 **Date:**

Please submit forms to groundwater@waternsw.com.au or send to WaterNSW, PO Box 398, Parramatta 2124

Form A Particulars of completed work

WaterNSW

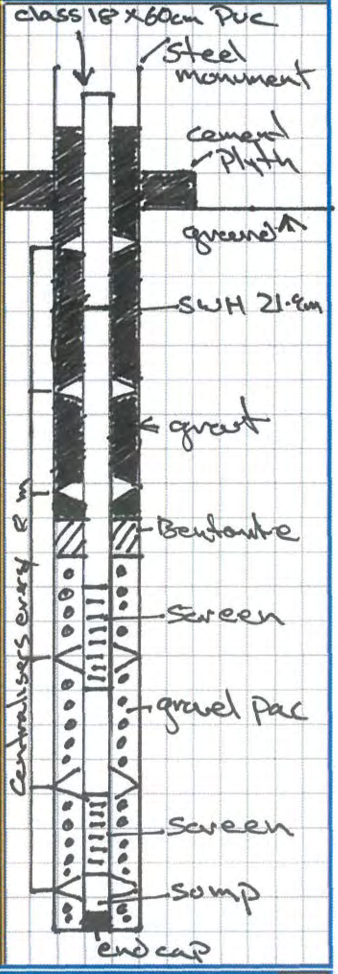
Work Licence No:

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY)

15

Depth From (m)	Depth To (m)	Description (See Code 15)
0	1	Clay red Fg soft
2	5	Siltstone red/Brown Fg Soft
6	21	Siltstone Pink/Brown fg Soft
22	31	Siltstone ~~Yellow~~/Brown Fg Soft
32	40	Siltstone ~~[illegible]~~ red/Brown Fg Soft
41	46	Siltstone lt grey Fg Soft
47	71	Siltstone grey Fg Firm
72	120	Siltstone Dk grey Fg Hard

WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG

16

Method of excavation: Hand dug [ ] Back hoe [ ] Dragline [ ] Dozer [ ] Other [ ]

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimentions of liner (m)	From Depth (m)	To Depth (m)

Please attach copies of the following if available

17

Geologist log (Yes/No) NO — Laboratory analysis of water Sample (Yes/No) NO — Pumping test(s) (Yes/No) NO

Geophysical log	(Yes/No)	NO	Sieve analysis of aquifer material	(Yes/No)	NO	Installed Pump details	(Yes/No)	NO

CODE TABLES

DRILLING METHOD (3)

1	Auger - Hollow Flight	9	Rotary - Percussion - (Down Hole Hammer)
2	Auger - Solid Flight	10	Rotary - Percussion - Foam injection
3	Cable Tool - Drill and Drive Casing	11	Rotary - Reverse circulation - Air
4	Cable Tool - Mud stabilised	12	Rotary - Reverse circulation - Mud
5	Rotary Air	13	Rotary - Coring
6	Rotary - Air/foam	14	Jetted - Air
7	Rotary - Mud	15	Jetted - Water
8	Rotary - Water	16	Other - See page 2, N0 11

WATER BEARING ZONE (4)

TEST METHOD				FLOW MEASURING DEVICE			
1	Airlift	6	Pump - Helical Rot	A	Container of known volum	F	Weir - Rectangular
2	Bailer	7	Pump - Jet	B	Flow meter	G	Weir - V Notch - 60°
3	Pump - Centrifugal	8	Pump - Turbine	C	Flume	H	Weir - V Notch - 90°
4	Pump - Cylinder	9	Freeflow	D	Orifice, plate & manomete	I	Other
5	Pump - Electric submersi			E	Ultra sonic meter		

CASING / LINER DETAILS (5)

MATERIAL						METHOD OF FIXING			
1	A.B.S.	6	PVC - Class 12	11	Steel - Stainless	1	Glued	6	Welded - Butt
2	Aluminium	7	PVC - Class 15	12	Steel - Stainless 304	2	Kwik-lock	7	Welded - Colla
3	Concrete cylinder	8	PVC - Class 18	13	Steel - Stainless 316	3	Packer	8	Other
4	Fibre glass (FRP)	9	Steel - ERW	14	Other	4	Riveted		
5	PVC - Class 9	10	Steel - Galvanised			5	Screwed		

CASING SUPPORT METHOD				TYPE OF CASING BOTTOM			
1	Driven into small hole	5	Held in clamp	1	Open end	5	Casing shoe
2	Seated on bottom	6	Other	2	End cap	6	Wash down shoe
3	Seated on backfill			3	Plug - concrete	7	Cementing shoe
4	Cemented			4	Plug - wood	8	Other

WATER ENTRY DESIGN (6)

OPENING TYPE				SLOT ALIGNMENT	
1	Casing - Bridge slot	7	Casing - Plasma-cut slot	D	Diagonal
2	Casing - Drilled holes	8	Casing - Perforated in hole	H	Horizontal
3	Casing - Hand sawn slot	9	Screen - gauze / mesh	V	Vertical
4	Casing - Louvre slot	10	Screen - round wire		
5	Casing - Machine slotted	11	Screen - wedge wire		
6	Casing - Oxy cut slot				

For MATERIAL and FIXING Codes Please refer to CASING DETAILS code table

GRAVEL PACK - METHOD OF PLACEMENT (7)

1	Poured or shovelled into annu	2	Placed through tremie pipe	3	Reverse circulated

WORK PARTLY BACKFILLED OR ABANDONED - SEALING MATERIAL (11)

1	Cement grout	3	Bentonite	5	Clay	7	Gravel
2	Concrete	4	Drilled cuttings	6	Sand	8	Coarse stone

DRILLER'S ROCK STRATA DESCRIPTION (15)

Reporting sequence	1 Rock type	2 Colour	3 Grain size	4 Texture	To save confusion, write the *full name of colour and abbreviate* *following:* light = lt, dark = dk, fine grained = fg, medium grained = mg, coarse grained = cg. *Texture can relate* weathered, fractured, broken, hard, soft etc.
Example	Sandstone	Dk Grey	mg	Fractured	

Nemw03-S

Form A Particulars of completed work

WaterNSW

Driller's Licence No:	DL 2494	1
Class of Licence:	4	
Driller's Name:	Alan Broad	
Assistant Driller:	mitch Hoffman	
Contractor:	Broad Drilling	
New bore	X	
Replacement bore		
Deepened		
Enlarged		
Reconditioned		
Other (specify)		
Final Depth	70 m	

Work Licence No:		2
Name of Licensee:	Aurelia metals	
Intended Use:	monitoring Bore	
Completion Date:	10 4 20	

DRILLING DETAILS 3

From (m)	To (m)	Hole Diameter (mm)	Drilling Method See Code 3
0	70	150	9

WATER BEARING ZONES 4

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method See Code 4		D D L at end of test (m)	Duration Hrs	Duration min	Salinity Cond (µS/cm)	Salinity TDS (mg/L)
30	31	1			·001	1	H			30		
60	61	1	23·3	~~23·3~~	·021				1			

CASING / LINER DETAILS 5

Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method Fixing Code 5
8	60	5			5

Casing support method (See Code 5): 9

Type of casing bottom (See Code 5): 9

Centralisers installed (Yes/No): Yes (indicate on sketch)

Sump installed (Yes/No): NO From m To m

Pressure cemented (Yes/No): Yes From 0 m To 26 m

Casing Protector cemented in place

WATER ENTRY DESIGN 6

Material Code 5	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Opening type See Code 6	Fixing See Code 5	Screen Aperture (mm)	Slot Length (mm)	Slot Width (mm)	Slot Alignment See Code 6
8	60	5	64	70	5	5	1	30	8	H

GRAVEL PACK 7

Type		Grade		Grain size (mm) From	Grain size (mm) To	Depth (m) From	Depth (m) To	Quantity Litres	Quantity m^3
Rounded	X	Graded		4	6	28	70	620	·62
Crushed		Ungraded							
Bentonite/Grout seal (Yes/No)	Yes					26	28	40	·04

Method of placement of Gravel Pack (See Code 7): 1

For Departmental use only: G W

Form A Particulars of completed work

WaterNSW

BORE DEVELOPMENT							8
Chemical used for breaking down drilling mud (Yes/No) NO		Name:					
Method	Bailing/Surging	Jetting	Airlifting	Backwashing	Pumping	Other:	
Duration	hrs	hrs	hrs	hrs	hrs	hrs	

DISINFECTION ON COMPLETION		9
Chemical(s) used	Quantity applied (Litres)	Method of application

PUMPING TESTS ON COMPLETION 10

Test type		Date	Pump intake depth (m)	Initial Water Level (SWL) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery: Water level (m)	Recovery: Time taken (hrs)	Recovery: Time taken (mins)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
	Stage 4									
Single stage (constant rate)										

Height of measuring point above ground level m Test Method See Code 4

WORK PARTLY BACKFILLED OR ABANDONED 11

Original depth of work: m Is work partly backfilled: (Yes/No)

Is work abandoned: (Yes/No) Method of abandonment: Backfilled Plugged Capped

Has any casing been left in the work (Yes/No) From m To m

Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	Sealing / fill type (See Code 11)	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist Geologist Driller Diviner Client Other 12

Lot No DP No 13

Work Location Co ordinates Easting 390688 Northing 6514130 Zone 54

GPS: (Yes/No) NO >> AMG/AGD or MGA/GDA (See explanation)

Longitude Latitude

Please mark the work site with "X" on the CLID provided map.

Indicate also the distances in metres from two (2) adjacent boundaries, and attach the map to this Form A package.

Signatures: [signature]

Driller: [signature]

Date: 10 4 20

Licensee: PEAK GOLD MINES PTY LTD

Date: 10 JUN 2020.

Form A Particulars of completed work

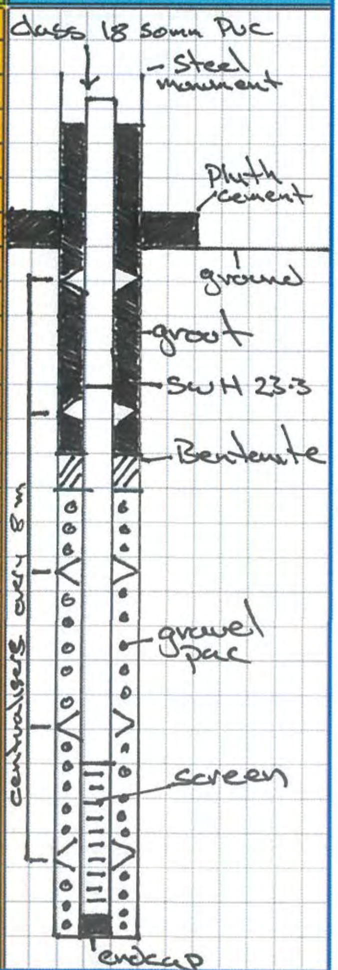
WaterNSW

Work Licence No:

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY)

Depth From (m)	Depth To (m)	Description (See Code 15)
0	1	Clay red Fg soft
2	5	Siltstone red/Brown Fg soft
6	21	Siltstone Pink/Brown Fg soft
22	31	Siltstone yellow/Brown Fg soft
32	40	Siltstone red Fg soft
41	46	Siltstone Lt grey Fg soft
47	70	Siltstone grey Fg Firm

WORK CONSTRUCTION SKETCH 15



WORK NOT CONSTRUCTED BY DRILLING RIG 16

Method of excavation: Hand dug [ ] Back hoe [ ] Dragline [ ] Dozer [ ] Other [ ]

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimentions of liner (m)	From Depth (m)	To Depth (m)

Please attach copies of the following if available 17

Geologist log (Yes/No) NO — Laboratory analysis of water Sample (Yes/No) NO — Pumping test(s) (Yes/No) NO

Geophysical log (Yes/No)	NO	Sieve analysis of aquifer material (Yes/No)	NO	Installed Pump details (Yes/No)	NO

CODE TABLES

DRILLING METHOD (3)

1	Auger - Hollow Flight	9	Rotary - Percussion - (Down Hole Hammer)
2	Auger - Solid Flight	10	Rotary - Percussion - Foam injection
3	Cable Tool - Drill and Drive Casing	11	Rotary - Reverse circulation - Air
4	Cable Tool - Mud stabilised	12	Rotary - Reverse circulation - Mud
5	Rotary Air	13	Rotary - Coring
6	Rotary - Air/foam	14	Jetted - Air
7	Rotary - Mud	15	Jetted - Water
8	Rotary - Water	16	Other - See page 2, N0 11

WATER BEARING ZONE (4)

TEST METHOD				FLOW MEASURING DEVICE			
1	Airlift	6	Pump - Helical Rot	A	Container of known volun	F	Weir - Rectangular
2	Bailer	7	Pump - Jet	B	Flow meter	G	Weir - V Notch - 60°
3	Pump - Centrifugal	8	Pump - Turbine	C	Flume	H	Weir - V Notch - 90°
4	Pump - Cylinder	9	Freeflow	D	Orifice, plate & manomete	I	Other
5	Pump - Electric submersi			E	Ultra sonic meter		

CASING / LINER DETAILS (5)

MATERIAL						METHOD OF FIXING			
1	A.B.S.	6	PVC - Class 12	11	Steel - Stainless	1	Glued	6	Welded - Butt
2	Aluminium	7	PVC - Class 15	12	Steel - Stainless 304	2	Kwik-lock	7	Welded - Colla
3	Concrete cylinder	8	PVC - Class 18	13	Steel - Stainless 316	3	Packer	8	Other
4	Fibre glass (FRP)	9	Steel - ERW	14	Other	4	Riveted		
5	PVC - Class 9	10	Steel - Galvanised			5	Screwed		

CASING SUPPORT METHOD				TYPE OF CASING BOTTOM			
1	Driven into small hole	5	Held in clamp	1	Open end	5	Casing shoe
2	Seated on bottom	6	Other	2	End cap	6	Wash down shoe
3	Seated on backfill			3	Plug - concrete	7	Cementing shoe
4	Cemented			4	Plug - wood	8	Other

WATER ENTRY DESIGN (6)

OPENING TYPE				SLOT ALIGNMENT	
1	Casing - Bridge slot	7	Casing - Plasma-cut slot	D	Diagonal
2	Casing - Drilled holes	8	Casing - Perforated in hole	H	Horizontal
3	Casing - Hand sawn slot	9	Screen - gauze / mesh	V	Vertical
4	Casing - Louvre slot	10	Screen - round wire		***For MATERIAL and FIXING Codes Please refer to CASING DETAILS code table***
5	Casing - Machine slotted	11	Screen - wedge wire		
6	Casing - Oxy cut slot				

GRAVEL PACK - METHOD OF PLACEMENT (7)

1	Poured or shovelled into annul	2	Placed through tremie pipe	3	Reverse circulated

WORK PARTLY BACKFILLED OR ABANDONED - SEALING MATERIAL (11)

1	Cement grout	3	Bentonite	5	Clay	7	Gravel
2	Concrete	4	Drilled cuttings	6	Sand	8	Coarse stone

DRILLER'S ROCK STRATA DESCRIPTION (15)

Reporting sequence	1 Rock type	2 Colour	3 Grain size	4 Texture	To save confusion, write the *full name of colour and abbreviate* *following:* light = lt, dark = dk, fine grained = fg,
Example	Sandstone	Dk Grey	mg	Fractured	medium grained = mg, coarse grained = cg. *Texture can relate* weathered, fractured, broken, hard, soft etc.

Ncmw06-s

Form A Particulars of completed work

WaterNSW

1	
Driller's Licence No:	DL2494
Class of Licence:	4
Driller's Name:	Alan Broad
Assistant Driller:	Mitch Hofman
Contractor:	Budd exploration drilling
New bore	X
Replacement bore	
Deepened	
Enlarged	
Reconditioned	
Other (specify)	
Final Depth	60 m

2	
Work Licence No:	
Name of Licensee:	Aurelia metals
Intended Use:	monitoring Bore
Completion Date:	11.4.20

DRILLING DETAILS (3)

From (m)	To (m)	Hole Diameter (mm)	Drilling Method (See Code 3)
0	60	150	9

WATER BEARING ZONES (4)

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Cumulative	Test method (See Code 4)		D D L at end of test (m)	Duration Hrs	min	Salinity Cond (µS/cm)	TDS (mg/L)
31	32	1			.15	1	H			30		
43	45	2			1.01					30		
52	53	1	32.1		1.11				1			

CASING / LINER DETAILS (5)

Material (Code 5)	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method Fixing (Code 5)
8	60	5	+1	54	5

Casing support method (See Code 5): 2

Type of casing bottom (See Code 5): 2

Centralisers installed (Yes/No): Yes (indicate on sketch)

Sump installed (Yes/No): NO From m To m

Pressure cemented (Yes/No): Yes From 0 m To 29 m

Casing Protector cemented in place

WATER ENTRY DESIGN (6)

Material (Code 5)	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Opening type (See Code 6)	Fixing (See Code 5)	Screen Aperture (mm)	Slot Length (mm)	Slot Width (mm)	Alignment (See Code 6)
8	60	5	54	60	5	5	1	30	8	H

GRAVEL PACK (7)

Type		Grade		Grain size (mm) From	To	Depth (m) From	To	Quantity Litres	m^3
Rounded	X	Graded		4	6	31	60	445	.45
Crushed		Ungraded							
Bentonite/Grout seal (Yes/No)	Yes					29	31	40	.04

Method of placement of Gravel Pack (See Code 7): 1

For Departmental use only: GW

Form A Particulars of completed work

WaterNSW

BORE DEVELOPMENT							8
Chemical used for breaking down drilling mud	(Yes/No) NO	Name:					
Method	Bailing/Surging	Jetting	Airlifting	Backwashing	Pumping	Other:	
Duration	hrs	hrs	hrs	hrs	hrs	hrs	

DISINFECTION ON COMPLETION			9
Chemical(s) used	Quantity applied (Litres)	Method of application	

PUMPING TESTS ON COMPLETION											10
Test type		Date	Pump intake depth (m)	Initial Water Level (SWL) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery			
								Water level (m)	Time taken (hrs)	(mins)	
Multi stage (stepped drawdown)	Stage 1										
	Stage 2										
	Stage 3										
	Stage 4										
Single stage (constant rate)											
Height of measuring point above ground level			m		Test Method			See Code 4			

WORK PARTLY BACKFILLED OR ABANDONED						11
Original depth of work:	m		Is work partly backfilled:	(Yes/No)		
Is work abandoned:	(Yes/No)	Method of abandonment:	Backfilled	Plugged	Capped	
Has any casing been left in the work	(Yes/No)		From	m	To	m
Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	

Site chosen by:	Hydrogeologist	Geologist	Driller	Diviner	Client X	Other	12

						13
Lot No		DP No				
Work Location Co ordinates	Easting	390517	Northing	6512735	Zone	54
GPS: (Yes/No) NO	>>	AMG/AGD	or	MGA/GDA	(See explanation)	
	Longitude		Latitude			

Please mark the work site with "X" on the CLID provided map.
Indicate also the distances in metres from two (2) adjacent boundaries, and attach the map to this Form A package.

Signatures:

Driller: [signature]

Licensee: PEAK GOLD MINES PTY LTD

Date: 11,4,20

Date: 10 JUN 2020.

Please submit forms to groundwater@waternsw.com.au or send to WaterNSW, PO Box 398, Parramatta 2124

Form A Particulars of completed work

WaterNSW

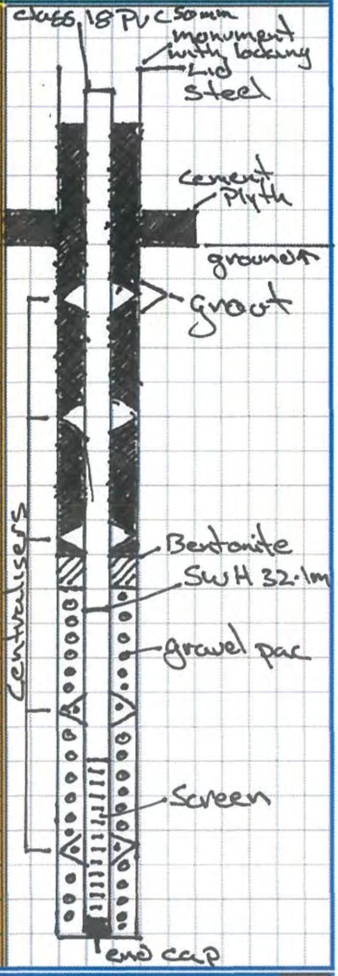
Work Licence No:

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY)

15

Depth From (m)	Depth To (m)	Description (See Code 15)
0	1	Siltstone Weathered Fg Soft Red
2	22	Siltstone weathered Fg soft Lt Brown
23	27	Siltstone Red Fg soft
28	38	Qurtz/siltstone Lt Brown-White Fg Firm
39	55	Qurtz white Fg Hard Broken
56	-60	Siltstone Lt Brown Fg Firm

WORK CONSTRUCTION SKETCH



WORK NOT CONSTRUCTED BY DRILLING RIG

16

Method of excavation: Hand dug [ ] Back hoe [ ] Dragline [ ] Dozer [ ] Other [ ]

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimentions of liner (m)	From Depth (m)	To Depth (m)

Please attach copies of the following if available

17

Geologist log (Yes/No) NO   Laboratory analysis of water Sample (Yes/No) NO   Pumping test(s) (Yes/No) NO

Geophysical log (Yes/No)		Sieve analysis of aquifer material (Yes/No)		Installed Pump details (Yes/No)	

CODE TABLES

DRILLING METHOD 3

1	Auger - Hollow Flight	9	Rotary - Percussion - (Down Hole Hammer)
2	Auger - Solid Flight	10	Rotary - Percussion - Foam injection
3	Cable Tool - Drill and Drive Casing	11	Rotary - Reverse circulation - Air
4	Cable Tool - Mud stabilised	12	Rotary - Reverse circulation - Mud
5	Rotary Air	13	Rotary - Coring
6	Rotary - Air/foam	14	Jetted - Air
7	Rotary - Mud	15	Jetted - Water
8	Rotary - Water	16	Other - See page 2, N0 11

WATER BEARING ZONE 4

TEST METHOD				FLOW MEASURING DEVICE			
1	Airlift	6	Pump - Helical Rot	A	Container of known volun	F	Weir - Rectangular
2	Bailer	7	Pump - Jet	B	Flow meter	G	Weir - V Notch - 60°
3	Pump - Centrifugal	8	Pump - Turbine	C	Flume	H	Weir - V Notch - 90°
4	Pump - Cylinder	9	Freeflow	D	Orifice, plate & manomete	I	Other
5	Pump - Electric submersi			E	Ultra sonic meter		

CASING / LINER DETAILS 5

MATERIAL						METHOD OF FIXING			
1	A.B.S.	6	PVC - Class 12	11	Steel - Stainless	1	Glued	6	Welded - Butt
2	Aluminium	7	PVC - Class 15	12	Steel - Stainless 304	2	Kwik-lock	7	Welded - Colla
3	Concrete cylinder	8	PVC - Class 18	13	Steel - Stainless 316	3	Packer	8	Other
4	Fibre glass (FRP)	9	Steel - ERW	14	Other	4	Riveted		
5	PVC - Class 9	10	Steel - Galvanised			5	Screwed		

CASING SUPPORT METHOD				TYPE OF CASING BOTTOM			
1	Driven into small hole	5	Held in clamp	1	Open end	5	Casing shoe
2	Seated on bottom	6	Other	2	End cap	6	Wash down shoe
3	Seated on backfill			3	Plug - concrete	7	Cementing shoe
4	Cemented			4	Plug - wood	8	Other

WATER ENTRY DESIGN 6

OPENING TYPE				SLOT ALIGNMENT	
1	Casing - Bridge slot	7	Casing - Plasma-cut slot	D	Diagonal
2	Casing - Drilled holes	8	Casing - Perforated in hole	H	Horizontal
3	Casing - Hand sawn slot	9	Screen - gauze / mesh	V	Vertical
4	Casing - Louvre slot	10	Screen - round wire		
5	Casing - Machine slotted	11	Screen - wedge wire		
6	Casing - Oxy cut slot				

For MATERIAL and FIXING Codes Please refer to CASING DETAILS code table

GRAVEL PACK - METHOD OF PLACEMENT 7

1	Poured or shovelled into annu	2	Placed through tremie pipe	3	Reverse circulated

WORK PARTLY BACKFILLED OR ABANDONED - SEALING MATERIAL 11

1	Cement grout	3	Bentonite	5	Clay	7	Gravel
2	Concrete	4	Drilled cuttings	6	Sand	8	Coarse stone

DRILLER'S ROCK STRATA DESCRIPTION 15

Reporting sequence	1 Rock type	2 Colour	3 Grain size	4 Texture	To save confusion, write the *full name of colour and abbreviate*
Example	Sandstone	Dk Grey	mg	Fractured	*following:* light = lt, dark = dk, fine grained = fg, medium grained = mg, coarse grained = cg. *Texture can relate* weathered, fractured, broken, hard, soft etc.

NCMW02-5

Form A Particulars of completed work

WaterNSW

1

Driller's Licence No:	DL2494
Class of Licence:	4
Driller's Name:	Alan Broad
Assistant Driller:	Mitch Hoffman
Contractor:	Budd Drilling
New bore	X
Replacement bore	
Deepened	
Enlarged	
Reconditioned	
Other (specify)	
Final Depth	60 m

2

Work Licence No:	
Name of Licensee:	Aurelia metals
Intended Use:	monitoring Bore
Completion Date:	12 4 20

3 DRILLING DETAILS

From (m)	To (m)	Hole Diameter (mm)	Drilling Method (See Code 3)
0	60	150	9

4 WATER BEARING ZONES

From (m)	To (m)	Thickness (m)	S W L (m)	Estimated Yield (L/s) Individual Aquifer	Estimated Yield (L/s) Cumulative	Test method (See Code 4)		D D L at end of test (m)	Duration Hrs	Duration min	Salinity Cond (µS/cm)	Salinity TDS (mg/L)
38	39	2			·5	1	H			30		
58	59	2	32m		2	1	H		1			

5 CASING / LINER DETAILS

Material (Code 5)	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Method Fixing (Code 5)
8	60	5	+1	30	5
8	60	5	40	57	5

Casing support method (See Code 5): 2

Type of casing bottom (See Code 5): 2

Centralisers installed (Yes/No): yes (indicate on sketch)

Sump installed (Yes/No): NO From m To m

Pressure cemented (Yes/No): Yes From 0 m To 34 m

Casing Protector cemented in place

6 WATER ENTRY DESIGN

Material (Code 5)	OD (mm)	Wall Thickness (mm)	From (m)	To (m)	Opening type (See Code 6)	Fixing (See Code 5)	Screen Aperture (mm)	Slot Length (mm)	Slot Width (mm)	Alignment (See Code 6)
8	60	5	38	40	5	5	1	30	8	H
8	60	5	57	60	5	5	1	30	8	H

7 GRAVEL PACK

Type		Grade		Grain size From (mm)	Grain size To (mm)	Depth From (m)	Depth To (m)	Quantity Litres	Quantity m^3
Rounded	X	Graded		4	6	36	-60	356	0·36
Crushed		Ungraded							
Bentonite/Grout seal (Yes/No)			Yes			34	36	40	·04

Method of placement of Gravel Pack (See Code 7): 1

For Departmental use only: GW

Form A Particulars of completed work

WaterNSW

BORE DEVELOPMENT							8
Chemical used for breaking down drilling mud (Yes/No) NO			Name:				
Method	Bailing/Surging	Jetting	Airlifting	Backwashing	Pumping	Other:	
Duration	hrs	hrs	hrs	hrs	hrs	hrs	

DISINFECTION ON COMPLETION		9
Chemical(s) used	Quantity applied (Litres)	Method of application

PUMPING TESTS ON COMPLETION 10

Test type		Date	Pump intake depth (m)	Initial Water Level (SWL) (m)	Pumping rate (L/s)	Water Level at end of pumping (DDL) (m)	Duration of Test (hrs)	Recovery Water level (m)	Recovery Time taken (hrs)	Recovery Time taken (mins)
Multi stage (stepped drawdown)	Stage 1									
	Stage 2									
	Stage 3									
	Stage 4									
Single stage (constant rate)										

Height of measuring point above ground level m Test Method See Code 4

WORK PARTLY BACKFILLED OR ABANDONED 11

Original depth of work: m Is work partly backfilled: (Yes/No)

Is work abandoned: (Yes/No) Method of abandonment: Backfilled Plugged Capped

Has any casing been left in the work (Yes/No) From m To m

Sealing / fill type (See Code 11)	From depth (m)	To depth (m)	Sealing / fill type (See Code 11)	From depth (m)	To depth (m)

Site chosen by: Hydrogeologist Geologist Driller Diviner Client X Other 12

13

Lot No DP No 389580, 6513871

Work Location Co ordinates Easting ~~390584~~ Northing ~~6512735~~ Zone 54

GPS: (Yes/No) NO >> AMG/AGD or MGA/GDA (See explanation)

Longitude Latitude

Please mark the work site with "X" on the CLID provided map.

Indicate also the distances in metres from two (2) adjacent boundaries, and attach the map to this Form A package.

Signatures: [signature]

Driller: [signature]

Date: 12 4 20

Licensee: PEAK GOLD MINES PTY LTD

Date: 10 JUNE 2020

Please submit forms to groundwater@waternsw.com.au or send to WaterNSW, PO Box 398, Parramatta 2124

Form A Particulars of completed work

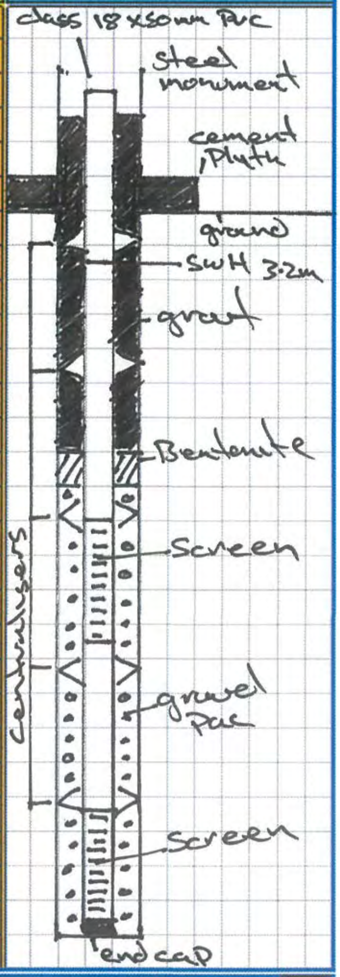
WaterNSW

Work Licence No:

DRILLER'S ROCK/STRATA DESCRIPTION (LITHOLOGY)

Depth From (m)	Depth To (m)	Description (See Code 15)
0	3	Clay red Fg Puggy
3	26	Siltstone Lt Brown Fg soft
27	31	Siltstone white Fg soft
32	52	Siltstone Lt green/Brown Fg soft
52	60	Siltstone Lt grey Fg Firm

15 WORK CONSTRUCTION SKETCH



16 WORK NOT CONSTRUCTED BY DRILLING RIG

Method of excavation: Hand dug ☐ Back hoe ☐ Dragline ☐ Dozer ☐ Other

Depth (m)	Length (m)	Width (m)	Diameter (m)	Lining material	Dimentions of liner (m)	From Depth (m)	To Depth (m)

17 Please attach copies of the following if available

Geologist log (Yes/No) NO | Laboratory analysis of water Sample (Yes/No) NO | Pumping test(s) (Yes/No) NO

Geophysical log	(Yes/No)	Sieve analysis of aquifer material	(Yes/No)	Installed Pump details	(Yes/No)

CODE TABLES

DRILLING METHOD (3)

1	Auger - Hollow Flight	9	Rotary - Percussion - (Down Hole Hammer)
2	Auger - Solid Flight	10	Rotary - Percussion - Foam injection
3	Cable Tool - Drill and Drive Casing	11	Rotary - Reverse circulation - Air
4	Cable Tool - Mud stabilised	12	Rotary - Reverse circulation - Mud
5	Rotary Air	13	Rotary - Coring
6	Rotary - Air/foam	14	Jetted - Air
7	Rotary - Mud	15	Jetted - Water
8	Rotary - Water	16	Other - See page 2, N0 11

WATER BEARING ZONE (4)

TEST METHOD				FLOW MEASURING DEVICE			
1	Airlift	6	Pump - Helical Rot	A	Container of known volun	F	Weir - Rectangular
2	Bailer	7	Pump - Jet	B	Flow meter	G	Weir - V Notch - 60°
3	Pump - Centrifugal	8	Pump - Turbine	C	Flume	H	Weir - V Notch - 90°
4	Pump - Cylinder	9	Freeflow	D	Orifice, plate & manomete	I	Other
5	Pump - Electric submersil			E	Ultra sonic meter		

CASING / LINER DETAILS (5)

MATERIAL						METHOD OF FIXING			
1	A.B.S.	6	PVC - Class 12	11	Steel - Stainless	1	Glued	6	Welded - Butt
2	Aluminium	7	PVC - Class 15	12	Steel - Stainless 304	2	Kwik-lock	7	Welded - Colla
3	Concrete cylinder	8	PVC - Class 18	13	Steel - Stainless 316	3	Packer	8	Other
4	Fibre glass (FRP)	9	Steel - ERW	14	Other	4	Riveted		
5	PVC - Class 9	10	Steel - Galvanised			5	Screwed		

CASING SUPPORT METHOD				TYPE OF CASING BOTTOM			
1	Driven into small hole	5	Held in clamp	1	Open end	5	Casing shoe
2	Seated on bottom	6	Other	2	End cap	6	Wash down shoe
3	Seated on backfill			3	Plug - concrete	7	Cementing shoe
4	Cemented			4	Plug - wood	8	Other

WATER ENTRY DESIGN (6)

OPENING TYPE				SLOT ALIGNMENT	
1	Casing - Bridge slot	7	Casing - Plasma-cut slot	D	Diagonal
2	Casing - Drilled holes	8	Casing - Perforated in hole	H	Horizontal
3	Casing - Hand sawn slot	9	Screen - gauze / mesh	V	Vertical
4	Casing - Louvre slot	10	Screen - round wire		
5	Casing - Machine slotted	11	Screen - wedge wire		
6	Casing - Oxy cut slot				

For MATERIAL and FIXING Codes Please refer to CASING DETAILS code table

GRAVEL PACK - METHOD OF PLACEMENT (7)

1	Poured or shovelled into annul	2	Placed through tremie pipe	3	Reverse circulated

WORK PARTLY BACKFILLED OR ABANDONED - SEALING MATERIAL (11)

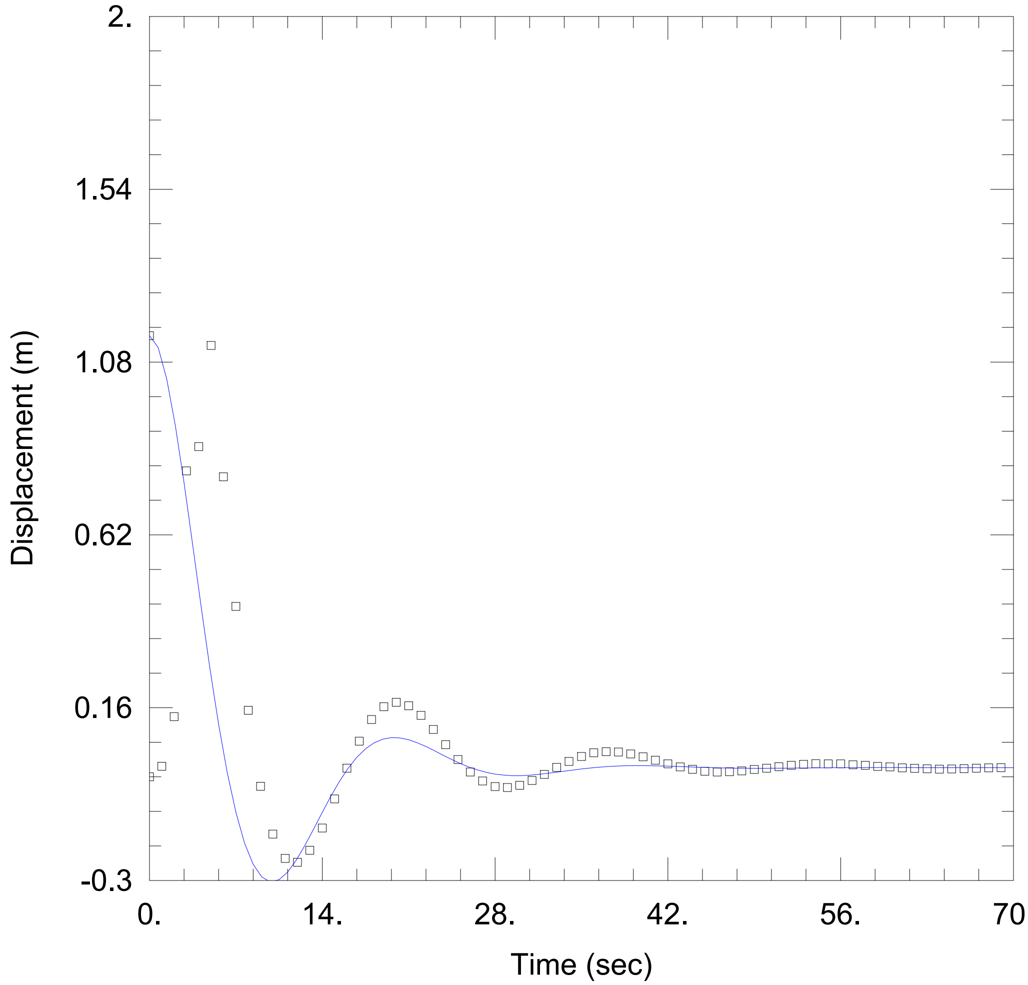
1	Cement grout	3	Bentonite	5	Clay	7	Gravel
2	Concrete	4	Drilled cuttings	6	Sand	8	Coarse stone

DRILLER'S ROCK STRATA DESCRIPTION (15)

Reporting sequence	1 Rock type	2 Colour	3 Grain size	4 Texture	To save confusion, write the *full name of colour and abbreviate* *following:* light = lt, dark = dk, fine grained = fg,
Example	Sandstone	Dk Grey	mg	Fractured	medium grained = mg, coarse grained = cg. *Texture can relate* weathered, fractured, broken, hard, soft etc.

Appendix C

Hydraulic conductivity test results



WELL TEST ANALYSIS

Data Set: \...\NCMW01_D.aqt
Date: 07/02/20　　Time: 14:47:06

PROJECT INFORMATION

Company: EMM Consulting
Project: J190278
Location: New Cobar
Test Well: NCMW01_D
Test Date: 13/05/2020

AQUIFER DATA

Saturated Thickness: 14. m　　Anisotropy Ratio (Kz/Kr): 1.

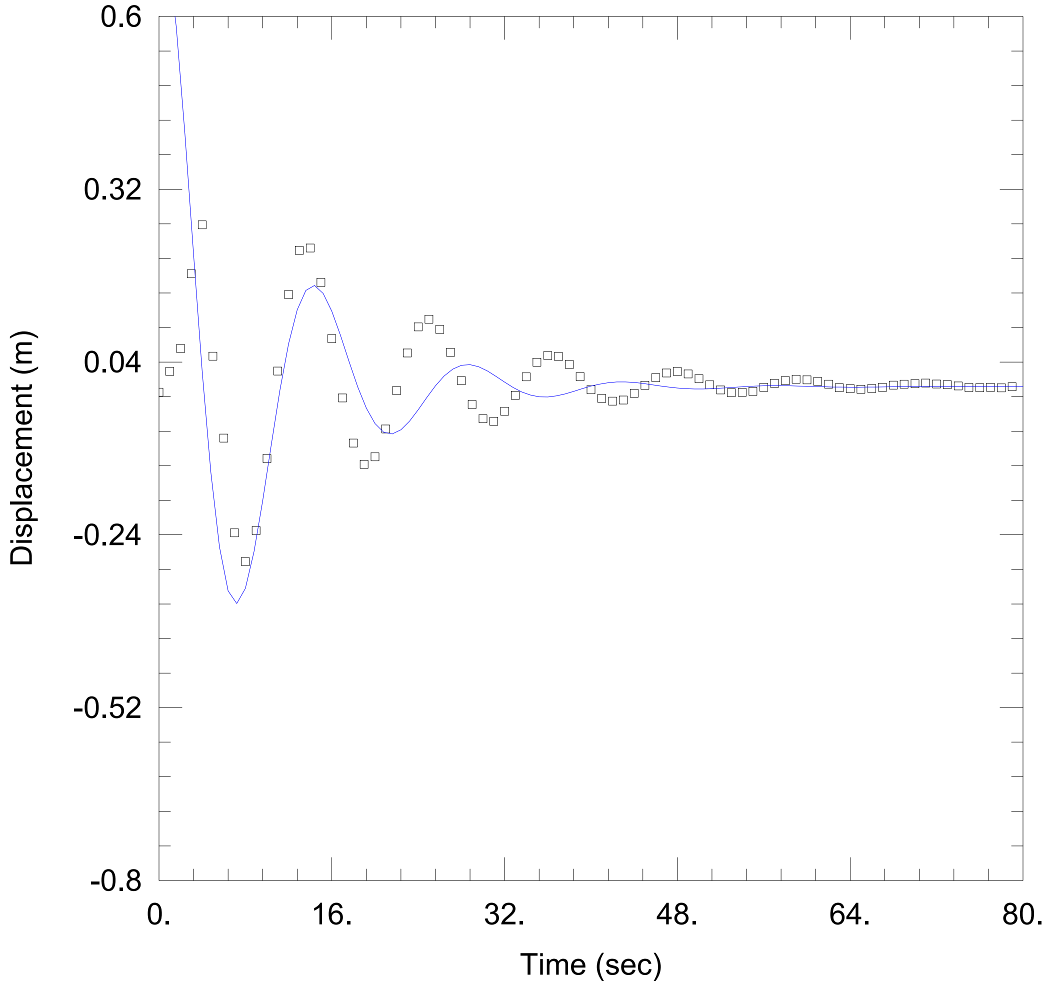
WELL DATA (NCMW01_D)

Initial Displacement: 1.15 m　　Static Water Column Height: 85.81 m
Total Well Penetration Depth: 80.7 m　　Screen Length: 6. m
Casing Radius: 0.025 m　　Well Radius: 0.025 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined　　Solution Method: Springer-Gelhar

K = 12.52 m/day　　Le = 82.81 m



WELL TEST ANALYSIS

Data Set: \...\NCMW01_S.aqt
Date: 07/02/20 Time: 15:20:28

PROJECT INFORMATION

Company: EMM Consulting
Project: J190278
Location: New Cobar
Test Well: NCMW01_S
Test Date: 13/05/2020

AQUIFER DATA

Saturated Thickness: 38.48 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NCMW01_S)

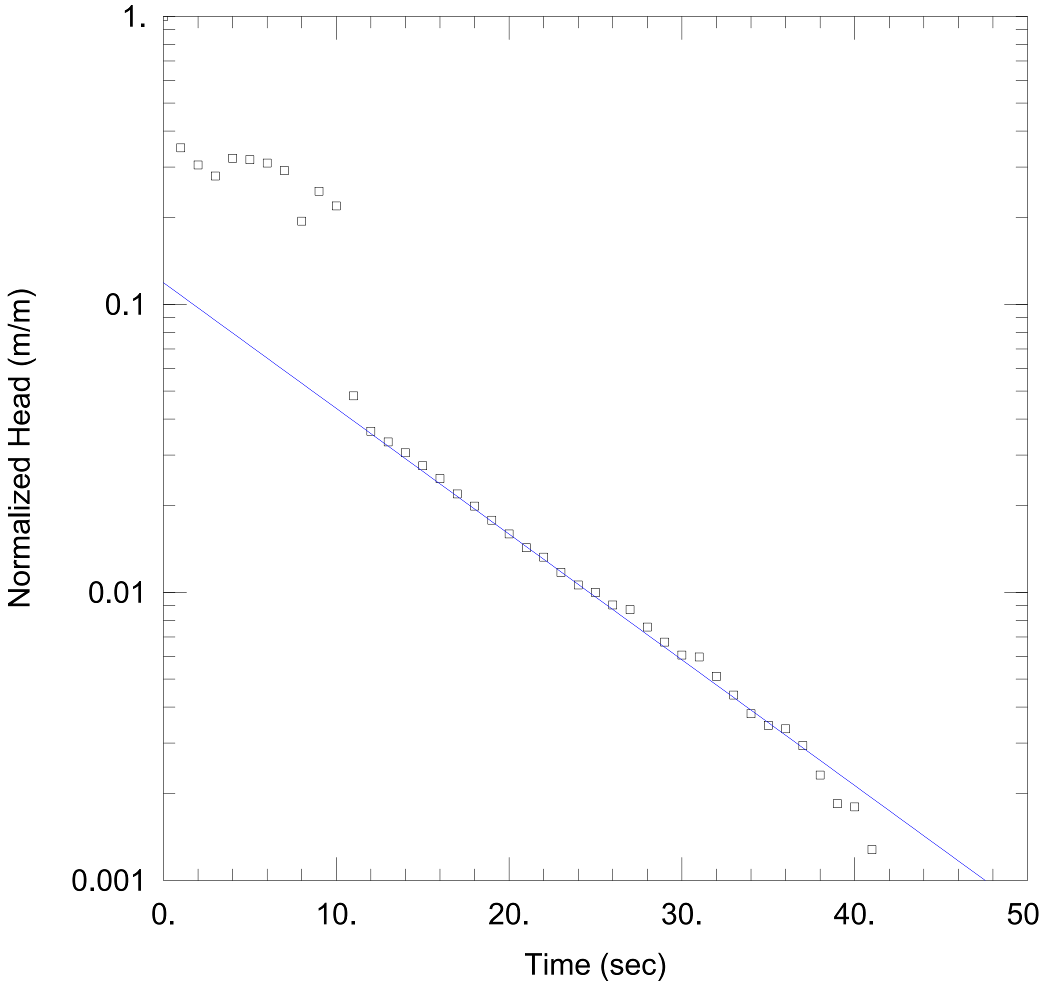
Initial Displacement: 0.7523 m
Total Well Penetration Depth: 38.48 m
Casing Radius: 0.025 m

Static Water Column Height: 38.48 m
Screen Length: 6. m
Well Radius: 0.025 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Springer-Gelhar

K = 25.14 m/day Le = 47.86 m



WELL TEST ANALYSIS

Data Set: \...\NCMW02.aqt
Date: 07/02/20 Time: 15:56:24

PROJECT INFORMATION

Company: EMM Consulting
Project: J190278
Location: New Cobar
Test Well: NCMW02
Test Date: 14/05/2020

AQUIFER DATA

Saturated Thickness: 58.22 m Anisotropy Ratio (Kz/Kr): 1.

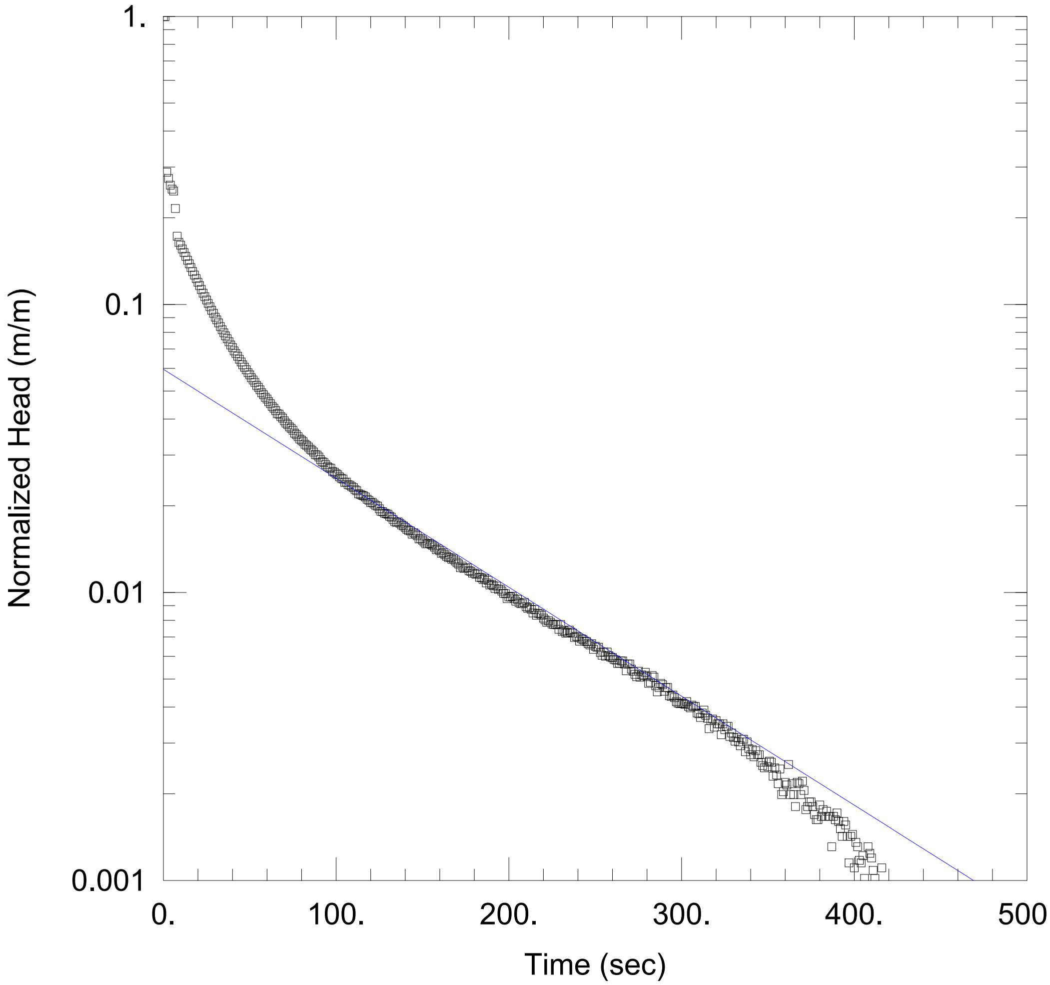
WELL DATA (NCMW02)

Initial Displacement: 2.112 m
Total Well Penetration Depth: 41.22 m
Casing Radius: 0.025 m
Static Water Column Height: 58.22 m
Screen Length: 6. m
Well Radius: 0.025 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.167 m/day y0 = 0.2512 m



WELL TEST ANALYSIS

Data Set: \...\NCMW03_D.aqt
Date: 07/02/20
Time: 16:13:54

PROJECT INFORMATION

Company: EMM Consulting
Project: J190278
Location: New Cobar
Test Well: NCMW03_D
Test Date: 13/05/2020

AQUIFER DATA

Saturated Thickness: 27. m
Anisotropy Ratio (Kz/Kr): 1.

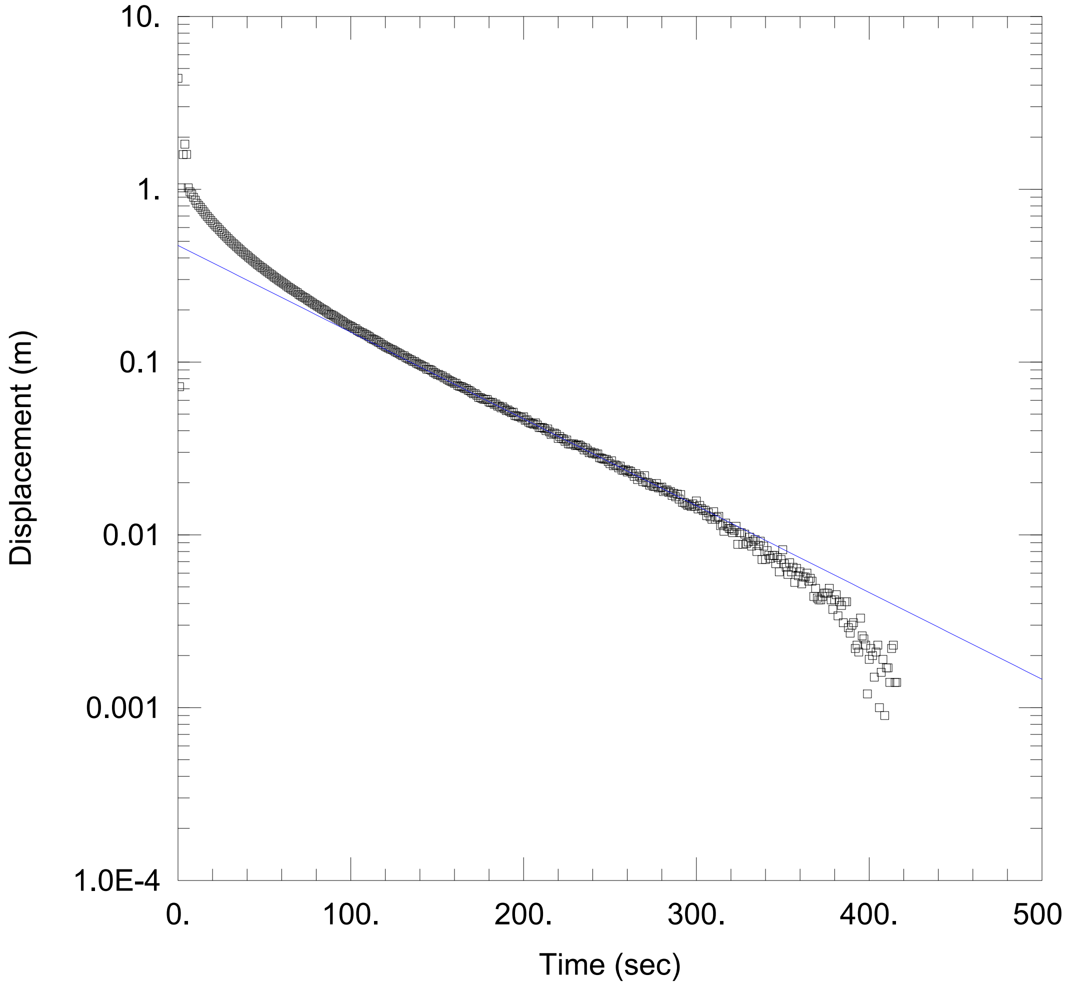
WELL DATA (NCMW03_D)

Initial Displacement: 4.431 m
Total Well Penetration Depth: 80.73 m
Casing Radius: 0.025 m
Static Water Column Height: 98.98 m
Screen Length: 6. m
Well Radius: 1. m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.09464 m/day
y0 = 0.2636 m



WELL TEST ANALYSIS

Data Set: \...\NCMW03_S.aqt
Date: 07/02/20
Time: 16:22:56

PROJECT INFORMATION

Company: EMM Consulting
Project: J190278
Location: New Cobar
Test Well: NCMW03_S
Test Date: 13/05/2020

AQUIFER DATA

Saturated Thickness: 49.07 m
Anisotropy Ratio (Kz/Kr): 1.

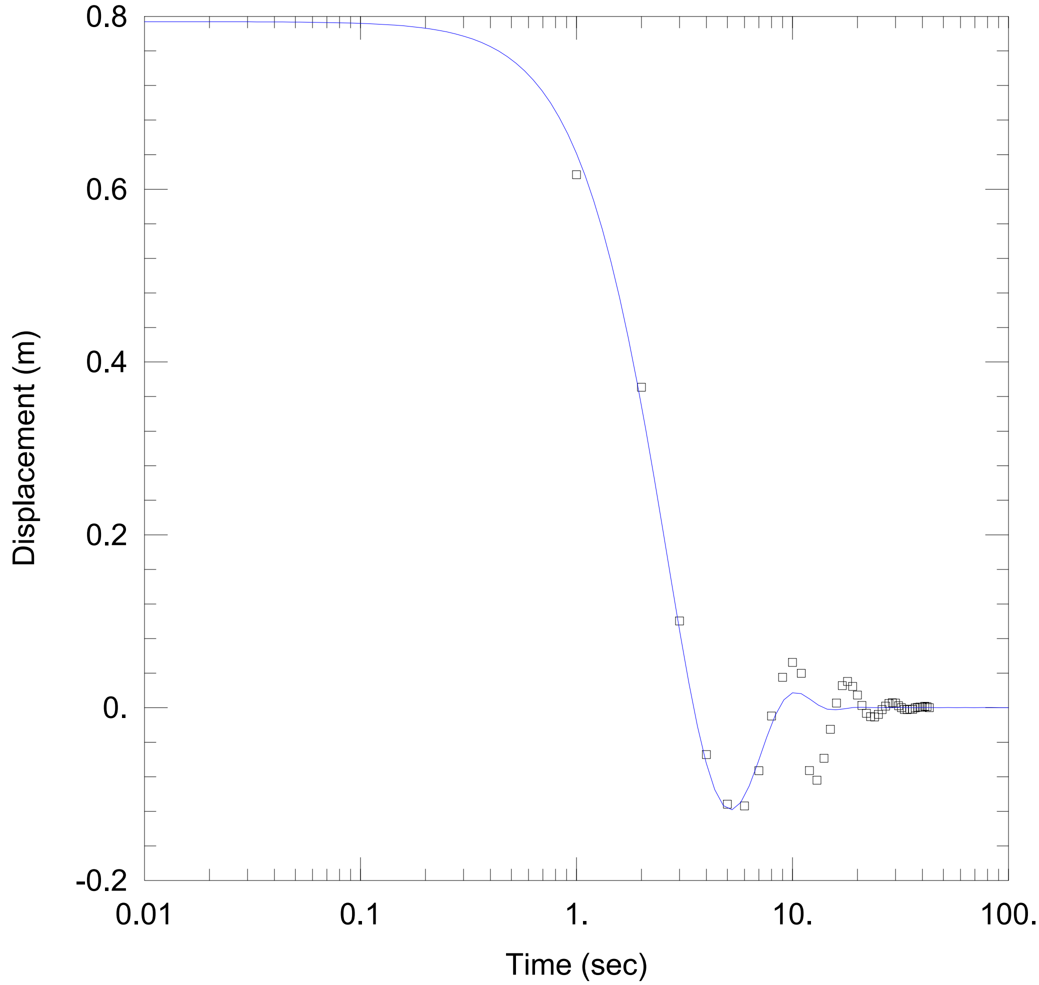
WELL DATA (NCMW03_S)

Initial Displacement: 4.389 m
Total Well Penetration Depth: 49.07 m
Casing Radius: 0.025 m
Static Water Column Height: 49.07 m
Screen Length: 6. m
Well Radius: 1. m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.1166 m/day
y0 = 0.4728 m



WELL TEST ANALYSIS

Data Set: T:\...\NCMW06_version 2.aqt
Date: 07/02/20 Time: 14:49:57

PROJECT INFORMATION

Company: EMM Consulting
Project: J190278
Location: New Cobar
Test Well: NCMW06
Test Date: 13/05/2020

AQUIFER DATA

Saturated Thickness: 30.03 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (NCMW06)

Initial Displacement: 0.7939 m Static Water Column Height: 30.03 m
Total Well Penetration Depth: 30.03 m Screen Length: 6. m
Casing Radius: 0.025 m Well Radius: 0.075 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Springer-Gelhar

K = 13.78 m/day Le = 19.48 m

Appendix D

Great Cobar shaft water supply modelling

D.1 Modelling objectives

Peak Gold Mines Pty Ltd (PGM) was granted a Water Supply Works Approval (85WA753861) on 2 December 2019, which allows PGM to pump groundwater from a shaft located within the historical Great Cobar underground mine workings and into the Great Cobar pipeline. The approval is required to meet future Project area water demands.

Part A of Section DS6593-00001 of the approval states that an updated groundwater model must be included as part of a Groundwater Management Plan (GMP). The GMP must include:

- conceptual groundwater model including a water balance;
- model calibration against observed heads; and
- sensitivity and/or uncertainty analysis.

EMM Consulting Pty Ltd (EMM) were engaged by PGM to build a numerical groundwater model (GC1.0) to support the Environmental Impact Statement (EIS) for the New Cobar Complex Underground Project. EMM has upgraded and refined the EIS model to specifically address the following requirements attached to approval 85WA753861:

- Additional refinement to simulate the historic Great Cobar underground workings, including the vertical shaft, at a finer detail;
- Modelling of additional predictive scenarios to simulate estimated water requirements; and
- Additional predictive uncertainty analysis on these scenarios.

D.2 Great Cobar makeup water supply

The predicted range of mine inflows (Sections 8.7.4 and 11.2) were used in the SWA to determine potential annual makeup water supply requirements during mining. The assessment considers groundwater inflows and available water volumes from Burrendong Dam under various climate conditions to estimate water shortfalls that must be supplied from a source outside of the New Cobar complex. Additional groundwater model scenarios were developed based on the results to simulate environmental impacts of obtaining this makeup supply from groundwater, in excess of mine related inflows. Conservative estimates were applied, neglecting any available storage from Burrendong Dam. Annual makeup water supply volumes are presented in Table D.1 against corresponding groundwater model stress periods, with identified new model scenarios. The predictive model scenarios are as follows:

- GC_tpred1: active mine dewatering for the **base case**, detailed in Sections 8.6 and 8.7;
- GC_tpred2: active mine dewatering for the **base case**, plus additional water supply from the Great Cobar shaft;
- GC_tpred3: active mine dewatering for **low** mine inflow aquifer properties (uncertainty run 2, Table 8.10), plus additional water supply from the Great Cobar shaft; and
- GC_tpred4: active mine dewatering for **high** mine inflow aquifer properties (uncertainty run 8, Table 8.10), plus additional water supply from the Great Cobar shaft.

Under current water supply work approvals, additional water supply can be sourced from the historic Great Cobar mine complex. This is accessible from surface via an historic shaft; with an estimated accessible water volume of

1.6 GL. For each of the groundwater model scenarios detailed in Table D.1, a pumping well (MODFLOW WEL package) was simulated through the profile of the historic shaft to access the required make-up water.

Table D.1 Great Cobar makeup water supply requirements

Year	Model stress period	GC_tpred2 water supply rate (kL/d)	GC_tpred3 water supply rate (kL/d)	GC_tpred4 water supply rate (kL/d)
2020	32	442	821	5
2021	33	834	1,074	364
2022	34	7	190	2
2023	35	0	210	0
2024	36	0	490	0
2025	37	0	83	0
2026	38	257	436	0
2027	39	760	981	159
2028	40	786	914	197
2029	41	1,074	1,298	1,062
2030	42	877	1,094	855
2031	43	1,563	1,580	1,544

Very little data is available on the geometry or connectivity of the historic mine voids. Additional predictive uncertainty models were developed based on GC_tpred2, varying the historic void space and effective hydraulic conductivity over the historic pit footprint. The additional runs are presented in Table D.2.

Table D.2 Great Cobar historic mine void uncertainty analysis

Model name	Historic mine void accessible water volume (ML)	Historic mine void effective hydraulic conductivity (m/d)
GC_tpred2	1,600	1,000
GC_tpred2_U1	400	1,000
GC_tpred2_U2	800	1,000
GC_tpred2_U3	1,200	1,000
GC_tpred2_U4	2,000	1,000
GC_tpred2_U5	2,400	1,000
GC_tpred2_U6	2,800	1,000
GC_tpred2_U7	1,600	100
GC_tpred2_U8	1,600	10
GC_tpred2_U9	1,600	1

D.3 Regional water table drawdown results

The maximum modelled extent of the 2 m drawdown contour for each of the new scenarios are presented in Figure D.1 and Figure D.2, against equivalent modelled drawdown without additional groundwater extraction. As in

Section 8.7.4, drawdown is presented as the maximum at any one time throughout the prediction period to appreciate the maximum change.

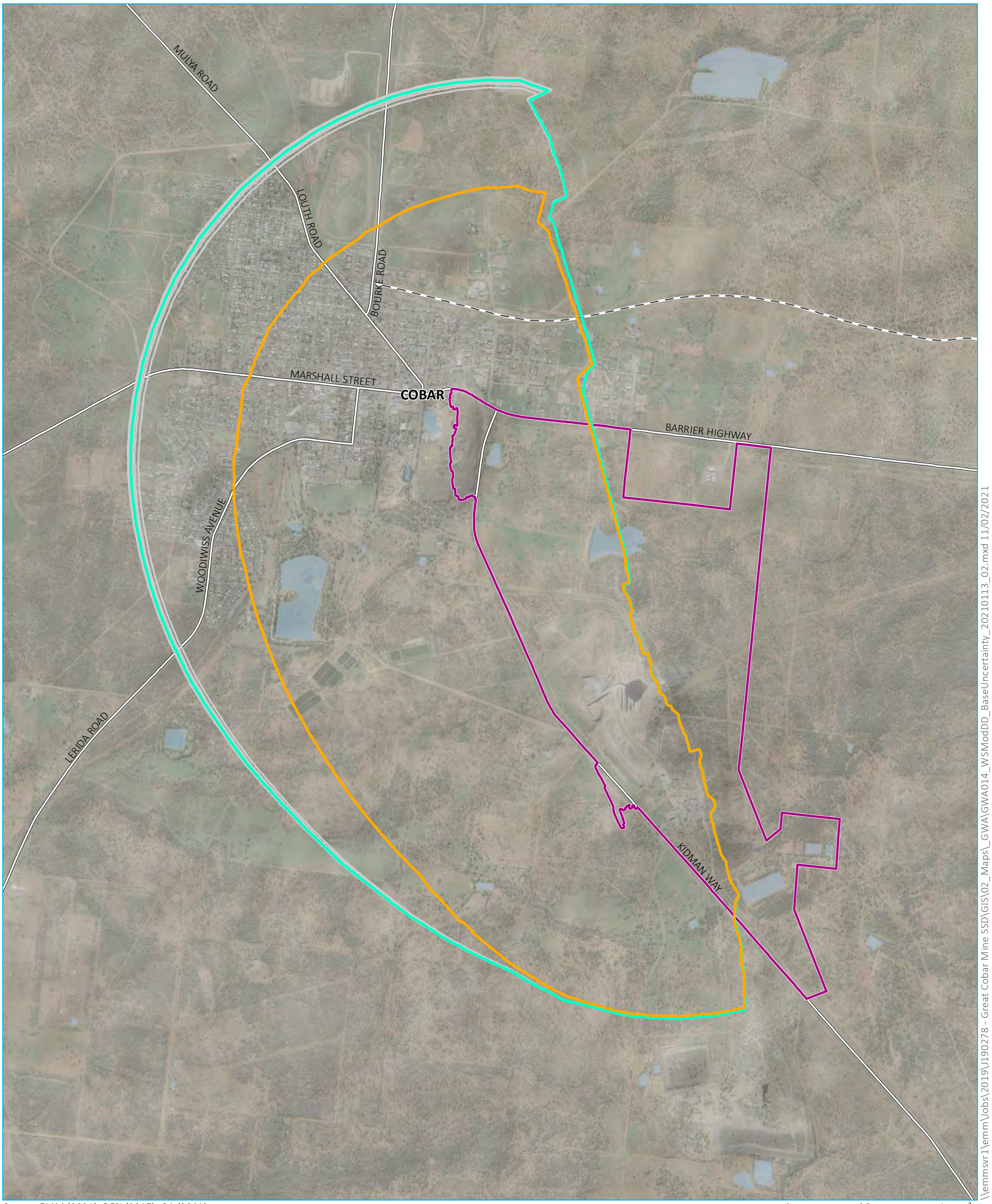
Figure D.1 shows modelled drawdown for GC_tpred1 and GC_tpred2, along with the additional predictive uncertainty models outlined in Table D.2. Groundwater extraction from the historic Great Cobar mine results in the following:

- Increased drawdown locally in the vicinity of the shaft, with maximum drawdown increasing from 20 to 50 m; and
- expansion of the 2 m drawdown contour by approximately 700 m to the north and west, covering much of the Cobar town.

There is virtually no change to modelled drawdown towards the south of the model domain. The uncertainty runs show minimal variance, with the modelled 2 m drawdown extent ranging by less than 100 m. The results indicated that drawdown caused by shaft pumping is localised and any additional regional drawdown will be minimal and is insensitive to assumptions made to the Great Complex void properties from a regional perspective.

Figure D.2 shows modelled maximum 2 m drawdown extent for GC_tpred2, GC_tpred3 and GC_tpred4. This figure shows how drawdown extend changes based on the uncertainty in regional aquifer properties and the required makeup water supply requirements from the shaft. The results indicated the following:

- modelled drawdown is less for the low inflow parameter values (GC_tpred3) as shown in Figure 8.17, although the requirement of addition extraction results in a significantly increased drawdown footprint, approximately 1,300 m to the north. This footprint is similar in extent to GC_tpred2, suggesting that the changes to model aquifer properties are proportional to the resultant increase in required makeup water; and
- the high inflow uncertainty model (GC_tpred4) corresponds to the largest modelled drawdown footprint, a resultant of the aquifer's higher diffusivity within the weathered fractured rock unit, which governs drawdown propagation. Comparatively, additional extraction has a less significant impact, increasing the 2 m drawdown contour footprint by approximately 550 m to the north and west. There is little variance in drawdown extent for the three model scenarios, showing the relationship between aquifer properties and combined mine inflow is balanced by makeup water supply requirements.



Source: EMM (2021); DFSI (2017); GA (2011)

0 0.5 1 km
GDA 1994 MGA Zone 55
N

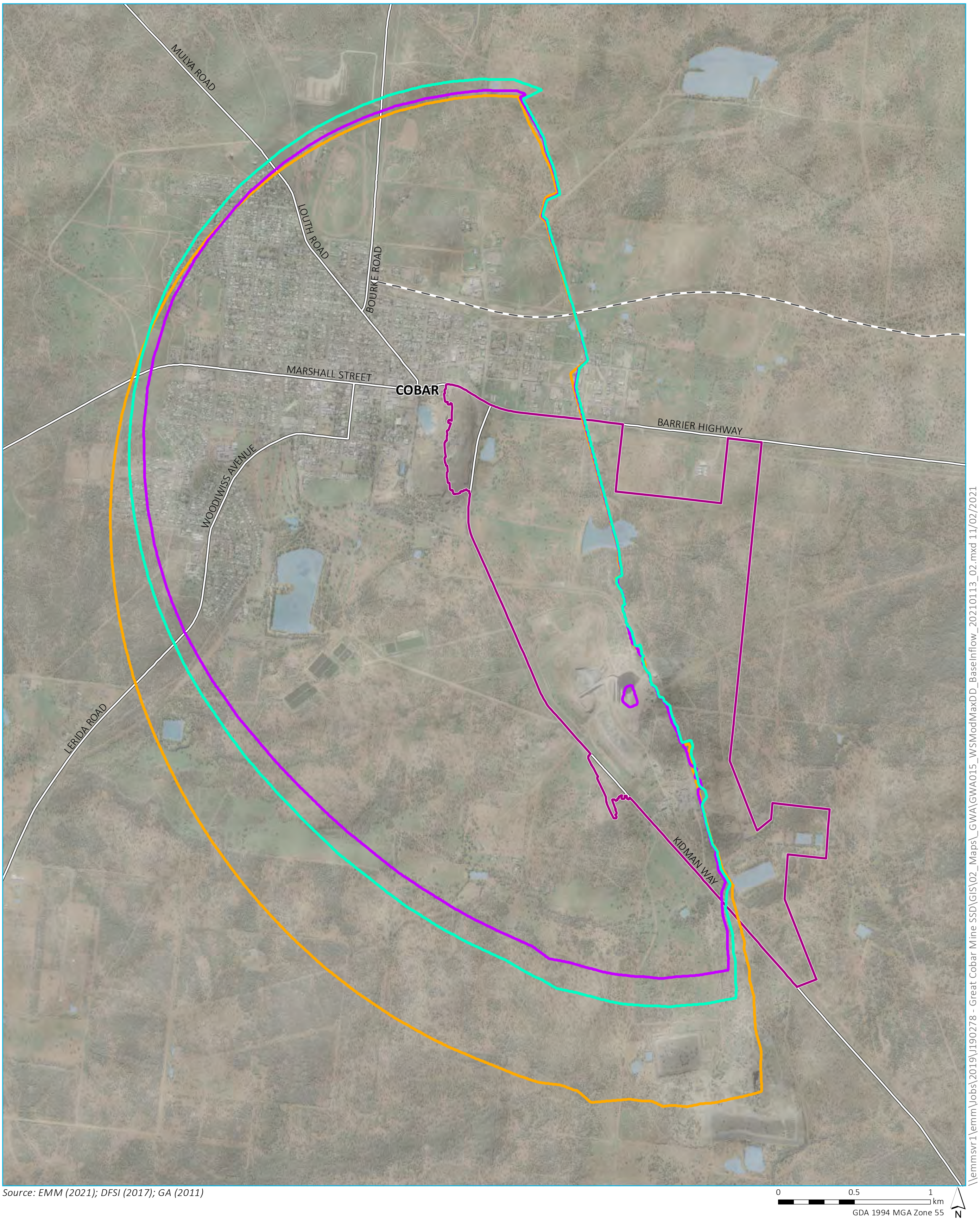
KEY

- Project area
- Base case modelled drawdown (2 m contour)
- Base case additional water supply modelled drawdown (2 m contour)
- Historic void uncertainty analysis modelled drawdown (2 m contour)
- Rail line
- Major road
- Waterbody

Base case and uncertainty runs makeup water supply modelled drawdown extents

Peak Gold Mines
New Cobar Complex Project
Groundwater assessment
Figure D.1

EMM
creating opportunities



Source: EMM (2021); DFSI (2017); GA (2011)

KEY

- Project area
- Base case additional water supply modelled drawdown (2 m contour)
- Low inflow additional water supply modelled drawdown (2 m contour)
- High inflow additional water supply modelled drawdown (2 m contour)
- Rail line
- Major road
- Waterbody

Base case, low and high inflow makeup water supply modelled maximum drawdown extent

Peak Gold Mines
New Cobar Complex Project
Groundwater assessment
Figure D.2

EMM
creating opportunities

D.4 Modelled hydrograph results

Groundwater elevation hydrographs for the additional model scenarios and uncertainty runs are presented for the one water supply work (GW803422) located at the Cobar District Rugby Club and the historic Great Cobar shaft in Figure D.3 through to Figure D.6.

Figure D.3 shows modelled hydrographs at GW803422 for the four predictive model scenarios, showing modelled induced drawdown and recovery following mine dewatering. Changing aquifer material properties results in changed starting groundwater levels, so drawdown is not directly compared for the scenarios. The base case model (GC_tpred1) with no additional dewatering results in a minimum groundwater elevation of approximately 200 m AHD. Shaft water supply extraction for GC_tpred2 results in an additional modelled drawdown of 5 m at this location. The bounds of within reasonable aquifer properties with water supply extraction from the historic void results in hydrographs on either side of this range, with minimum groundwater elevation from 193 to 201 m AHD. Each of the scenarios show drawdown of 10 m or more.

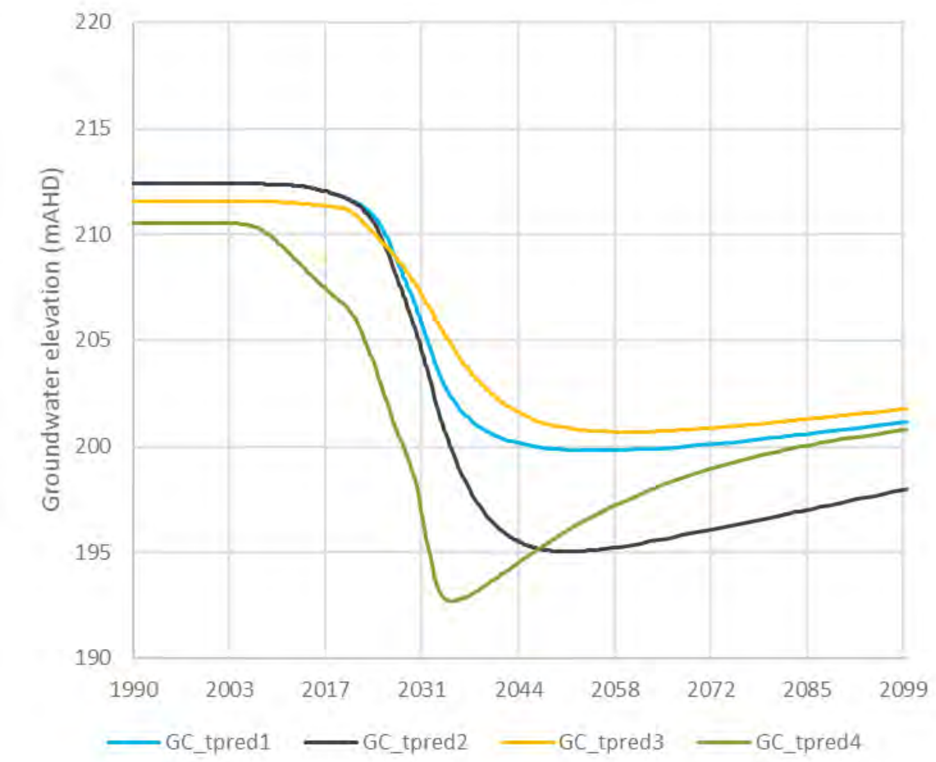


Figure D.3 Modelled groundwater elevation hydrograph at water supply work GW803422

Modelled groundwater level hydrographs at GW803422 for GC_tpred2 and the void properties uncertainty runs are presented in Figure D.4. As with the maximum spatial extent of drawdown, there is very little influence that the void geometry and adopted parameters have on more regional drawdown effects, including those felt at GW803422.

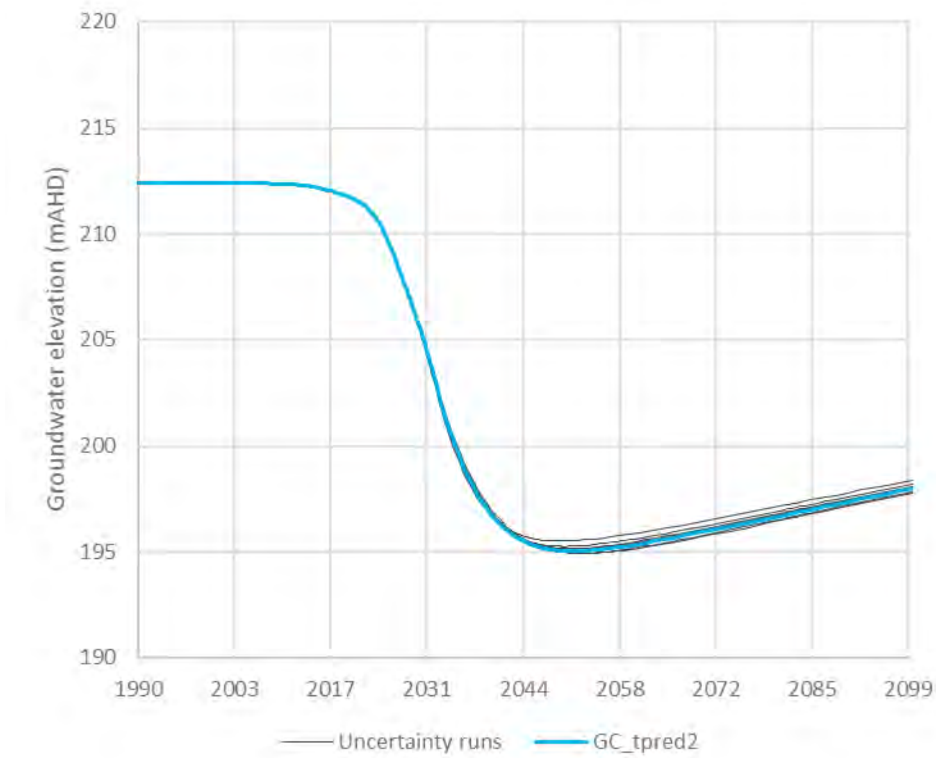


Figure D.4 Rugby club bore modelled mine void uncertainty analysis groundwater elevation hydrograph

Modelled historic shaft groundwater level hydrographs for the predictive scenarios are given in Figure D.5. The water level and trends are representative across the entire historic void footprint, due to the high hydraulic connectivity. The model run without shaft extraction (GC_tpred1) shows drawdown of approximately 30 m due to the planned mine dewatering. The addition of makeup water supply pumping simulates a maximum drawdown of over 165 m (GC_tpred2), gradually recovering to a similar level as the scenario without extraction.

The low inflow aquifer properties (GC_tpred3) require a greater extraction rate, and this is reflected by enhanced drawdown in the shaft and slightly faster water level recovery. The high inflow rate scenario (GC_tpred4) simulates significantly less drawdown; approximately 60 m.

Modelled drawdown hydrographs within the shaft and historic workings for the void uncertainty model runs are presented in Figure D.6. Similar to the regional drawdown results shown on Figure D.1, there is not a lot of variation between the model runs. The most significant difference is the peak drawdown (ranging from 135 m to 230 m) and the rate of recovery. None of the model runs simulate a full dewatering of the historic void, based on current assumptions made to the historical void geometry.

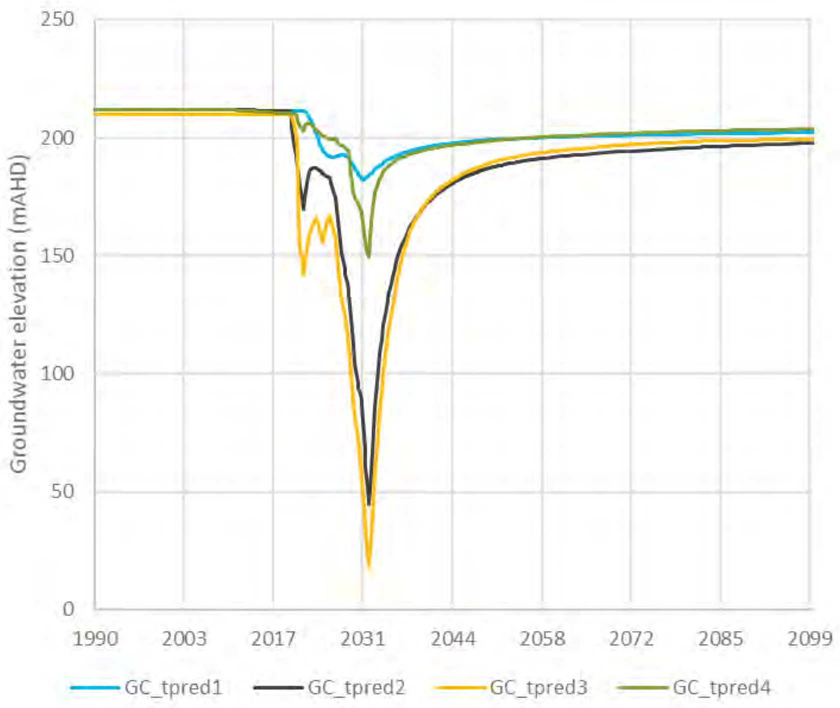


Figure D.5 **Great Cobar shaft modelled groundwater elevation hydrograph**

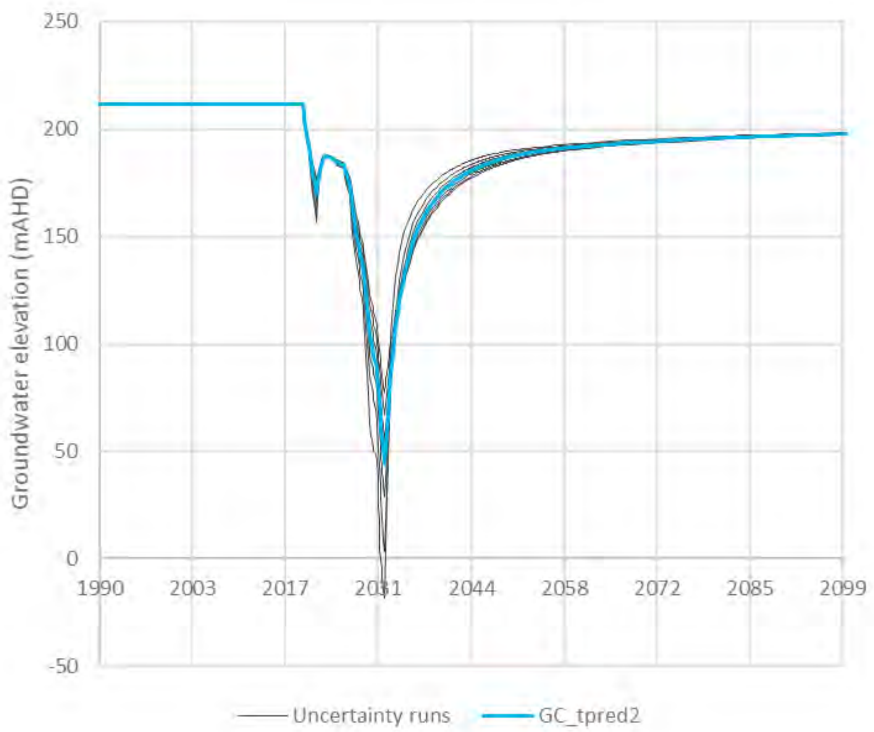


Figure D.6 **Great Cobar shaft modelled mine void uncertainty analysis groundwater elevation hydrograph**

Appendix E

Geochemistry review

New Cobar Complex Project (SSD 10419) - Geochemistry review

Prepared for Peak Gold Mines Pty Ltd
December 2020

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New Cobar Complex Project (SSD 10419) - Geochemistry review

Report Number

J190278 RP#15

Client

Peak Gold Mines Pty Ltd

Date

17 December 2020

Version

v2.0 Draft

Prepared by

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14 July 2020

Approved by

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Associate, ECAD
14 July 2020

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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Figures

1 Introduction

Peak Gold Mines Pty Ltd (PGM), a wholly owned and operated subsidiary of Aurelia Metals Limited (Aurelia), owns and operates the Peak Gold Mines operation south-east of Cobar, far western New South Wales (NSW).

The PGM operation comprises the New Cobar Complex located 3 kilometres (km) to the south-east of Cobar town centre and the Peak Complex located 10 km south-east of the town centre. Both complexes are located adjacent to Kidman Way, which connects Cobar to Hillston and Griffith to the south.

PGM has been operational since modern mining commenced at the Peak Complex in 1991 and all current mining operates under development approvals issued by Cobar Shire Council (CSC).

The New Cobar Complex Project State Significant Development (SSD) (the project) is an amalgamation of underground mining at New Cobar, Chesney and Jubilee deposits and development of new underground workings of the Great Cobar and Gladstone deposits to create the New Cobar Complex Project.

PGM is also seeking to consolidate all existing development approvals applicable to the New Cobar Complex into a single modern consent issued by the Department of Planning, Industry and Environment (DPIE). Approval will be sought for project elements accessed from, and undertaken within, the existing New Cobar Complex located within consolidated mining lease (CML) 6, mining purposes lease (MPL) 0854 and mining leases (ML) ML 1483 and ML 1805.

1.1 Planning context and purpose of this report

EMM Consulting (EMM) has been engaged by PGM to prepare and submit an environmental impact statement (EIS) to support an SSD application for development consent under section 4.12 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). It has been prepared to the form and content requirements set out in clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) as well as clause 8(1) and clause 5 of Schedule 1 of *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP). The Peak Complex, which is not part of this SSD application will continue to operate under local government (CSC) approvals, as there is no proposed change to this arrangement.

PGM requested Secretary's Environmental Assessment Requirements (SEARs) from the Department of Planning, Industry and Environment (DPIE) for the SSD EIS in December 2019; these were received in February 2020 and were re-issued in October 2020 following the receipt of a Biodiversity Development Assessment Report waiver. The SEARs included a requirement to assess potential geochemical risks associated with the construction and operation of the project, including:

- an assessment and life of mine management strategy of the potential for geochemical constraints to rehabilitation (eg acid rock drainage, spontaneous combustion etc.), particularly associated with the management of overburden and reject material; and
- the processes that will be implemented throughout the mine life to identify and appropriately manage geochemical risks that may affect the ability to achieve sustainable rehabilitation outcomes.

This geochemical assessment has been prepared to address the relevant SEARs, provide information to be used in the EIS and support the SSD application for the project.

1.2 Project background

PGM proposes to use the decline, infrastructure and intake and exhaust ventilation elements developed for the Great Cobar exploration drive (approved by Resources Regulator, but not constructed) to facilitate project development. Ore processing (and tailings storage) is undertaken at the Peak Complex with ore from the New Cobar Complex trucked by public road to processing facilities at the Peak Complex. Processing will remain at the existing approved rate of up to 800,000 tpa, with production of ore from the Great Cobar and Gladstone deposits making up for the future decrease in production from other workings across PGM. Additionally, there are remaining resources in the New Cobar and Chesney deposits that are mineral rich, but which are currently not economical to mine in isolation. Keeping the New Cobar Complex operational and gaining access to Great Cobar and Gladstone deposits will lead to increases in economies of scale and maximise opportunities to mine these resources and keep the PGM operational until 2035.

As with all major mining projects a degree of waste material generation is to be expected (primarily in the form of waste rock from the initial box cut and decline excavation, which will be developed as part of the already approved exploration drive, and from tailings post ore processing). PGM commissioned EMM to undertake a review of the existing waste material geochemical characterisation and waste management plans to:

- Assess the potential risks associated with waste (waste rock and tailings) anticipated to be generated during the proposed development and whether the current knowledge-base was sufficient to assess the risks.

- Assess whether current and future waste management will adequately account for the risks.

2 Technical scope and method

Successful implementation of mine ore and waste material management and rehabilitation strategies relies on a comprehensive understanding of the geochemical risks of the material involved. This includes:

- The potential for the material to generate acidic or saline drainage when exposed to atmospheric conditions (acid and metalliferous drainage; AMD).
- The behaviour of the material once placed and exposed to water and oxygen, which includes understanding the generation of potential acidic and saline drainage, the composition of the drainage (eg heavy metal concentrations) and the potential deleterious impacts to environmental values of the drainage if released.

The risk of adverse geochemical impacts also depends on the length of exposure of potentially environmentally hazardous material, with different risks associated with short-term storage (eg run-of-mine pads) versus longer-term storage (eg waste rock dumps) and storage in perpetuity (eg post-mining rehabilitated landforms).

The geochemical assessment was conducted as a desktop technical study and included a review of existing geochemical information and current mine waste management details.

2.1 Existing geochemical information

The technical study compiled and reviewed the geochemical information supplied by PGM to assess whether the current knowledgebase was sufficient to understand the geochemical risks that may be associated with the proposed development. The information reviewed consisted of the following (Section 3):

- Existing geology and waste characterisation reports (waste rock, tailings etc).
- Information from the exploration drilling program of the New Cobar Complex.
- Water quality data from groundwater monitoring bores, seepage collection points (eg from tailings embankments, waste rock dumps and run-of-mine pads), tailings pond water, and any other surface water currently monitored.

2.2 Current mine waste management plans

This technical study reviewed the current waste management plans within the current Mining Operations Plan (MOP; (Peak Gold Mines, 2019)) to assess the adequacy of these plans for the proposed development (Section 4).

3 Review of existing geochemical information

The following section details the review of the available geochemical information used to assess the potential geochemical risks of the proposed development.

3.1 Waste classification guidelines

The existing geochemical characterisation studies have focussed on the reactivity of waste rock and tailings, which represent the primary waste streams following mining operations at the existing New Cobar and Peak Complexes. Characterisation follows industry practice (eg AMIRA International ARD Test Handbook (AMIRA, 2002)[1], Global Acid Rock Drainage (GARD) Guide (INAP, 2009)[2]), with screening criteria from the Department of Foreign Affairs and Trade (DFAT) *Preventing Acid and Metalliferous Drainage Leading Practice Sustainable Development Program for the Mining Industry* (DFAT, 2016).

Following the recommended guidelines, the screening criteria include the net acid generation (NAG) pH, which is obtained through oxidation of a sample using hydrogen peroxide and represents the pH expected following aggressive oxidation of sulfide within the sample. A waste classification scheme based on NAPP and NAG pH screening criteria is presented in Table 3.1.

Table 3.1 AMD potential screening criteria

Classification	Net acid producing potential (NAPP) in kilograms of sulfuric acid per tonne of waste material (kg H_2SO_4/t)	Net acid generation (NAG) pH
Potentially acid forming (PAF)	>10	<4.5
PAF-low capacity (PAF-LC)	0-10	<4.5
Non-acid forming (NAF)	<0 (negative)	≥4.5
Acid-consuming (AC)	< -100	≥4.5
Uncertain (UC)	>0	≥4.5
	<0	≤4.5

3.2 Cobar complex geology

The Cobar deposits mined from the New Cobar Complex and Peak Complex are located along the eastern margin of the Early Devonian Cobar Basin, which is within the central belt of the Lachlan Orogen. The primary lithologies consist of metamorphosed Ordovician sedimentary basement rock with granite intrusions, overlain by the Late Silurian to Early Devonian Cobar Basin sediments. These in turn are overlain by Late Devonian post-orogenic cover and minor remnants of Mesozoic sediments. Weathering during the Cenozoic has formed deep regolith, which has been locally intruded by minor leucitite lava flows (ELA, 2019).

[1]http://www.amira.com.au

[2]http://www.inap.com.au/gard-guide

The Cobar deposits are located within the Great Cobar Slate, which is the upper stratigraphic member of the Devonian Nurri Group meta-sediments, and is associated with a major, north-north-west striking, steeply dipping shear zone (the Great Chesney Fault; Figure 3.1).

Proposed mining operations as part of the project will target deposits within the same stratigraphy as all existing PGM operations at both Peak Complex and New Cobar Complex (Peak Gold Mines, 2019).

The simplified stratigraphy is shown in Table 3.2.

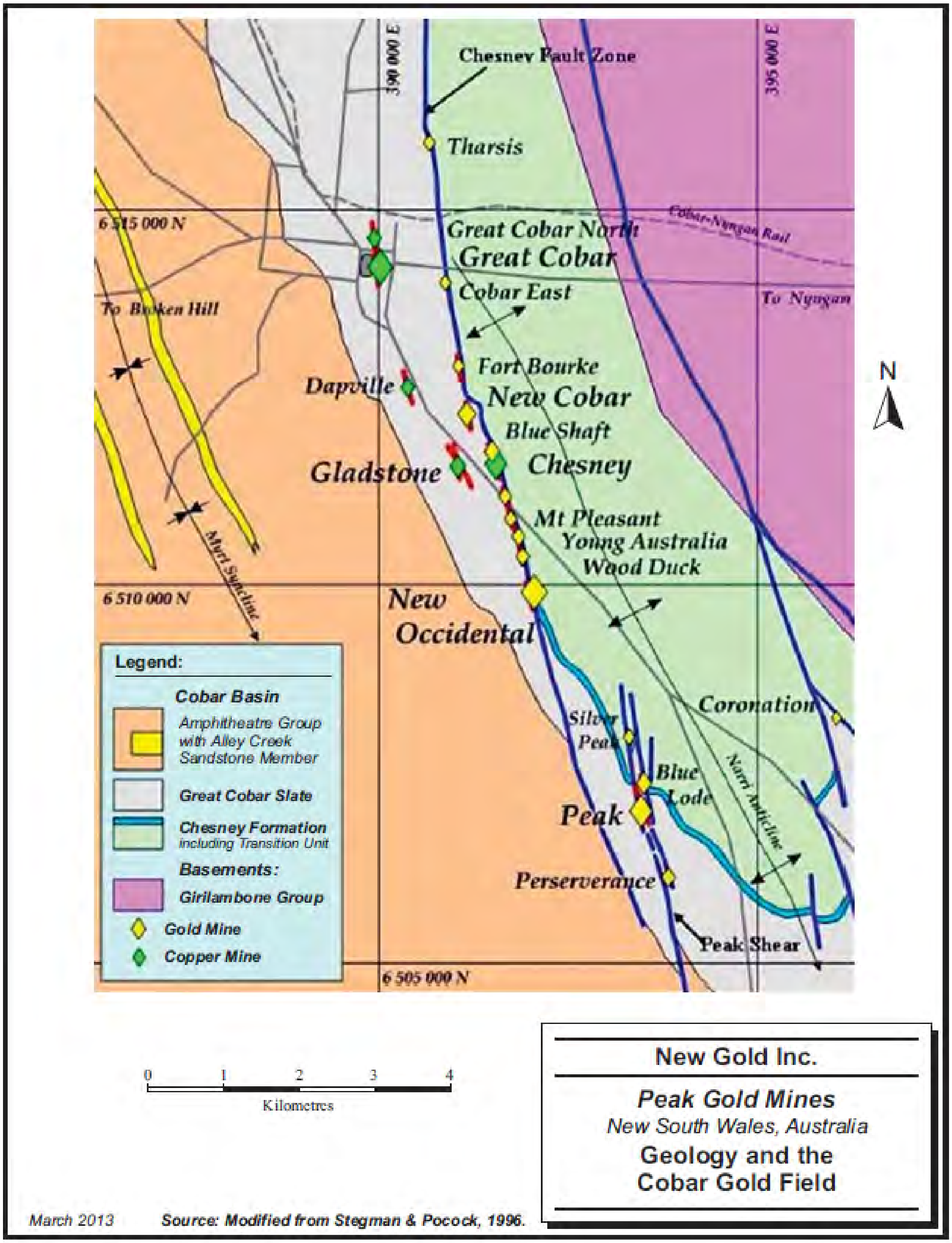

Figure 3.1 Simplified Cobar geology

Table 3.2 Simplified stratigraphy of the Cobar district

Age	Geological setting	Unit	Composition
Late-Mid Devonian ~395-360 million years (Ma) before present (BP)	Cover	Mulga downs Group	Sandstone, siltstone & shale
Early Devonian ~395-420 Ma BP	Post-rift shelf	Winduck Group	Sandstone & siltstone
	Post-rift basin	Amphitheatre Group	
		• Upper Amphitheatre Group	Sandstone, siltstone & mudstone
		• Biddaburra Formation	Sandstone, siltstone & mudstone
		• Alley Sandstone Member	Sandstone
		• Lower Amphitheatre Group	Sandstone, siltstone, mudstone, minor limestone & volcanics
		• CSA Siltstone	Siltstone & mudstone
	Syn-rift basin	Nurri Group	
		• Great Cobar Slate	Siltstone & mudstone
		• Unnamed Silicic Volcanics	Porphyry & rhyolite
		• Chesney Formation	Sandstone & siltstone
		• Bee Conglomerate Member	Fan conglomerates & sandstones
	Syn-rift shelf	Kopyje Group Meryula Formation	Siltstone, sandstone, conglomerate & limestone
Silurian ~420-445 Ma BP	Basement	Wild Wave Granodiorite	Granodiorite
Cambrian-Ordovician ~445-485 Ma BP	Basement	Girilambone Group	Sandstones, siltstones & meta-sediments

After RPA (2013). Technical Report on the Peak Gold Mines, NSW, Australia

3.3 Cobar waste material geochemistry

The ore targeted in the new development will be processed at the Peak Complex and tailings will be disposed of at the Peak tailings storage facility (TSF). Examination of tailings geochemistry therefore provides an indication of the geochemistry of the New Cobar deposits as well as the Peak deposits and is described in Section 3.3.1.

Although waste rock from the project will not be placed on the surface and will instead be used to backfill completed stopes, it is important to understand the potential geochemical risks of increased exposure of the formerly buried waste material during mining operations to determine the potential risk of AMD once operations cease. Waste rock exposure may include:

- exposure during excavation of the ore (ie waste rock will be exposed during mining); and
- exposure of the faces of the decline.

Oxygen ingress may be enhanced following excavation and dewatering. Exposure of waste rock to oxygen may result in the oxidation of sulfide, which may contribute to AMD with potentially deleterious impacts to groundwater after operations cease. Section 3.3.1 discusses the geochemical characterisation of tailings and Section 3.3.2 reviews the current waste rock characterisation to understand the potential risk of AMD.

3.3.1 Geochemical characterisation of tailings

SRK Consulting (SRK) sampled various locations within the Peak Complex TSF in 2007 to establish the potential for acid generation and metals/metalloid leachability (SRK, Geochemical Characterisation of Tailings, 2007). All samples studied were classified as PAF. Acidic paste pH values and the increased leachability of elements (eg iron) indicated that oxidation has progressed furthest near the edges of the TSF. SRK determined that readily leachable contaminants were likely to be accumulating in these regions (coinciding with the presence of reaction products from oxidation). The report determined that during decommissioning and closure, the distribution of actively oxidising regions within the TSF was likely to increase as process water drains from the areas of active deposition.

The minor and trace element (metal/metalloid) chemistry was found to be variable. Silver, bismuth, copper, lead, selenium and arsenic were enriched relative to crustal averages across the entire TSF (eg (Berkman, 1976); (Bowen, 1979)). Copper, arsenic and selenium (if associated with sulphide minerals) would be expected to leach from the tailings under acidic oxidising conditions (ie released via oxidation of host sulfide and soluble under acidic conditions). Leach tests confirmed that copper and selenium leach from the tailings and further indicated that other minor/trace elements (eg zinc, cadmium, cobalt and nickel) also leach at elevated concentrations under acidic conditions.

In 2020, SGM Environmental Pty Ltd (SGM) investigated two tailings samples that were reportedly similar in characteristics to those recorded in the (SRK, Geochemical Characterisation of Tailings, 2007) study, with high electrical conductivity (EC), acidic pH and elevated water-soluble cadmium, cobalt, manganese, nickel and zinc relative to topsoil and waste rock concentrations (SGM, Cover Column Trials, 2020).

An overview of environmental risks associated with the TSF material is outlined in Table 3.3.

Table 3.3 Geochemical environmental risk assessment (adapted from SGM 2020)

Risk name	Cause	Pathway	Receptor	Impact	Risk level	Rationale
AMD	Sulfide oxidation with or without associated neutralisation reactions.	Infiltration, seepage, runoff	Surface water, groundwater, groundwater dependent ecosystems	Poor seepage water quality. Poor water quality in surface water and groundwater. Surface salts from evaporation of near surface infiltration.	Very high	Geochemical Testing indicates tailings are acid forming and metal leaching. Tailings have little ANC.
Exposure of PAF tailings	Catastrophic failure. Gully erosion. Differential settlement and cracking of TSF.	Infiltration, seepage, runoff, wind	Surface water, groundwater, groundwater dependent ecosystems	Increased solute load to environment.	Very high	As above.
Poor quality seepage	Heavy rainfall events. Lack of water mixing.	Infiltration, seepage	Surface water, groundwater, groundwater	Poor seepage water quality. Release of heavy metals and salts from TSF by leaching.	Very high	As above.

Table 3.3 Geochemical environmental risk assessment (adapted from SGM 2020)

	Poor water management.	dependent ecosystems	Poor water quality in surface water and groundwater.
	Constituents of concern in tailings.		Surface salts from evaporation of near surface infiltration.

3.3.2 Geochemical characterisation of waste rock

Waste rock from the existing New Cobar open-cut and waste rock generated by ongoing underground mining (if not used to backfill previous workings), is stored adjacent to the pit in the New Cobar Complex waste rock dump (WRD). The WRD has been partly, temporarily rehabilitated, but waste rock is PGM's primary source of capping material for future rehabilitation works on the TSF at the Peak Complex. Two sampling and geochemical analysis programs (2017 and 2018) were undertaken at the WRD. SGM were commissioned to undertake a review of the geochemistry sampling and analysis program of the WRD (SGM, 2019). Of the samples screened:

- 55 samples were classified NAF. NAF waste rock was generally observed in the western and central areas of the WRD.
- 10 samples were classified as PAF and a further 28 samples were classified as low-capacity potentially acid forming (PAF-LC). PAF and PAF-LC waste rock is generally located in the centre or eastern half of the WRD.
- 29 samples were classified as uncertain (UC).
- 6 samples range between UC and PAF-LC.

The low pH, elevated EC and water-soluble sulfates recorded across the eastern half of the WRD suggest that significant readily water-soluble acidity and adsorbed/readily available hydrogen ions are present. This was generally less of an issue in NAF waste rock. EC and water-soluble sulfates are lower in the western half of the WRD indicating that existing acidity is lower.

The concentration and significance of sparingly-soluble acidity is unknown and was not addressed in the (SGM, 2019) report. If AMD, neutral mine drainage (NMD) or saline drainage (SD) are observed to form, the eastern half of the dump is likely to be the major contributor to salinity in the form of water-soluble sulfate.

The majority of NAF and UC samples had lower concentrations of water-soluble sulfate. NAF samples in the eastern half of the WRD generally had lower water-soluble sulfate than other waste rock in the area but had higher concentrations than the NAF and UC samples in the western half of the WRD. As a result of this, EC ranged from low (18 µS/cm) to high (3,580 µS/cm) with a median of 309 µS/cm. Metals/metalloids GAI[3] values indicate that in the event of AMD, NMD or SD formation, seepage may contain elevated arsenic, cadmium, copper, gold, manganese and lead.

In 2020, two waste rock samples from the New Cobar WRD were collected for geochemical characterisation (conducted by Aurelia in 2019 and reported in (SGM, 2020)). The recent samples confirmed the geochemical behaviour reported in the earlier study and indicated that the New Cobar waste rock is slightly acidic and records moderate to moderately high EC, with most of the salinity derived from sulfate salts, rather than chloride.

[3] GAI: Geochemical Abundance Index. This is calculated by comparing a sample elemental composition to a standard (generally the global median crustal composition) to provide an indication of the enrichment of the sample and hence, the potential for the sample to provide a source of potentially deleterious metals/metalloids in leachate.

3.3.3 Ore assay data

PGM oversees a large exploration core database containing > 40,000 geochemical assay analyses across the New Cobar and Peak complexes. As expected during exploration, the assay data are primarily focussed on determining the location of ore bodies, rather than waste rock characterisation from overburden layers. Nevertheless, the existing assay data are useful to assess the range in compositions that may be expected across the different Cobar ore bodies.

Figure 3.2 and Figure 3.3 show the range in major element and sulfur contents recorded in the Great Cobar deposit assay samples, indicating that the Al and Mg content of the ore is relatively predictable. Figure 3.2 also shows waste material samples fall within the range of sulfur and calcium concentrations recorded in the Great Cobar deposit.

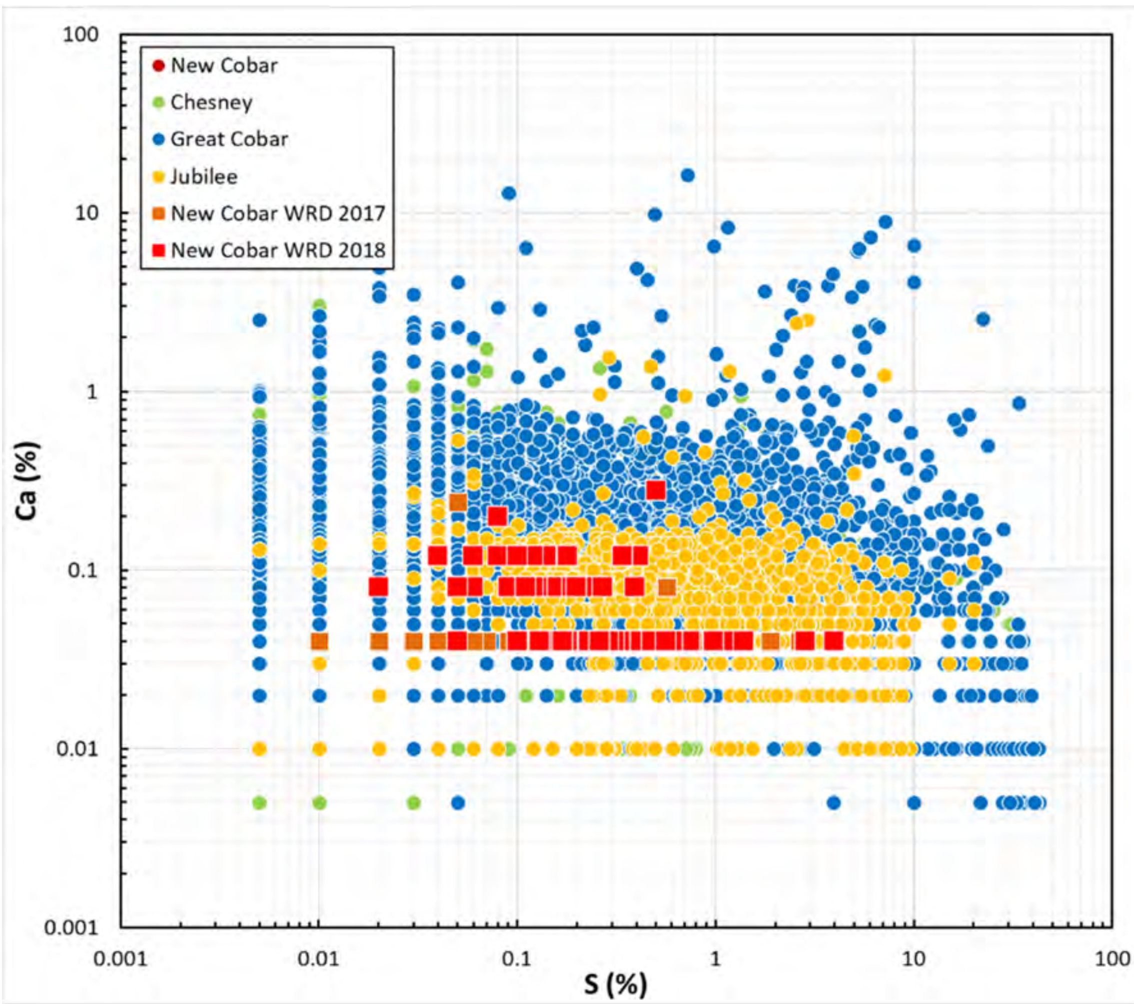

Figure 3.2 Calcium versus sulfur for New Cobar Complex ore body assays and waste rock

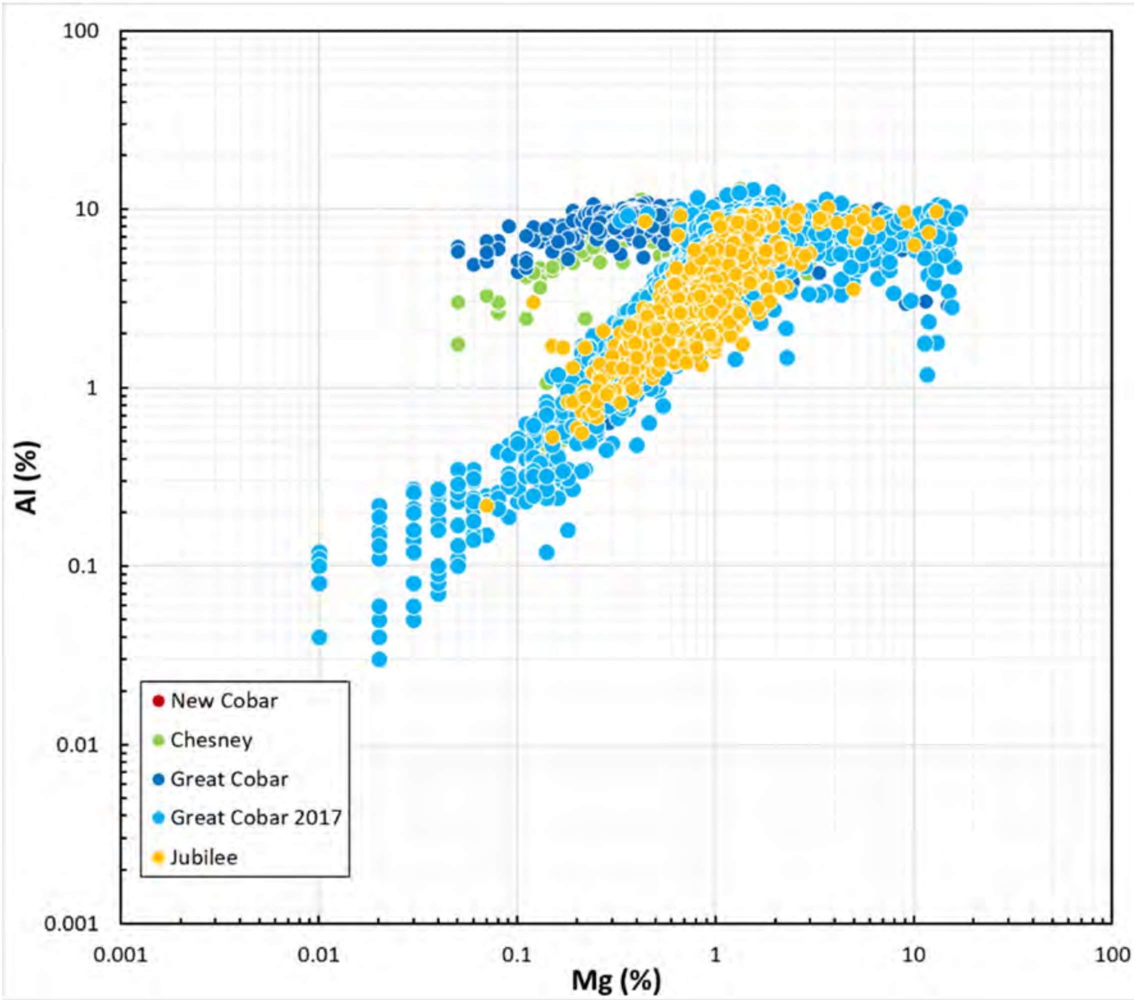

Figure 3.3 Major element magnesium versus aluminium for New Cobar Complex ore body assays

3.3.4 Summary of waste material characteristics

The acid-base characteristics of waste rock and tailings stored at the New Cobar and Peak complexes are summarised in Figure 3.4 and indicate the following:

- Peak Complex tailings is predominantly PAF, with most samples reporting a relatively high capacity for acid generation (NAPP ~ 20 – 80 kg H_2SO_4/t) and limited buffering capacity.
- New Cobar Complex waste rock samples record a range in the potential for acid generation with many samples reported as PAF-LC, although some samples have NAPP values comparable to the highest values in the tailings (~ 80 kg H_2SO_4/t). Even though a range of waste rock samples are reported as NAF, these samples are close to the NAF-UC-PAF thresholds, indicating that the acid buffering capacity is almost equal to the acid generating capacity.
- As outlined in the studies reviewed above, generation of acidity in both tailings and waste rock may mobilise heavy metals as AMD.

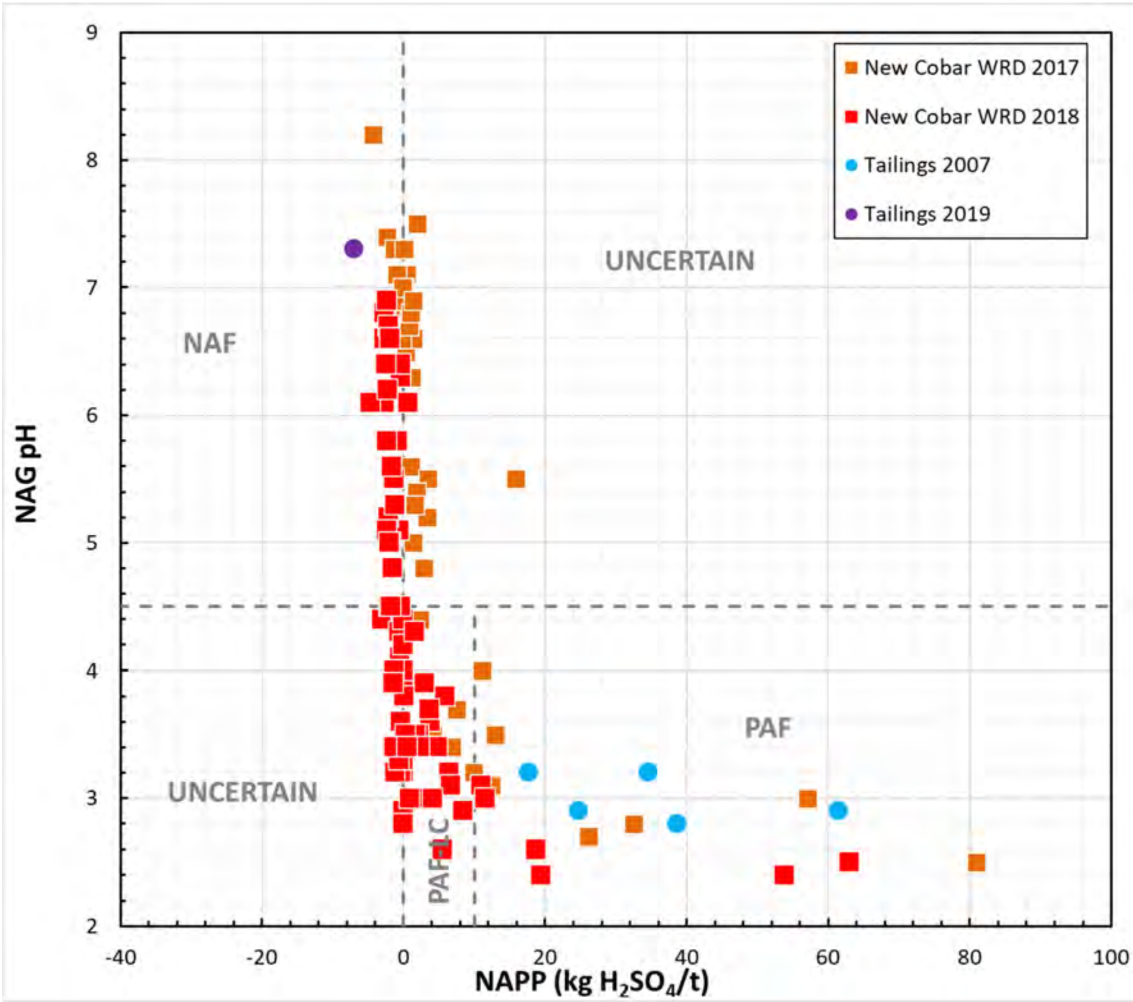

Figure 3.4 NAPP versus NAG pH for Cobar waste material

Since the new development will largely mine material within the Great Cobar Slate and the geochemistry of the ore bodies and waste material is largely understood (Sections 3.3.1 to 3.3.3), the high capacity PAF waste material (waste rock and tailings) sampled from the current waste facilities may be used to represent the 'worst case' for waste material generated from future workings. This is not unreasonable since the existing large exploration assay dataset provides a means of predicting the likely geochemistry of the new deposit samples.

3.4 Water quality

Waste rock and tailings generated during operations have the potential to develop undesirable drainage (eg AMD) if exposed to oxygen followed by infiltration of water (eg groundwater, rain water etc), which may cause the mobilisation of acidity, increased salinity and / or heavy metals in leachate and seepage and may impact both groundwater and surface water environmental values.

To assess the potential for leachate / seepage impacts, both groundwater quality and surface water quality were examined; the rationale behind this is as follows:

- *Groundwater quality.* Although it is anticipated that the waste rock generated during the project will be used as backfill, mining operations (eg dewatering) will alter the existing groundwater regimes along the decline and excavated areas. This will potentially allow oxidation of rock in the decline faces and excavated areas. As mining operations cease and the groundwater system returns to pre-mining conditions, deleterious leachate ('contact water') may mobilise into the recovering groundwater systems. It is therefore important to understand the pre-mining groundwater quality to provide a baseline from which to monitor and assess potential impacts from the project.

- *Surface water quality*. Assessment of current surface water quality may provide an indication of both the current state of surface water quality of site facilities and potentially an understanding of the current leaching behaviour of waste rock and tailings stored on the surface.

- In addition, laboratory testing of tailings sampled from the Peak Complex TSF provides an indication of the likely leaching behaviour of the tailings. The results of the leaching tests provide the primary means currently of assessing the likely leachate characteristics of waste rock and tailings produced during the project.

The following sections provide a summary of the groundwater quality and surface water quality at the New Cobar Complex, Peak Complex and Great Cobar sites, where available. Further details are provided in *Groundwater Impact Assessment* (EMM, 2020b) and the *Surface Water Impact Assessment* (EMM, 2020a).

3.4.1 Groundwater quality

EcoLogical Australia Pty Ltd (ELA) reviewed the available groundwater quality as part of a review of environmental factors (ELA, 2019). In addition, PGM has conducted recent (2020) monitoring of New Cobar Complex groundwater quality. The results of both studies are summarised below.

i ELA 2019 groundwater quality review

The primary findings of the ELA investigation were:

- Figure 3.5 and Figure 3.6 indicate that the New Cobar and Great Cobar mine sites report similar groundwater geochemical compositions (Na-Cl-SO_4 water type), although Great Cobar groundwater records increased magnesium and sulfate contents. All water samples are moderate in alkalinity; Great Cobar groundwater reports slightly higher pH (~ 8) and TDS (16,000 mg/L) than New Cobar groundwater which reports pH generally from 6 – 8 and TDS between 4,000 and 6,000 mg/L).

- Figure 3.6 confirms that the Great Cobar mine water storage areas (including old underground workings) are similar to the Great Cobar and New Cobar groundwater; groundwater across the region may therefore be described as slightly to moderately saline (3,000 – 7,000 mg/L) and dominated by sodium-chloride-type waters (Figure 3.5). Within the mine area, groundwater may contain significant sulphate (up to 9,500 mg/L, but generally less than 2,000 mg/L), with higher concentrations associated with more acidic conditions. These groundwaters are associated with the fractured rock aquifer and (Soroka, 2008) suggests evaporation and water-rock interactions are the main processes influencing groundwater quality within the Cobar region.

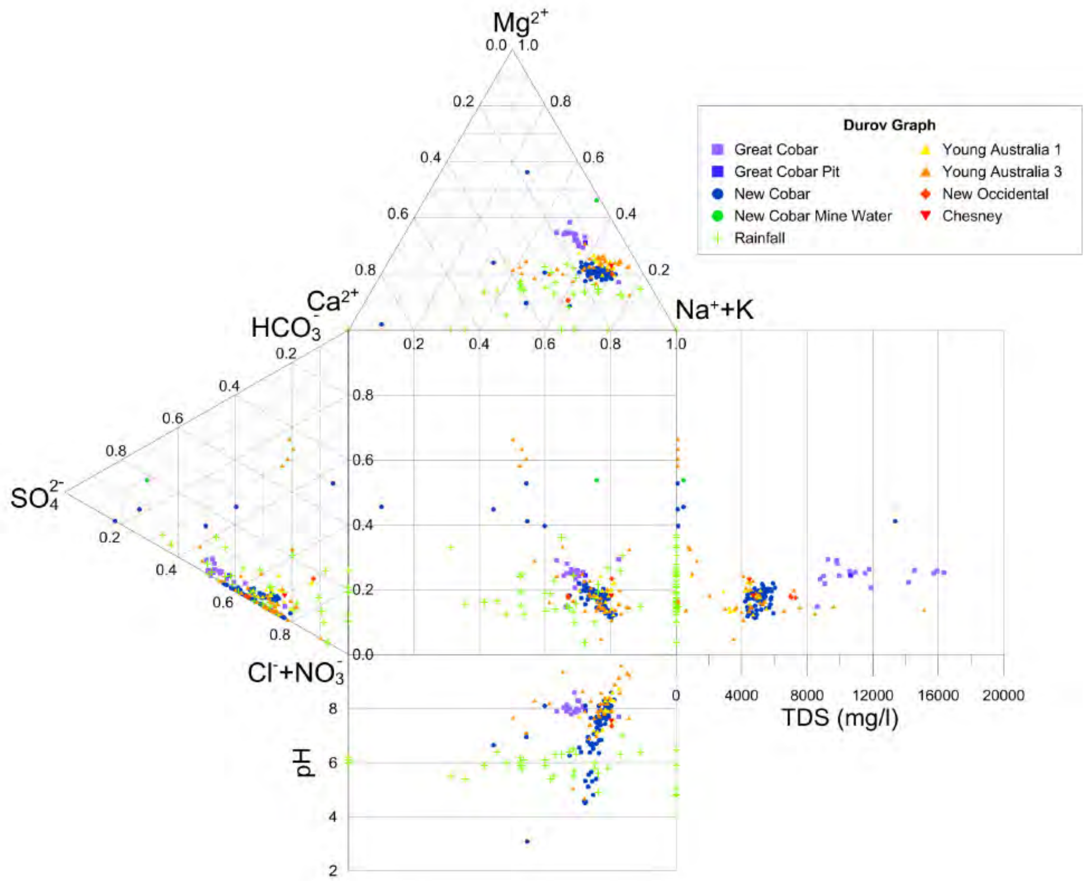

Figure 3.5 Major ion concentrations (as meq/L) for Cobar groundwater samples

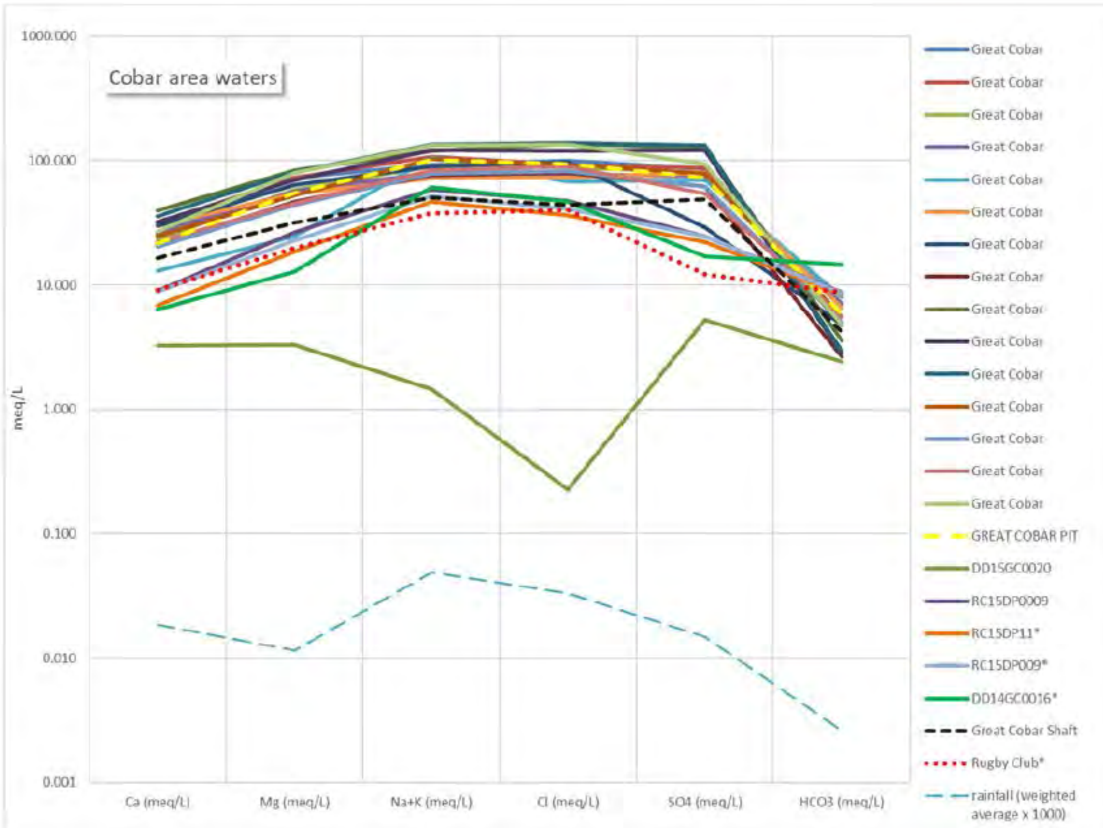

Figure 3.6 Major ion contents (as meq/L) for Great Cobar groundwater

Note: also shown are major ion contents for the Great Cobar shaft water, Great Cobar Pit water, Rugby Club bore water, average rainwater and groundwater from exploration bores

- Assessments of groundwater quality across the local region suggest that the surface water and groundwater constitute two distinct types ((Water Studies, 2000); (Soroka, 2008)). A simplistic separation of chloride-dominant groundwaters and sulphate-dominant surface waters, however, does not appear to consider the distinct groundwaters within mineralised zones, which are also generally of sodium-chloride-sulphate type, though beyond the mineralised areas this distinction appears valid (McQueen, 2008) and suggests minimal mixing between surficial and deep waters.

- Of note, a groundwater sample taken from the Rugby Club bore, (which is near the Great Cobar slag dump but is approximately 1.5 km from the New Cobar Complex and is the only private bore in the area) in September 2016 presents a distinct chemical profile compared to the Great Cobar samples (Figure 3.6). Calcium, magnesium and sulphate concentrations are lower and bicarbonate contents are higher than might be expected from groundwaters impacted by mine water. The profile suggests a closer origin to an evaporated rainwater sample, though a single sample is not conclusive of this disconnect. Other samples collected from local open exploration bores, sampling up to 1,000m depth (eg DD14GC0016), also produced water of comparable, though not identical, quality in 2016 (Figure 3.6).

- Also of note is the chemistry of bore DD15GC0020, which is a bore completed in the tailings pile of the Great Cobar Open Pit. Groundwater from this bore exhibits a strongly leached profile (sodium-chloride depleted) likely reflecting the influence of rainwater percolation in the transmissive surficial sediments.

- The minor and trace element concentrations of the water samples reflect the mineralised nature of the host rocks, with periodically recorded high iron (up to 8 mg/L), manganese (4 mg/L) and copper (0.3 mg/L).

ii New Cobar Complex 2020 groundwater monitoring

PGM is continuing to monitor groundwater quality from shallow and deep bores at the New Cobar Complex. These are summarised in the *Groundwater Impact Assessment* (EMM 2020x) and findings are summarised below:

- Concentrations of major ions (alkalinity, chloride, sulphate, calcium, magnesium, potassium and sodium) are broadly similar to the results reviewed in the ELA study, with TDS ranging between 1,400 and 9,000 mg/L and sulfate between 300 and 1,700 mg/L.

- Values of pH are mildly alkaline to alkaline (pH 7-8) and are comparable to values previously reported.

- Bore NCMW01-D in contrast reports alkaline pH, with values up to pH 12.

- Metals/metalloids concentrations are generally below 0.1 mg/L for the majority of analytes with boron, barium, chromium, manganese and zinc concentrations elevated at or close to 1 mg/L (Figure 3.7).

- Bore NCMW01-D generally records the highest metal/metalloid concentrations, including higher aluminium and cobalt.

- Cyanide concentrations are all reported below the limit of reporting (<0.004 mg/L).

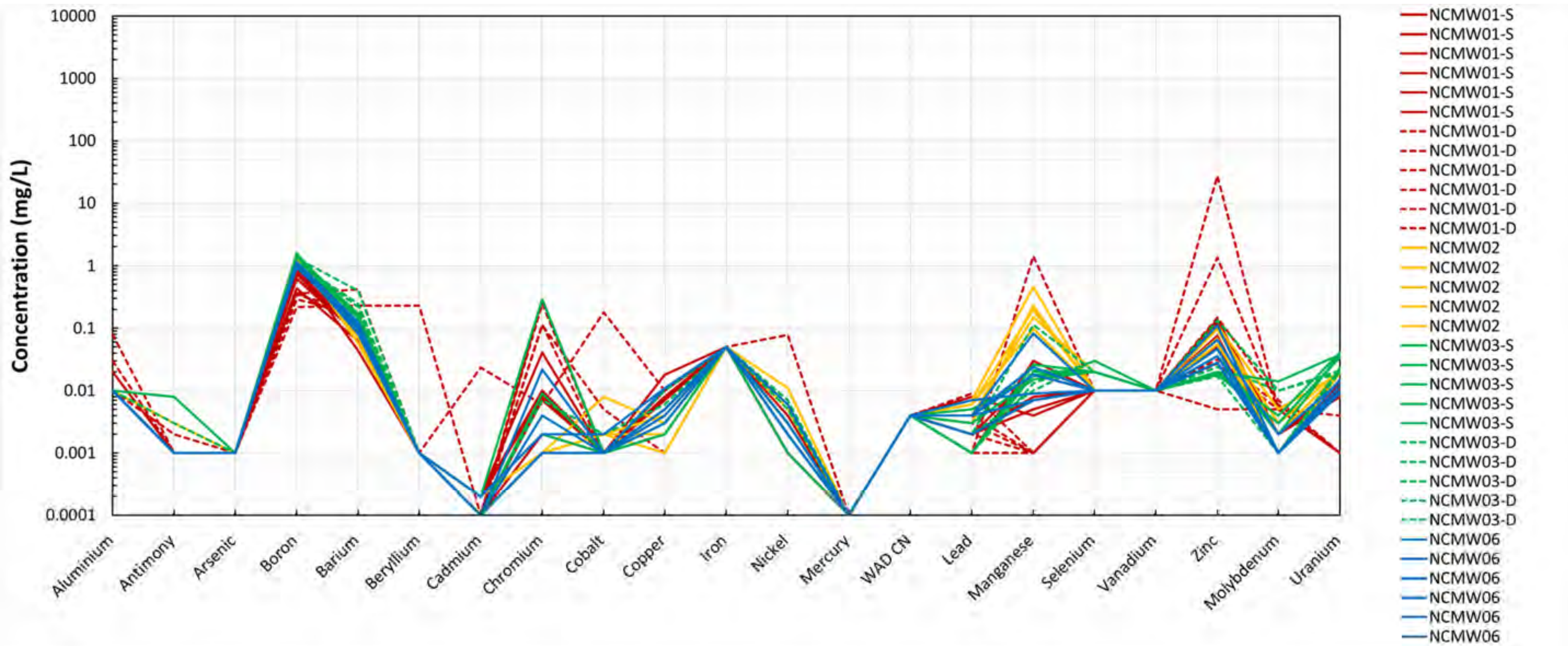

Figure 3.7 Metal/metalloid concentrations of New Cobar Complex groundwater monitoring bores

3.4.2 Surface water quality

PGM monitor surface water quality across the New Cobar Complex site. Surface water quality monitoring locations are described in detail in the *New Cobar Complex Project Surface Water Assessment* (EMM, 2020a) and include the following:

- New Cobar 1 sediment basin.
- New Cobar 2 sediment basin.
- New Cobar 3 sediment basin.
- New Cobar 4 sediment basin.
- Samples taken from 'the Salty' waterbody downstream of Spain's Dam.
- Samples taken from the western side of Spain's Dam (licenced evaporation dam for mine dewatering water).
- Young Australia 1, samples taken from the Young Australia Complex (licenced evaporation dams for mine dewatering water).
- Young Australia 2D, samples taken from Young Australia Complex (licenced evaporation dams for mine dewatering water).
- Young Australia 3, samples taken from Young Australia Complex (licenced evaporation dams for mine dewatering water).
- Young Australia Rehab, sample taken from a rehabilitation area downstream of the Young Australia complex.

Figure 3.8 displays box and whisker plots[4] for key physico-chemical and major ion parameters. Where relevant, water quality objective (WQO) values (from ANZECC 2000 livestock watering default trigger values; (ANZECC & ARMCANZ, 2000)) are also shown as a dotted grey line. Figure 3.9 displays box and whisker plots for metals that exceed WQO values (shown as a dotted grey line).

Results are detailed in *New Cobar Complex Project Surface Water Assessment* (EMM, 2020a) and are summarised below:

- pH ranges between 4.0 and 7.7 and is generally found to be lower (more acidic) at Spain's Dam compared to the Young Australia Complex locations. The Salty, Young Australia 3, and Young Australia Rehab have near neutral pH (approximately a pH of 7).
- Salinity (as indicated by electrical conductivity) and total dissolved solids are elevated relative to WQO values in most mine contact water dam samples.
- Total suspended solids concentrations are generally similar across all locations. However, higher concentrations are occasionally observed at the Salty and Young Australia Complex locations.
- Nitrate and nitrite concentrations are below WQO values in all samples.
- Calcium concentrations are below WQO values in all samples while sulphate concentrations frequently exceed WQO values in all mine contact water dams.

[4] The box (the rectangle) represents the data range for the middle 50% of values (the data between the first and third quartiles). The horizontal line in the middle of the box represents the median value. The whiskers represent the smallest and larges values within 1.5 times the interquartile range.

- Metal concentrations are generally below WQO values except for:
  - cadmium and copper exceed WQO values on a frequent basis in all mine contact water dams except Young Australia 3; and
  - lead, nickel, selenium and zinc exceed WQO values on an occasional basis at Spain's Dam. Lead is elevated in one New Cobar 3 and Young Australia 2D sample.

Water quality across the site is influenced by whether a waterbody receives mine contact water or not. Water management dams that receive mine contact water are shown to have higher concentrations of electrical conductivity, total dissolved solids, sulphate, and metals. Spain's Dam generally has the highest concentrations of these substances which may be attributed to it being the primary discharge point for excess mine dewatering water.

Young Australia 2D generally experiences poorer water quality than Young Australia 3, indicating that water quality improves moving downstream in the Young Australia Complex. Water quality improvements may be attributed to runoff from a broader catchment area diluting mine contact discharge, and/or the settlement of sediment as water passes through the series of water management dams.

The water quality of waterbodies that receive runoff from dirty water or rehabilitated catchments is generally within WQO ranges. This is also the case for the Salty which is located downstream of Spain's Dam and receives runoff from both a natural catchment and the Cobar town stormwater network. Total suspended solids concentrations are relatively high in one of the two samples taken at the Salty. Elevated total suspended solids concentrations are often attributed with stormwater runoff from urban/developed areas. Water quality at the Salty is expected to be primarily influenced by runoff from the upstream stormwater network.

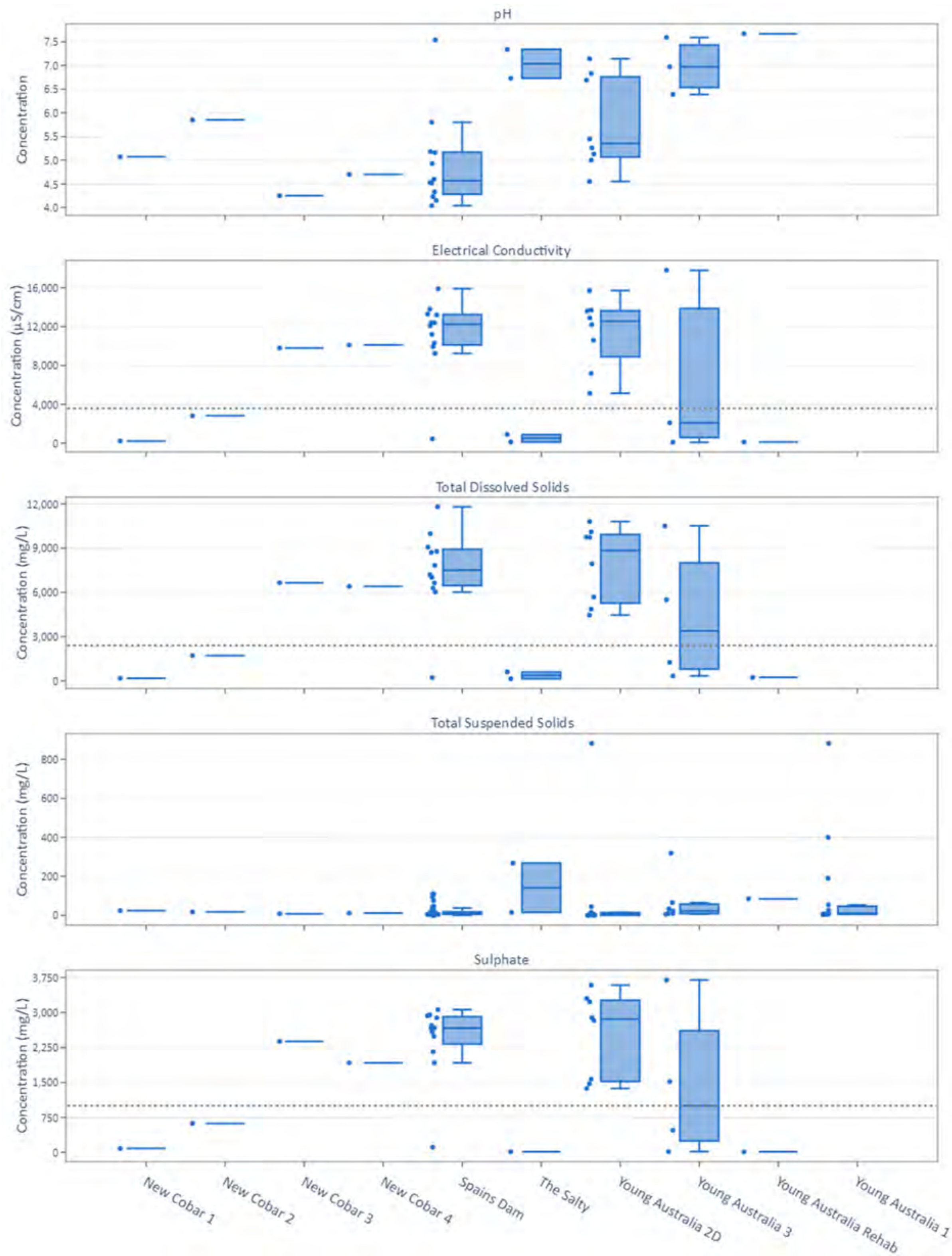

Figure 3.8 Water quality summary – general

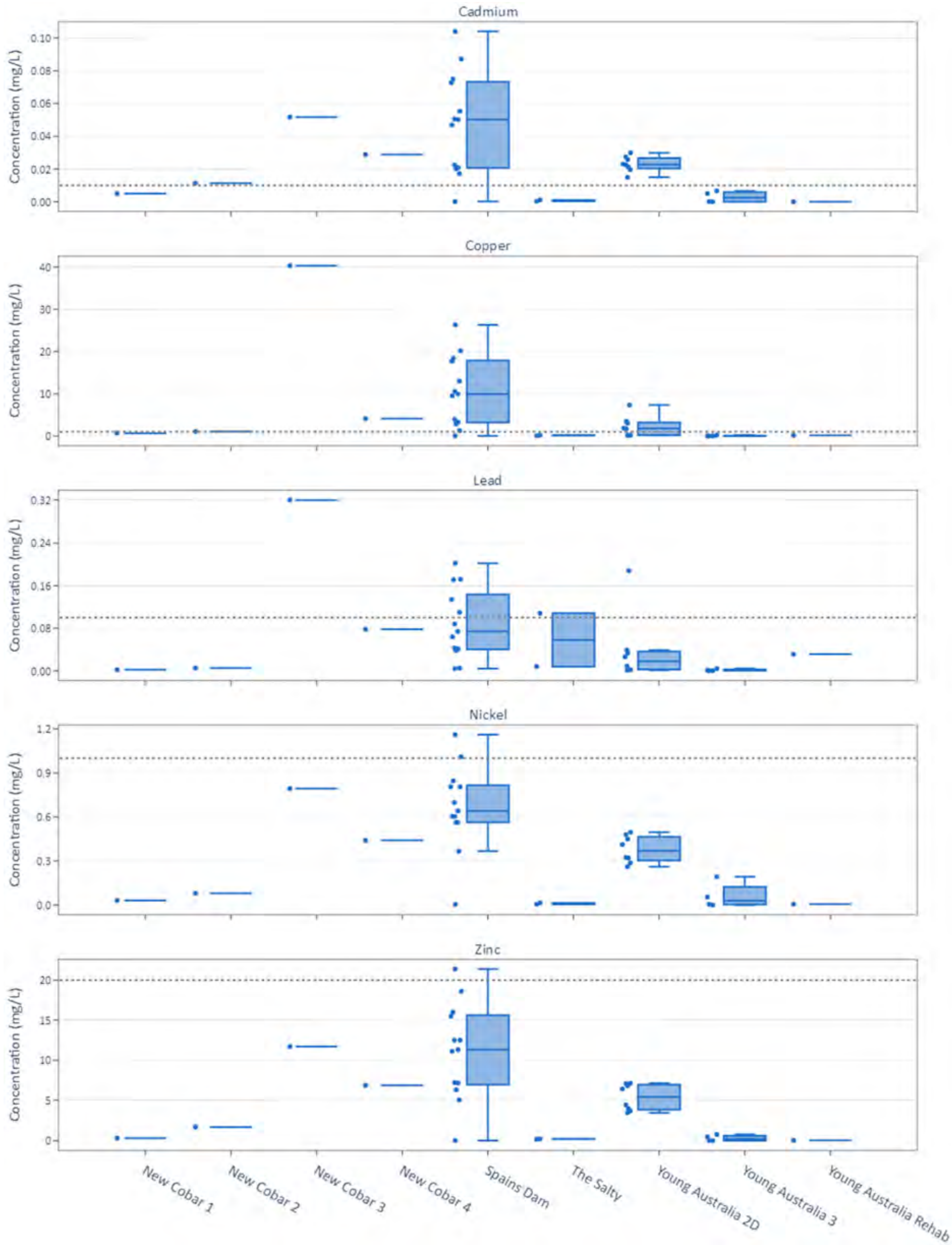

Figure 3.9 Water quality summary – metals

3.4.3 Tailings leachate water quality and potential impacts

As part of a geochemical characterisation of tailings at the Peak Complex TSF, SRK conducted a series of leach tests on tailings samples to identify leaching characteristics and potential analytes that may be mobilised in leachate (SRK, 2007). Ten tailings samples were subjected to contact with dilute sulphuric acid (to represent acidic waters being generated in the TSF) for a period of 24 hours. Following the leach period, pH, electrical conductivity and element concentrations in the leach solutions were recorded.

SRK noted that relatively high concentrations of sulfur, chloride, potassium and sodium were leached from the samples, especially those samples collected from near-surface locations, which may indicate that near-surface samples have higher concentrations of readily soluble sulphate and chloride salts. In the near-surface region of the TSF, it is likely that evaporation of the process water leads to increased precipitation of Na- and K-bearing salts.

Aluminium, iron, magnesium and manganese were found to be recorded in higher concentrations in leachate with the lowest the lowest pH values, which ranged from ~ 3 – 7. SRK suggested that these elements were entering solution due to dissolution of minor oxyhydroxide or hydrated sulphate phases present in the samples (such phases are common products of weathering/oxidation). The solubility of oxyhydroxides is pH dependent, with greater solubilities under acidic conditions, explaining the higher leached concentrations in tests associated with acidic final pH values.

Metals/metalloids concentrations are summaries in Figure 3.10. Copper and zinc reported the highest leachable concentrations (sometimes in excess of 10mg/L. Camium, cobalt, nickel, lead and selenium were typically recorded at concentrations between 0.001 and 10 mg/L.

Laboratory leachate concentrations generally underestimate pH and metals/metalloids concentrations observed in the field (on site). This is to be expected due to:

- differences in scale between the laboratory-controlled conditions and those on-site (eg crushed laboratory samples versus waste material in-situ);
- differences in timescale between laboratory tests (eg 24 hours) and long-term observations taken on-site (months and years); and
- differences in dilution factors between controlled laboratory testing (known and consistent dilution) and on-site conditions, which are subject to seasonal variations.

Nevertheless, the tailings leachate results provide an indication of the New Cobar and Peak complexes waste weathering characteristics: comparison of the tailings leachate concentrations with the groundwater quality (Figure 3.7) and surface water quality (Figure 3.8 and Figure 3.9) monitoring results shows that project waste may have the potential to impact on groundwater and surface water pH, cadmium, copper, lead, manganese and zinc concentrations if not adequately managed.

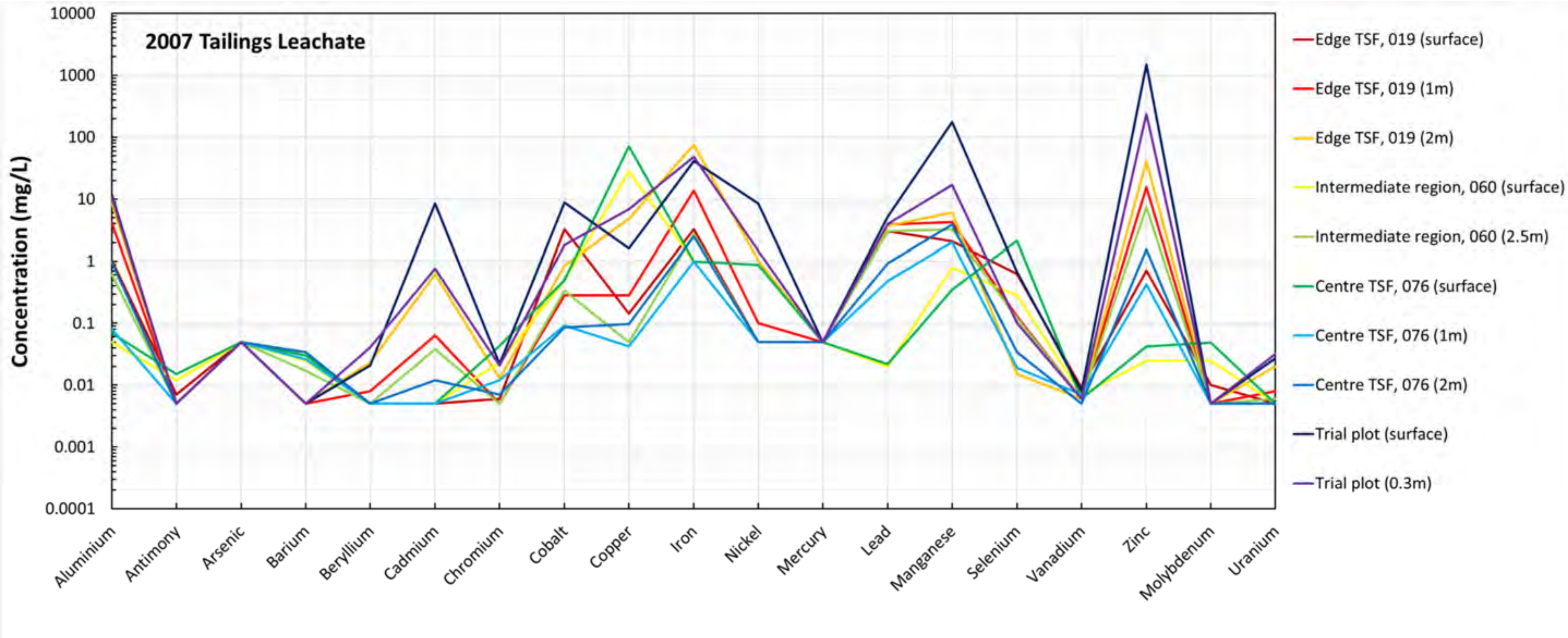

Figure 3.10 Peak Complex tailings samples and leachate testing concentrations

4 Review of current mining operations plan

Following the review of the geochemical information on New Cobar Complex and Peak Complex waste rock, tailings and ore (Section 3), the next stage of this study was to review the current MOP to determine whether provision has been made to adequately manage the waste material (waste rock, tailings) projected to be generated during the new development and to mitigate potential risks associated with this material. This is outlined in the following sections.

4.1 Waste management

Waste material associated with the current and proposed mining operations includes waste rock and tailings. The current MOP (Peak Gold Mines, 2019) makes provision for waste material handling, which comprises:

- Harvesting of waste rock. Waste rock generated during excavations will be primarily handled as follows:
  - Deployed immediately underground for use in backfilling.
  - Non-acid forming (NAF) waste rock will be transported to the surface for on-site use for construction / rehabilitation tasks (eg tailings dam lifts).
  - Potentially acid forming (PAF) waste rock that necessitates transport to the surface will be placed in the WRD at the New Cobar Complex where at the end of mine life it will be capped, or progressively returned underground for disposal;
- Mineral processing will remain at the Peak Complex, with the existing TSF expanded to accommodate the additional tailings generated by the new development. Preliminary assessments undertaken by PGM have identified a further three TSF wall lifts would be necessary to maintain storage capacity functionality to 2035.
- Temporary storage of ore within the existing surface run-of-mine (ROM) pad.

A risk assessment performed on site waste material ranked the risk of contamination from AMD produced by mine activities as medium. To manage this risk a Waste Rock Management Plan was prepared to cover PGM operations. A draft of this plan was submitted to the Resources Regulator on 19 March 2020 for consultation. No response has been received. Only NAF waste rock is used to amour the outside embankment walls of the Peak TSF. All PAF waste rock is used on internal embankments. If, at cessation of operations, PAF material is present that is not practical to place back underground, a specific cover layer will be designed and installed to prevent the ingress of water and oxygen to prevent the formation of acid. PGM undertakes sampling programs to identify the extent and the acid generating capacity of PAF material. Once identified, mitigation measures are implemented, such as:

- Installation of containment structures.
- Installation of diversion drains.
- Installation of bunds.
- Appropriate embankment design.
- Preparation of deposition strategies.
- Pumping to remove PAF contaminated material.

4.2 Waste rock emplacement

4.2.1 Peak Mining Complex

Waste rock from the Peak and Perseverance ore bodies has been classified as PAF (NSR, 2000). The majority of Peak and Perseverance waste rock is used for backfilling underground at the Peak Complex. Small volumes of waste rock have been used previously to aid the construction of the TSF wall lifts, and the spine and causeway lifts. Occasionally waste rock is deposited at New Cobar Complex waste rock dump. Waste rock is currently being stockpiled for use in the TSF wall lift, to be undertaken during the MOP term. Stockpiling and storage of rock is considered to be temporary and will be removed during the construction process. Areas where waste rock is stockpiled will not require rehabilitation, as they are located within the TSF footprint. During the proposed MOP term, waste rock will also be temporarily stored within the Peak compound. This material will be used as backfill.

4.2.2 New Cobar Mining Complex

A section of the WRD stores sulfidic PAF material generated from mining operations (Section 4.2.3). This has been confirmed by a recent sampling program undertaken by PGM (SGM, 2019). The PAF is stored alongside lower reactivity material, which will be used for capping at the completion of mining operations. This PAF material will preferentially be used as backfill, construction material for internal batters of the TSF lifts or remain in the WRD. All waste rock stockpiles, excluding the stockpile adjacent to the open pit, have previously undergone rehabilitation to mitigate air quality issues and are moderately vegetated. Existing waste emplacement facilities are summarised in Table 4.1.

Table 4.1 Existing waste emplacement facilities

Operation	Description
New Cobar	• Large mineral waste emplacement from the New Cobar open cut and underground. Some of this material is earmarked for rehabilitation of the Peak TSF.
Great Cobar	• A number of small remaining mineral waste dumps and very large slag deposits as a result of historic mining between 1870 and 1919. These cover an area of 23.6 ha.

4.2.3 New Cobar Complex sulfide Pit

The sulfide pit was established during operation of the open cut at the New Cobar Complex and is used for the storage of sulfidic PAF waste rock. The sulfide pit remains an active mining area and is surrounded by NAF waste rock material. The sulfide pit has been designed to encapsulate all material deposed of within the void. As the sulfide pit is filled, PGM will install a capping layer over the sulfide pit as part of decommissioning and rehabilitation works, which will prevent the ingress of water and oxygen, therefore preventing the development of AMD.

4.3 Tailings emplacement

Active and historic TSFs are present at the mine:

- Active tailings deposition currently occurs at the Peak Complex TSF.
- Historic tailings deposition occurred at New Occidental and Chesney (marked as 'other' in the MOP plans).

The Peak TSF covers an area of approximately 97.3 ha. The TSF was prescribed in 2000 by the NSW Dam Safety Committee and is classified as a "Significant Hazard" on a "Sunny Day Hazard Rating" and "Imminent Failure Flood Hazard" category. PGM utilises a central thickened discharge (CTD) method for disposing of tailings as described below:

- Tailings are pumped via a bunded pipeline that extends to a central spine on the TSF.

- Tailings are then discharged via a number of spigots along this spine that are alternated as required.
- The thickening of the tailings produces a non-segregating slurry that forms a conical beach with slopes varying between 3% at the toe and >10% at the discharge point.

The upstream slope of the embankment has a coarse screened rock layer to drain seepage through the first uncompacted section of the wall. Along the centre of the embankment is a vertical sand filter, which catches any water seeping through the first uncompacted half of the wall. On the downstream half of the wall, four piezometers have been installed to identify if water is seeping through the two filter defences described above. Seven piezometers have been installed on the TSF in total. Additionally, twelve survey beacons are installed at intervals around the new embankments to determine if any movement or settlement occurs.

PGM intends to maintain the same tailings depositional strategy throughout the current MOP term. The potential for the TSF to produce acid leachate is moderately high, as all ore is collected from highly mineralised sheer zones. As a result, PGM has classified all tailings contained within the TSF as acid generating. To prevent the occurrence of AMD during the active phase of the TSF, PGM has implemented a number of control methods. These include:

- A deposition strategy for centrally thickened discharge.
- Appropriate wall design.
- Appropriate drainage design.

PGM's deposition strategy allows water contained within discharged tailings to be removed through evaporation. Evaporation reduces the likelihood of the water reacting with oxygen and reduces the sulphur in the tailings that generates acid leachate. All tailings are discharged to the TSF at approximately 60% solid and discharged evenly over the beach to ensure a good spread of deposited material to maximise evaporation. The drainage design of the TSF prevents ponding of water on the tailings dam. The design enables all water to flow to the spillways to the Decant Dam and restricts ingress of water into the tailings.

4.4 Environmental risk management

4.4.1 Surface Water

In response to the potential risk of poor water quality discharges during operations, PGM will follow the MOP (Peak Gold Mines, 2019). Erosion and sediment control measures will also continue to be implemented to minimise the potential for polluted water. PGM has a number of surface water management measures implemented across all operational and historic sites that prevent potential pollution. They include clean, dirty and contaminated diversion drains, small collection drains, retention dams, sediment ponds and pumps and piping. These measures are in place to ensure all clean water is prevented from entering any contaminated catchments, and all contaminated and dirty water is contained separately. Further details of the water management system at PGM are outlined in the Water Management Plan (WMP); (EMM, 2020c).

A water monitoring program is undertaken to measure the performance of the water management system. Refer to the WMP for further details regarding this monitoring program. All of PGM water monitoring results are reported annually in the PGM Annual Environmental Management Report (AEMR).

4.4.2 Groundwater

Contamination of groundwater and groundwater accumulation in underground workings are both considered to be medium risks (Peak Gold Mines, 2019). As a result, during the MOP term PGM is currently developing groundwater monitoring strategies.

Monitoring of water quality is required to assess the success of the management strategies implemented. Changes in water quality provide a clear indicator of AMD, with the following changes generally attributed to potential AMD:

- increases in sulfate concentrations or the sulfate to chloride mass ratio (SO_4/Cl) in groundwater over time;

- progressive reduction in the alkalinity of groundwater over time; or
- progressive increases in the total acidity of groundwater over time.

Six groundwater monitoring bores have been installed in the New Cobar area to assess the groundwater quality (Table 4.2)

Table 4.2 Groundwater monitoring bore summary

Borehole	Easting	Northing	Ground elevation (RL, m)	Depth (mbgl)	Geology	Target	Blank casing depth (mbgl)	Screen casing depth (mbgl)
NCMW01_S	389980	6513814	234.185	60	Weathered rock	Oxidised zone	0-54	54-60
NCMW01_D			234.185	110	Fresh rock	Fresh rock zone	0-104	104-110
NCMW02_S	389202	6513620	232.226	60	Weathered rock	Oxidised zone	0-54	54-60
NCMW03_S	390688	6514130	237.019	70	Weathered rock	Oxidised zone	0-64	64-70
NCMW03_D			237.019	120	Fresh rock	Fresh rock zone	0-114	114-120
NCMW06_S	390517	6512735	248.704	60	Weathered rock	Oxidised zone	0-54	54-60

After (SLR, 2019)

PGM utilises a number of management measures to prevent groundwater contamination, which include:

- testing of soil infiltration rates within contaminated areas; and
- fit-for-purpose audits conducted on all bunding within PGM operations.

4.4.3 Contaminated land

PGM has a number of historical sites that are potentially impacted by mining activities. These sites are managed on a case-by-case basis. However, the following mitigation measures are implemented at all historic sites:

- Containment. Water containment structures have been constructed to prevent surface water from flowing onto or off site. The nature of the contaminated area will determine the size, number and type of water containment structures required.
- Stockpiling. Contaminated waste is consolidated into stockpiles, to allow for progressive rehabilitation.
- Soil Sampling. Soil sampling is undertaken to identify the chemical and physical properties and the level of contamination. The results are used to determine success of rehabilitation works.
- Reprocessing. Reprocessing of historic material at the Processing Plant to recover metals, where practical. The remaining material is placed in a mineral waste emplacement or TSF.

Monitoring of contaminated land is undertaken annually. The monitoring program entails:

- Site Inspections. Inspection of the integrity of all water containment structures and stockpiles for erosion.
- Water Monitoring. Water quality monitoring is undertaken after significant rainfall.

5 Proposed operations

5.1 Project waste material

Both the current mine operations and the proposed development are principally located within a highly mineralised shear zone (refer Section 3.2) and both the ore and the waste material produced have been assumed to be PAF. Although the wide array of exploration assay information is primarily focussed on ore deposit geochemistry (refer Section 3.3.3), the new developments are expected to produce waste material with geochemical properties falling within the ranges of those investigated for acid-base accounting and metal leaching (Sections 3.3.1 and 3.3.2) and waste management of this new material is anticipated to follow the provisions within the MOP (refer Section 4).

5.2 Project waste handling

Subject to approval, project waste rock will be managed in accordance with existing protocols outlined in Section 4. In accordance with the Waste Rock Management Plan, characterisation of waste rock material as a result of the project as either PAF or NAF material will be undertaken by geological and engineering personnel prior to long-term storage using the following methods, geologists will be responsible for identifying zones likely to be NAF via:

- visual assessment of characteristics including the weathering profile, sulfidic minerals, seepage stains and precipitates of iron and aluminium hydroxides; and
- field-based measurements of mineral abundances conducted using hand-held X-ray fluorescence (XRF) analysers.

Prior to use of identified NAF material for construction or rehabilitation purposes (particularly for the TSF raises), categorisation of NAF material will be validated through static acid-base accounting testing of underground rock samples. Static tests may include NAG testing, NAPP, paste pH, sulfur speciation, mineral determination by X ray diffraction, elemental composition by XRF and static deionised leach tests, as required. Where the results of static tests are inconclusive, kinetic laboratory tests (eg humidity cell and column leach tests) will be conducted. Additionally, analysis of seepage (where available) will be undertaken for major ions, major and trace elements and parameters including pH, EC, TDS and alkalinity.

Following characterisation and validation of samples, data illustrating the locations of geological units containing NAF material will be retained and reviewed by PGM on a regular basis to support maximum recovery of NAF material for construction and rehabilitation purposes. The handling of waste rock generated as a result of the new development will follow the current MOP waste handling and will include:

- The preferential return of PAF waste rock material underground for void backfilling.
- Transportation of PAF and NAF waste rock to the surface on a campaign basis for construction projects (eg TSF raises, which will use PAF material on internal TSF walls only).
- Transportation of NAF waste rock to the surface for storage in designated stockpiling areas within the New Cobar WRD footprint prior to use for future construction and rehabilitation purposes.
- Preferential usage of PAF waste rock as backfill in underground voids. If voids are unavailable, transportation of PAF waste rock to the surface and storage in New Cobar WRD.

As material will be stored underground or within the existing New Cobar WRD and the management measures detailed in the Waste Rock Management Plan will be implemented, it is considered that impacts associated with the additional waste rock produced by the new development will be limited. Notwithstanding the fact that the additional material could readily be accommodated within the existing New Cobar WRD, PGM anticipate that approximately 135,000m^3 of NAF material and approximately 70,000m^3 of PAF material will be required for TSF raises (Stages 5 to 7) which will be the subject of a separate local government (Cobar Shire Council) development application.

Additional waste rock generated by the project will be utilised in the construction of future TSF raises. Furthermore, monitoring of standing water level and water quality will continue (refer Section 4.4.2), allowing the assessment of the efficacy of waste rock management measures and the identification of any impacts (eg AMD) associated with additional waste rock material stored at the New Cobar WRD.

6 Summary

The primary findings of the geochemistry review are summarised below.

Previous studies provide an indication of the waste rock and tailings geochemistry. Since the new development will mine the shear zone within the Great Cobar Slate, the existing geochemical database (ABA and ore assay data; Section 3) may be considered as being representative of the waste rock and tailings anticipated to be generated during the new development. Waste rock and tailings management will be most effective (conservative) by planning around the handling of the higher capacity PAF waste rock and tailings identified in the previous studies (ie planning for mitigation of the 'worst case'). Based on the geochemical characterisation studies performed so far:

- AMD is likely to be generated if PAF waste material oxidises. PAF waste rock will be preferentially used as backfill in underground voids to limit oxidation. If PAF waste rock is bought to surface it will be stored in the existing New Cobar WRD where it will be used in TSF lifts (internal batter only) or capped in the WRD at the cessation of mining.

- Tailings will be managed within the existing facility at the Peak Complex.

- Additional and appropriate testing will be required to classify the material and determine how to manage it. PGM has outlined waste management measures for the new development, which will include field testing, sampling and analysis of potential waste material and water quality monitoring as the development progresses.

The current *MOP 1 August 2019 - 31 July 2022* (Peak Gold Mines 2019) contains provision for handling of PAF waste and has made provision for the new development waste (assuming a worse case). The provisions made are assessed as adequate for the proposed work.

7 Assumptions and limitations

Surface water and groundwater monitoring programs are beyond the scope of this review, which primarily focusses on potential solid waste streams. This review is a summary of previous information.

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