Appendix F

Mitigation Methods

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F-1 Introduction

This appendix outlines the mitigation measures proposed to meet the desired water quality outcomes downstream of the Macraes Mine associated with the Macraes Phase 4 Project. An overview of the project description is provided in Section 2 of the “Macraes Phase 4 Project – Surface and Groundwater Assessment” to which this Technical Memorandum is attached as Appendix F. Limitations and assumptions detailed in Section 1 of the “Surface and Groundwater Assessment” are applicable to this appendix.Table F-1.1 provides an overview of the principal mitigation measures proposed to address potential water quality issues throughout the Project. The measures include physical infrastructure and management practices to be implemented, and mine design refinements that have been proposed for the purpose of reducing off-site water quality risks. These measures are described in detail in Section F-2 of this Appendix.

The implementation schedule for the proposed mitigation measures is outlined in Figure F-1.1. This timeline allows for improved monitoring of surface water and groundwater to be implemented during the early phases of the project. It also provides for the detailed design and construction of physical water management features to take place including:

– Construction of seepage capture drains and toe bunds,
– Implementation of a water treatment plant, and
– Construction of the Camp Creek and Coal Creek augmentation dams.

In addition to these measures, the following is also proposed:

– Ongoing monitoring and water treatment of pit lakes through ferric chloride dosing to help manage the concentrations of dissolved arsenic and other metals,
– Implementation of a flushing flow regime for streams (where motivated by periphyton monitoring programs), and
– Improvements to current and future waste rock stack (WRS) construction methodology to minimise infiltration rates.

The timeline proposed for implementing these mitigation measures, enabling a planned transition to revised water quality compliance criteria, is recognised in the water balance model (WBM) and associated results. Improvements to water quality in the receiving environment are expected to take time, as the mine site is large and substantial work is required to manage the water and contaminants already mobilised within the site structures.

F-1.1 Purpose of this Appendix

The purpose of this appendix is to outline the proposed mitigation measures, describe how they are incorporated into the WBM and describe how they can be implemented in practice. It includes information drawn from other sources to document the status of the measures as implemented in the modelling.

F-1.2 Scope and Limitations

This document is an appendix to GHD Report – Macraes Phase 4 FTA, Surface and Groundwater Assessment. Scope and Limitations apply as outlined in that document.

F-1.3 Mitigations and Implementation Overview

Table F-1.1 summarises the mitigation measures proposed for the Project and represented in the WBM. The proposed implementation timeline for these measures is provided in Figure F-1.1.

Table F-1.1 Summary of mitigation measures

Type	Mitigation	Overview	Objectives
Source control	WRS construction methodology	Lift height limitations and amended capping design approach to minimise infiltration.	Rehabilitated WRS promoting water shedding and minimising infiltration.
	WRS interim management	Change in current WRS construction practices to reduce unrehabilitated WRS areas and hence reduce infiltration. This will be achieved with implementing a WRS construction management plan.	Reduce WRS infiltration through mining, and hence captured and uncaptured seepage loads. This mitigation is not quantified and not included in the modelling, however, offers a qualitative improvement to the existing practices.
	Mine design	Amended mine designs to improve water quality outcomes and reduce risks. See Section F-1.4 below.	The outcomes of these adjustments are captured in the project description and allow for improved long-term water management.
	Water diversion	Permanent water diversion constructed around Trimbells WRS to Trimbells Gully.	Reduction of potential seepage through the WRS that could have been generated by ponding against the stack.
Discharge controls	Return pumping	Pumping of silt pond water to the mine water management system.	The capture and return of contaminated water reduces potential containment discharges to receiving water bodies.
	Seepage capture	Interception and capture of point source and diffuse seepage flow paths.	Contaminated seepage waters are captured near the source (i.e. at WRS margins) and returned to the mine water management system, reducing contaminant loads to receiving water bodies.
Water Treatment	Water Treatment Plant (WTP)	Treatment of captured WRS seepage and tailings storage facility (TSF) underdrain waters prior to discharge to receiving water bodies (ProcessFlow, 2026a).	Significant reductions in contaminant mass load discharges to receiving waters.
	Pit lake water treatment	In pit ferric-chloride dosing for treatment of arsenic (MWM, 2026g).	Reduced arsenic concentrations in developing and overflow pit lakes.
	Passive water treatment	Application of passive treatment technologies for treatment of mine waters.	For future development. Not proposed as a baseline mitigation measure for the Project.
Flow augmentation	Flow augmentation dams	Camp Creek Dam for low flow augmentation in Deepdell Creek. Coal Creek Dam for low flow augmentation in the Mare Burn.	Provides flow augmentation to mitigate potential flow losses within the catchments due to mining activities. Reduces contaminant concentrations in receiving waters during low flow periods.
	Flushing flows	Flushing flows from augmentation dams and WTP discharges.	Help to Manage eutrophication effects and periphyton growth through dry summers

F-1.4 Implemented Mine Design Changes for Water Management

Throughout undertaking the MP4 assessment there have been a number of changes made to the proposed mine design to address identified water management concerns. These changes have been incorporated into the project description and represented as the base case for assessment. They are not discussed explicitly as mitigation measures, however, are outlined here for the purpose of clarifying understanding of the proposal for readers with background knowledge of the Macraes Operation. These include:

1. The future overflow from Coronation North Pit has been re-designed to a lower level (reducing from 580 mRL to 562.5 mRL). The purpose of this was to avoid; i) the potential for seepage flow paths developing through Coronation North WRS once the level exceeds the proposed outlet level, and ii) a prior design of the proposed Coronation North pit backfill acting as a large dam (this is now cutdown to achieve the proposed outlet at 562.5 mRL). The original design would have resulted in all pit discharge being seepage through the backfill.
2. The future overflow from Coronation Pit has been redesigned at a lower level of 625 mRL (from approximately 665mRL) and discharges to the Camp Creek catchment. This avoids the lake ponding against the existing Trimbells Gully WRS which intersects the pit at approximately 630 mRL, from where the lake would drain through the stack towards Trimbells Gully. This avoids the potential for the existing Trimbells Gully WRS acting as a large dam once the lake fills and avoids potential seepage flow paths through the WRS to Trimbells Gully, and subsequent water quality concerns related to this seepage water.
3. The placement of waste rock within the Coronation Pit as backfill up to a level of 620 mRL, allowing for the waste rock to be saturated and reducing contaminant load generation compared to the waste rock being located external to the pit.
4. The proposal for bores to be used for long-term seepage capture within Golden Point Pit instead of attempting to block the historic adits connecting the pit with Deepdell Creek. This reduces the risk that uncontrolled contaminant plumes could develop through the Golden Point Pit wall to Deepdell Creek.
5. The application of a dry cap to Frasers TSF once filled to its final level, recognising that attempting to maintain a wet cap posed long-term reliability risks once the lake reaches the upper storage levels. This is due to evaporative losses and groundwater outflows increasing as the TSF level raises. At the proposed fill level, the water balance did not provide confidence that a reliable wet cap could be retained across a range of expected climate conditions, potentially leaving un-rehabilitated tailings exposed and drying out.

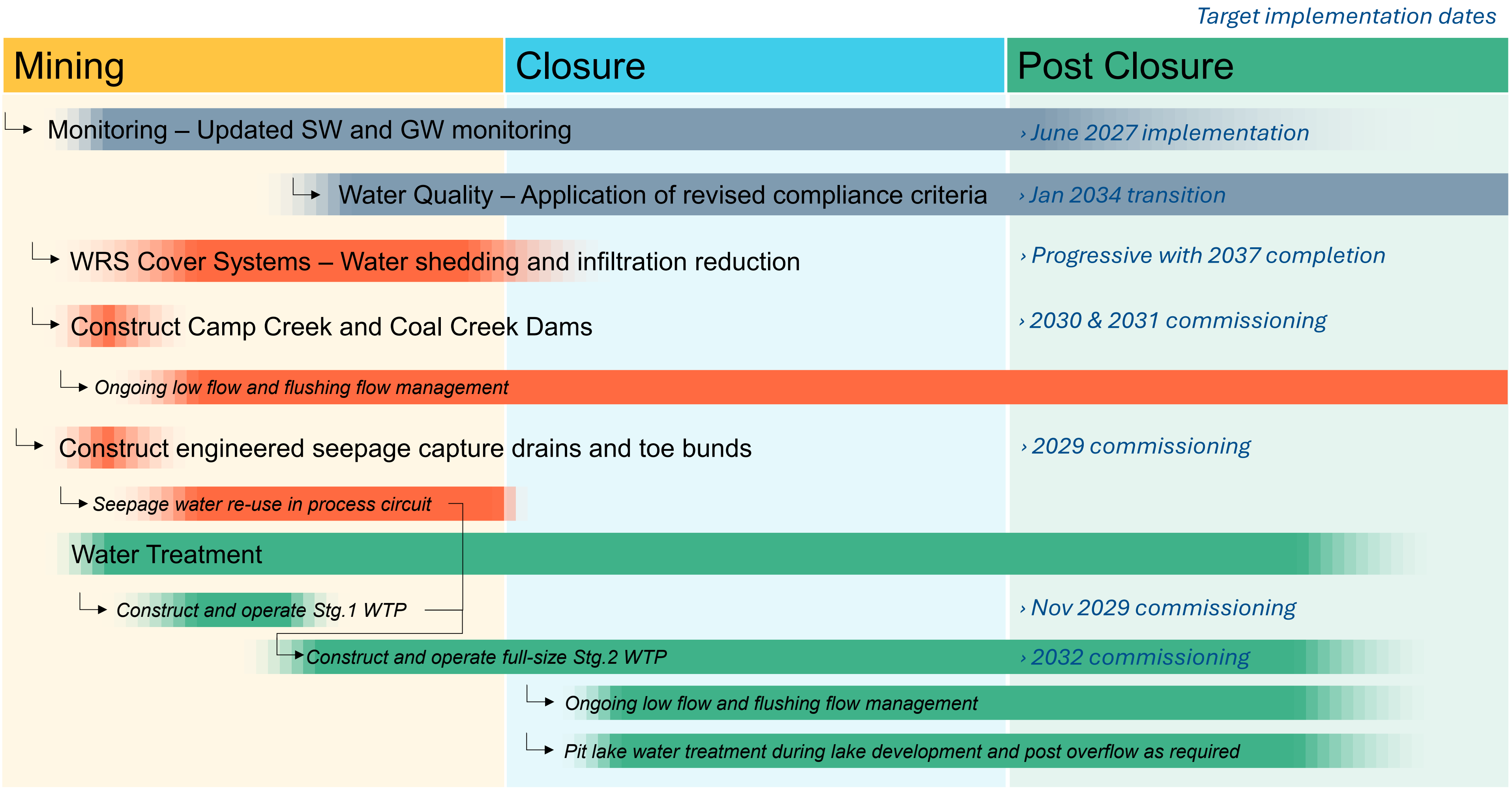

Figure F-1.1 Proposed implementation timeline for water quality mitigation measures

F-2 Mitigation Methods

This chapter includes a summary of the principal mitigation measures applied to surface water modelling.

F-2.1 Active Water Treatment

Active water treatment is proposed in two forms:

1. Water treatment plant (WTP) – construction and operation of a centralised WTP treating seepage waters collected from WRSs and TSFs prior to discharging to receiving waters.
2. Pit lake dosing with ferric chloride – in pit water treatment primarily to reduce dissolved arsenic concentrations in developing pit lakes, with secondary reductions of other dissolved metals.

These two treatment mechanisms are outlined in the following sub-sections.

F-2.1.1 Water Treatment Plant

A key change to existing water management practices at the Macraes Operation proposed for MP4 is the inclusion of an active WTP operating through the mining period and into the future to treat water prior to discharge to the environment, reducing contaminant mass load discharges from site. Water treatment is to be implemented during MP4 mining operations for the treatment of captured WRS seepage waters. Following close of mining operations, the plant is to treat both WRS and TSF seepage waters as per the timeline in Figure F-1.1.

At present a single centralised WTP is proposed. However, this intent does not preclude the installation of several treatment plants located at key points across the mine site producing similar environmental outcomes.

A two-stage water treatment process is applied in the WBM based on the studies presented in a report by Process Flow (2026a). This process includes pre-treatment through lime dosing and settling, followed by a reverse osmosis (RO) treatment process. The removal fractions for this two-stage process are summarised in Table F-2.1 for the constituents represented in the WBM.

For the purpose of modelling the lime dosing pretreatment, RO plant and associated treatment efficiencies are implemented as per results from treatment trials and design specifications (Process Flow 2026a). However, the assessment is not intended to prescribe this approach as the only acceptable treatment technology. Alternative or complementary treatment processes (for example ferric chloride dosing pretreatment or ettringite precipitation processes) may be adopted by OGL through the mining and closure phases, provided they can be demonstrated to achieve the required downstream environmental water quality outcomes. It is proposed to develop the RO-based WTP in two stages. The first stage being commissioned by November 2029 with a capacity of 5 L/s, and the second stage being commissioned by January 2032. The second stage (full scale WTP) will be provisioned to manage the seepage sources outlined in Table F-2.4 including TSF underdrain waters on mine closure. The lead time for the second stage WTP allows for two years of operational data from the first stage of treatment of water from seepage capture drains to establish a baseline for refining the WTP operational practise, size and efficiency.

Table F-2.1 Water Treatment Plant – treatment removal rates.

Constituent	Units	Pre-Treatment Removal Rates[1]	RO Treatment Removal Rates[1]	Application Notes
Ammoniacal-N	g/m³	0%	83.6%	
Arsenic	g/m³	98.5%	75%	
Copper	g/m³	-	96.0%	
Hardness	g/m³ as $CaCO_3$	-	99.3%	Hardness adjustments post treatment are not allowed for in modelling, offering conservatively lower hardness levels in discharge waters when considering the toxicity modifiers on the compliance criteria.
Iron	g/m³	-	96.0%	
Lead	g/m³	-	96.0%	
Nitrate-N	g/m³	0%	89.5%	
Sulphate	g/m³	15.1%	99.1%	
Zinc	g/m³	94.5%	96.0%	
DOC	g/m³	-	96.0%	
Chloride	g/m³	3.6%	97.7%	A chloride adjustment is applied to the discharge flows (to a maximum of 200 g/m³) for the purpose of reducing toxicity effects of uncaptured nitrate-N in receiving water.
pH	pH units	-	-	No pH adjustment is modelled through the WTP, influent hydrogen ions balance determines discharge. In practice pH adjustments are likely to be applied and consider receiving water characteristics in doing so.
Water	L/s		15%	Assumed 15% of influent water discharged as brine. This reduction in returned flows is represented in the WBM.

Figure F-2.1 shows the proposed water capture and treatment process to be implemented on closure, including the following key steps:

1. **Mine water capture** – mine affected waters with high concentrations of key contaminants is captured and pumped to the WTP from the following capture locations:
   a. **TSF underdrains** and seepage capture systems associated with the MTI, SP11, TTTSF, and FTSF facilities,
   a. **Engineered seepage capture drains** at Frasers West WRS and Coronation North WRS, and
   b. **Toe bunds** capturing seepage discharges from:
      i. Māori Hen silt pond,
      ii. Trimbells Gully silt pond (including minor toe seeps on eastern aspects of CNWRS and TWRS),
      iii. Coronation silt pond,
      iv. Frasers West silt pond,
      v. Frasers East silt pond,
      vi. Murphys Gully silt pond
      vii. Roundhill Sump.
2. **Treatment** – combined waters are treated through the two-stage WTP process based on the mass removal fractions defined in Table F-2.1.
3. **Return** – treated water is modelled as being redistributed back to each catchment based on the received flow split. In practice it is expected that active management of the return flows will enable

improvements to this arrangement to provide beneficial flow augmentation or flushing flows in particular catchments as needed. A map showing the proposed seepage capture locations and treated water discharge locations is shown in Attachment 1. Changes in the discharge location will affect the WBM results and may affect ultimate compliance and/or the ecological effects assessment (undertaken by Viridis (2026)).

During the mining phase a similar implementation will be followed, with the exception of the TSF underdrain flows, which will be returned to the site water management system without treatment. During implementation of the stage one WTP, the discharge s assumed to be to the Waikouaiti River North Branch (between NBWRGR and NBWRRB).

Figure F-2.1 shows a flow diagram of how the WTP fits within the overall seepage management system. Further detail on how the discharge of the treated water is to be managed is provided in Section F-2.2.

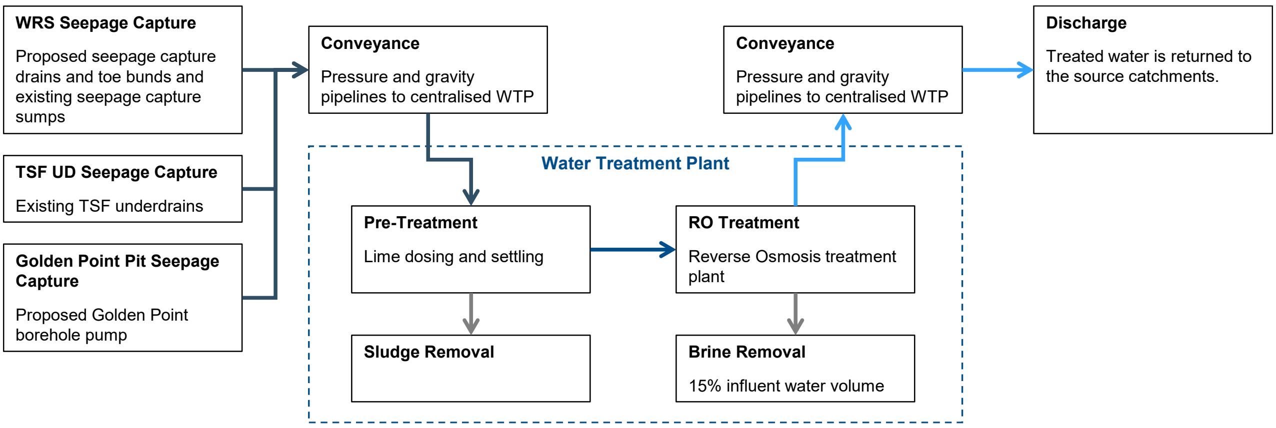

Figure F-2.1 Seepage capture, treatment and discharge process flow diagram

F-2.1.2 Pit Lake Water Treatment

Pit lake water treatment is proposed to enable a reduction in dissolved arsenic (and potentially other trace elements) concentrations through ferric chloride dosing of pit lake waters. MWM (2026g) has determined that ferric chloride dosing could achieve dissolved arsenic removal rates of 88%. Figure F-2.2 shows the projected arsenic concentrations in the Coronation North (CN), Coronation (CO), Innes Mills (IM) and Golden Bar (GB) without treatment. This figure also presents the projected treated concentrations with 88% reduction in arsenic resulting from ferric chloride treatment. In practice, it is anticipated that each ferric chloride treatment will result in a sharp decrease in lake water concentration followed by a slow subsequent increase, leading to a sawtooth pattern in concentrations. It is expected that treatment will commence prior to outflows from the developing pit lakes occurring and multiple and ongoing treatments will be required to maintain the pit lakes below a targeted maximum concentration.

The maximum discharge concentration modelled is assumed to be 0.042 g/m^3 (this is applied as a fixed number in the modelling unless the untreated pit lake concentration is lower). An assumed trigger for commencing ferric chloride treatment in pit lakes is an arsenic concentration of 0.042 g/m^3. Where this is implemented as a trigger for water treatment, it will result in a concentration sawtooth pattern below this trigger value over time, with concentrations following treatment being as low as 0.01 g/m^3. Thus, the modelled constant arsenic contaminant mass fluxes discharging to the receiving environment are expected to be a conservative representation of what will occur in practice where the trigger value initiates treatment cycles. Should a lower concentration be targeted, a more frequent dosing is likely to be required to achieve this target.

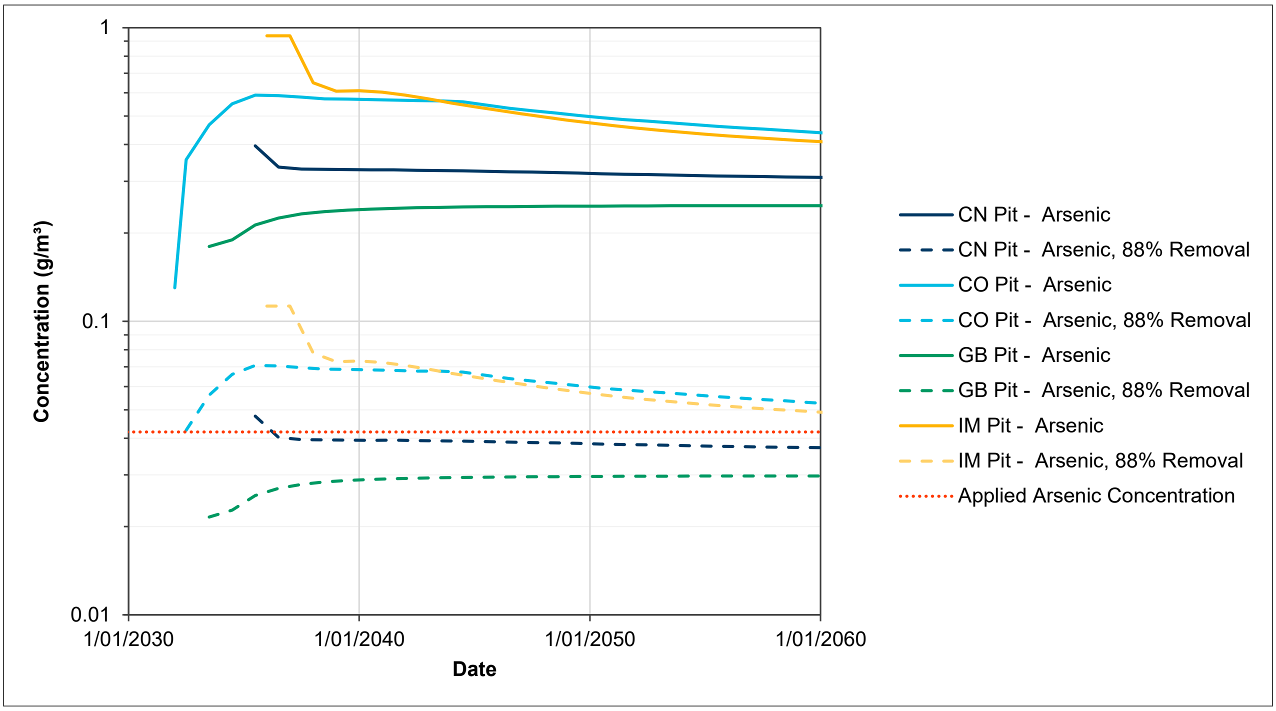

Figure F-2.2 Pit Lake arsenic concentrations from cessation of dewatering (data source: MWM 2026ci,di,ei,fi)

F-2.2 Seepage Capture Systems

F-2.2.1 Concept

Capture and return pumping encompasses currently implemented practices and proposed improvements to seepage water management for the Project. In relation to mine affected water and seepage waters from mine features, current water management practices on site allow for:

– **TSF seepage capture** – via constructed underdrain networks within the tailings impoundments and embankment or chimney drains within the TSF embankments.
– **WRS water discharge** – generally direct and untreated to receiving water bodies, where discharges from the WRSs can be generally described under the following categories:
  - **Surface runoff** – surface water runoff via overland flow paths, typically of improved water quality following capping and rehabilitation of the WRSs,
  - **Discrete toe seepage** – seepage water discharging from the toes of WRSs within incised valleys (typically upstream of a constructed sediment retention pond or silt pond as is normal practice at Macraes mine),
  - **Distributed toe seepage** – seepage water discharging over an extended perimeter of the WRS or to minor tributaries where there is no significant confining valley, and
  - **Basal seepage** – seepage water that percolates through the WRS before entering the underlying in-situ schist and generating a groundwater contaminant plume beyond the extents of the WRS.

To reduce the volume of mine-impacted seepage exiting the site and therefore reduce the contaminant load carried by that seepage, it is proposed that discrete points of WRS toe seepage will be captured using subsoil bunds and distributed toe seepage will be captured using subsoil drains retrofitted to existing WRSs. The proposed seepage collection system will direct seepage water to collection sumps and pump it to the mine water management system or the WTP prior to being discharged from site.

A concept design for the seepage capture systems is presented in GHD (2026a) and a description of how these features are implemented in the modelling is described in the following sections.

F-2.2.2 Existing Seepage Capture Systems

Return pumping is current implemented to manage WRS seepage water discharges at:

- Māori Tommy Silt Pond (and upstream Sump B),
- Northern Gully Silt Pond (Figure F-2.3a),
- Murphys Creek Silt Pond (Figure F-2.3b), and
- Frasers East Silt Pond

Water from these areas is used onsite within the mine water management system and does not contribute to receiving environment flow under typical conditions. At significantly high flows (storm events) pumping capacity may be exceeded and direct discharge might be possible from these sites.Return pumping is also implemented to manage seepage water from TSFs through existing underdrains, mattress drains, and embankment drains, feeding into existing seepage collection sumps from:

- Mixed Tailings Impoundment (MTI),
- Southern Pit Impoundment (SP11), and
- Top Tipperary Tailings Storage Facility (TTTSF).

***Figure F-2.3** (a, Left): Northern Gully Silt Pond, (b, Right): Murphys Creek Silt Pond*

F-2.2.3 Proposed Seepage Capture Systems

As the site progresses towards closure, the existing return pumping systems installed within the silt ponds offer a sub-optimal arrangement for water quality management as they capture seepage water and surface water runoff, resulting in elevated flow rates. This is due to the surface runoff contribution to the ponds having relatively good water quality, compared to the WRS seepage waters. as most of the contaminant mass load is received from WRS seepage water separating flows from the two surfaces provides water management efficiencies. Typically, these seepage discharges are located in incised valleys. For example, the WRS toe seepages reporting to Northen Gully and Murphys Creek silt ponds (Figure F-2.3) and Māori Hen Silt Pond (Figure F-2.8).

Where seepage is distributed over a broad perimeter of a WRS toe, there is typically no current mine infrastructure installed to capture this seepage. Examples of distributed seepage include the western aspects of Coronation North WRS (Figure F-2.5) and the perimeter of Frasers West WRS (Figure F-2.6). The contaminant load from these areas is significant with respect to the overall aim of meeting the revised water quality compliance criteria proposed for the Project. Two key seepage capture systems are proposed to reduce direct seepage discharges to the receiving environment. These are:

1. Seepage capture drains – to capture distributed seepage, and
2. Seepage capture toe bunds – to capture discrete toe seepage.

Engineered seepage capture drains and seepage capture bunds have been designed (to a concept level) to enable capture of seepage water from WRSs before diffuse or direct discharge to the receiving environment occurs. Implementation of these systems enables the mine-impacted waters to be retained within the mine water management system or treated prior to discharge to the environment.

A map showing the proposed seepage capture locations and treated water discharge locations is shown in Attachment 1. A concept design for the seepage capture drains is outlined in GHD (2026a) and a schematic cross-section of the drains is shown in Figure F-2.4. The drains function on the principle that the bulk of water infiltrating WRSs seeps vertically through the placed waste rock until reaching the lower permeability in-situ schist. The infiltrated water then predominantly seeps laterally following above the pre-existing topography until it discharges from the toe of the WRS or enters shallow alluvial sedimentary deposits that transmit the seepage away from the WRS. The proposed drains intercept this flow path by creating a high permeability drain with a perforated drainage pipeline conveying seepage water to collection sumps. Figure F-2.9 and Figure F-2.10 show two key areas at Coronation North WRS and Frasers West WRS where construction of the drains is proposed.

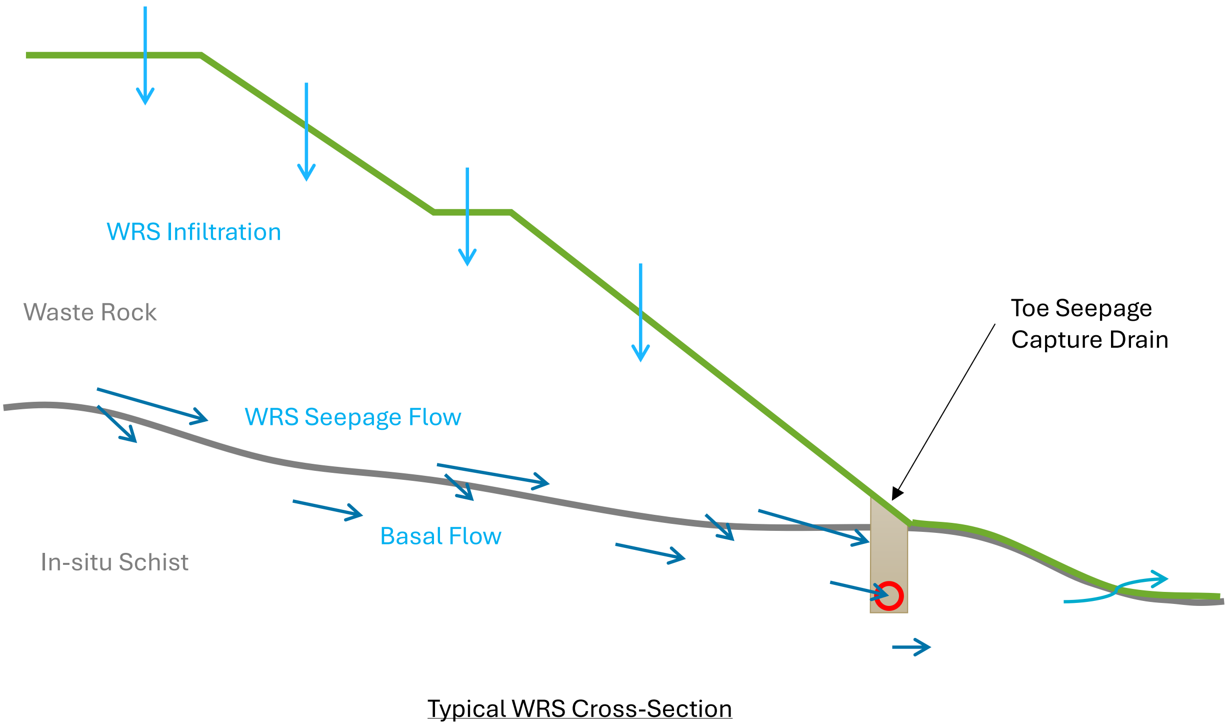

Figure F-2.4 Schematic representation of seepage capture toe drains

Figure F-2.5 Coronation North WRS, looking south towards Coal Creek Seepage 2

Figure F-2.6 Frasers West WRS looking north-west towards NBWRGR with distributed toe seepage.

Toe bunds are proposed for capturing significant discrete seepage discharges from WRSs. A schematic representation of this approach is shown in Figure F-2.7 and concept designs are outlined in GHD (2026a), Drawing 12682240-GHD-00-00-DRG-00019. These toe bunds seek to capture the bulk of the seepage water discharging from WRSs by intercepting the portion of seepage that propagates along the pre-mine, or in-situ schist, topography to the toes of WRSs. This approach is applicable to discrete seepage points located within incised gullies.

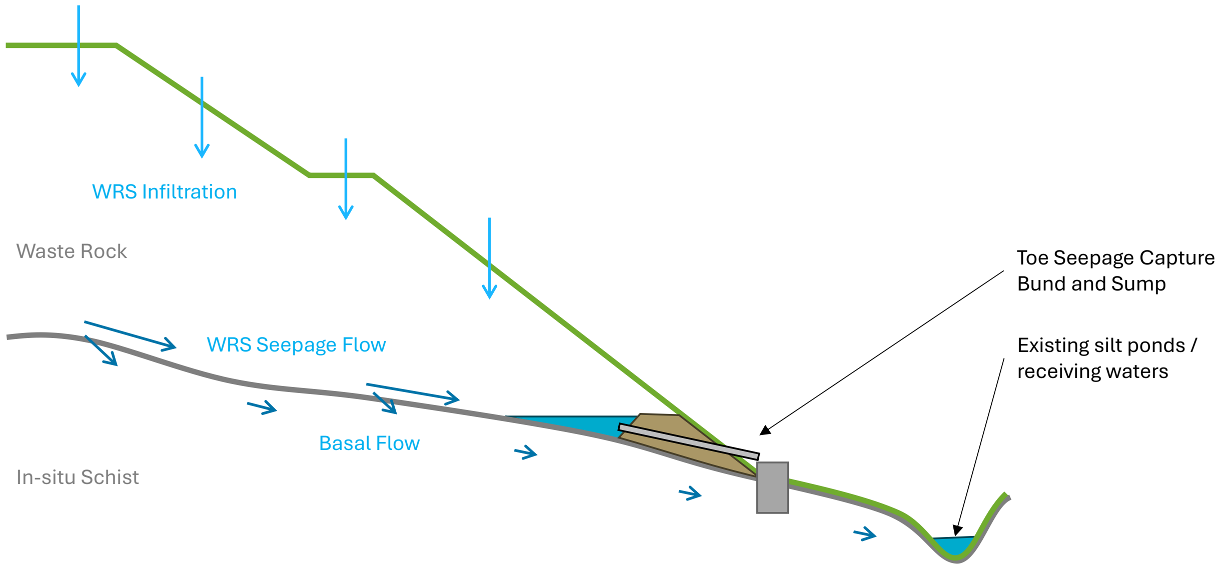

Figure F-2.7 Schematic representation of seepage capture bunds

Figure F-2.8 Māori Hen Silt Pond, looking south towards Coronation North WRS, showing location of discrete toe seepage and proposed toe bund

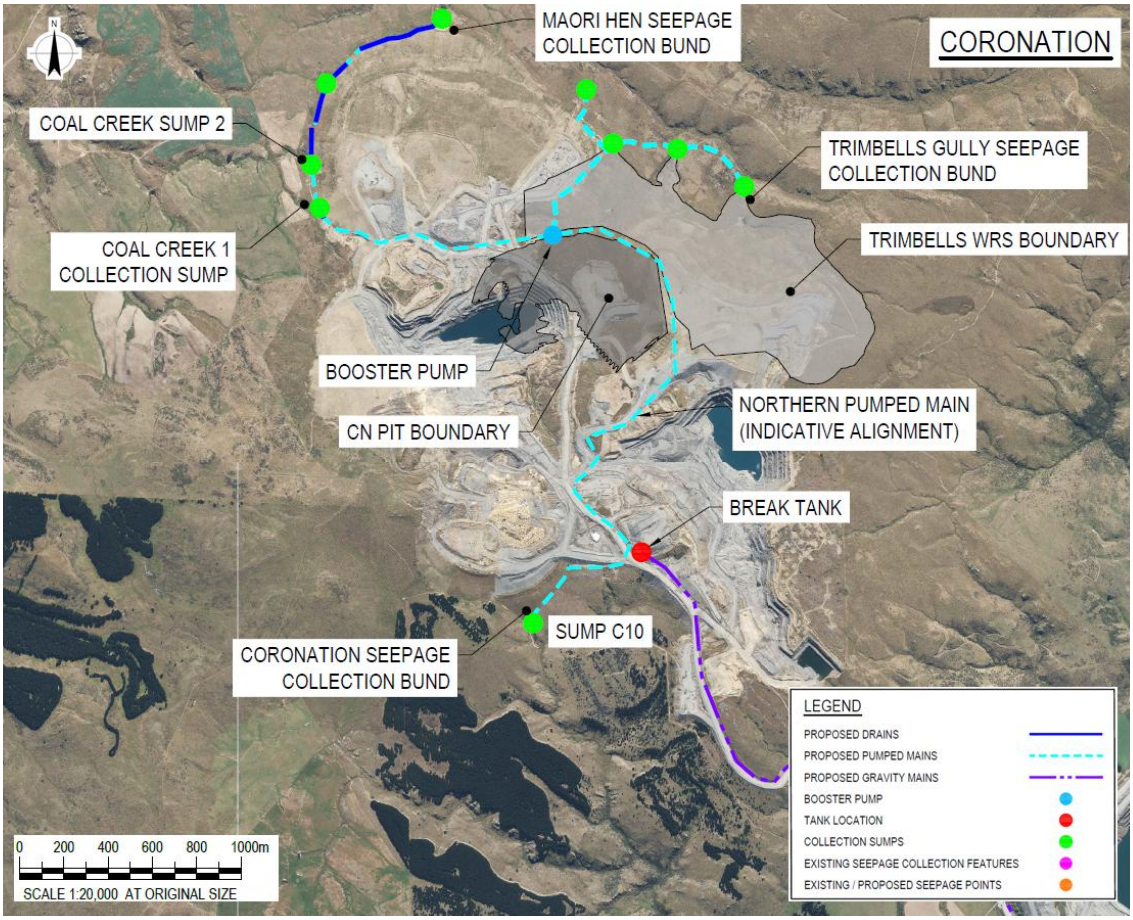

Figure F-2.9 Proposed seepage capture drains and toe bunds – Coronation Area (GHD 2026a., Drawing: 12682240-GHD-00-00-DRG-00010)

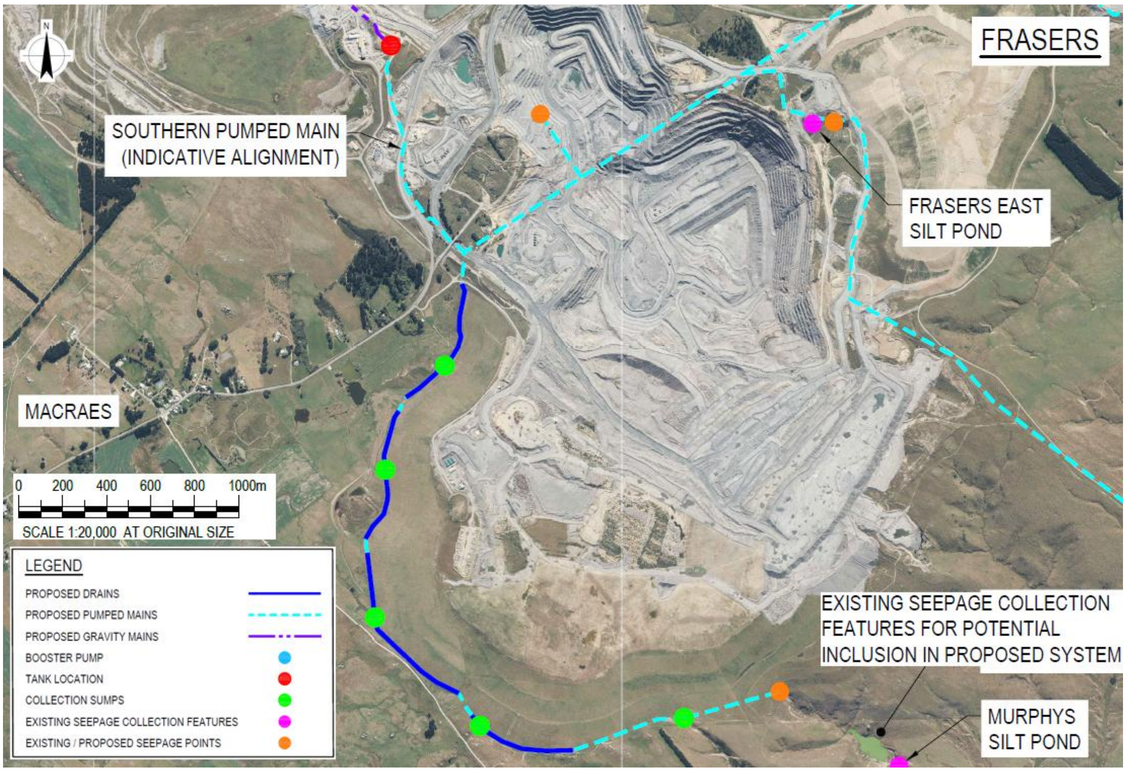

Figure F-2.10 Proposed seepage capture drains and toe bunds – Frasers Area (GHD 2026a., Drawing: 12682240-GHD-00-00-DRG-00010)

Seepage capture is proposed to be completed at the locations outlined in Table F-2.4. Construction of the systems are proposed to be completed as per the water quality mitigation timeline in Figure F-1.1. The system layout, incorporating aspects of the Coronation area and Frasers area seepage capture system is shown in Figure F-2.9 and Figure F-2.10 respectively.

F-2.2.3.1 Seepage Capture Efficiency

To represent the seepage capture systems in the WBM, the following approach is taken:

1. If there is a seepage capture system in place, the portion of the seepage (based on contributing area) that is intercepted by the capture system is determined and assigned a capture fraction (P_{WRS}) between 0 and 1, where the whole area being intercepted would be represented by 1.
2. The capture systems cannot practically capture all seepage and a portion of seepage will contribute to plume development via basal flow. This distributed basal flow will eventually reach downgradient water bodies contributing a mass flux to the receiving waters. A capture efficiency (E_{WRS}) is defined to represent the removed component of the seepage.
3. The resultant captured flow ($Q_{Seepage\ Capture}$) is determined by Equation 1, where A_{WRS} is the area of the WRS assigned to a downstream model node and $I_{WRS,t}$ is the infiltration rate assigned to the WRS as a function of time (or mine stage).

$$Q_{Seepage\ Capture} = I_{WRS,t} \times A_{WRS} \times P_{WRS} \times E_{WRS} \qquad \text{EQ. 1}$$

4. The uncaptured flow ($Q_{Seepage\ Discharge}$) is then represented by Equation 2. It is noted that the WBM does not represent the time delay and groundwater storativity that would buffer the basal seepage flow and is conservatively represented as immediately reaching the downstream node.

$$Q_{Seepage\ Discharge} = I_{WRS,t} \times A_{WRS} \times (1 - P_{WRS}) \times (1 - E_{WRS}) \qquad \text{EQ. 2}$$

5. The contaminant mass flux ($M_{Seepage}$) assigned to the seepage and basal flow is determined by Equation 3, where $C_{WRS,t}$ is the concentration of the WRS seepage as a function of time.

$$M_{Seepage} = Q_{Seepage} \times C_{WRS,t} \qquad \text{EQ. 3}$$

For application in the WBM, these toe seepage capture bunds and sumps are set to have a maximum efficiency (E_{WRS}) of 75% mass flux capture from the contributing seepage catchment, unless location-specific assessments indicate that an alternative value is appropriate. The sections below outline where groundwater modelling has been undertaken to estimate site specific capture efficiencies.

F-2.2.3.1.1 Coronation Mining Area

The approach to modelling the surface water contaminant transport including the seepage capture systems, within the WBM, is to achieve an equivalent or conservative representation of the contaminant mass flux to receiving waters when compared to the groundwater model (GWM). Table F-2.2 demonstrates the balance of mass fluxes represented in both models and determines a capture efficiency (as a percentage of contributing net percolation) such that; (1) the mass flux to the receiving waters is greater in the WBM than predicted by the GWM, and (2) as a second priority the captured mass is equivalent in both models. The table presents long term projections from the GWM based on nominally 400 years of transient simulation and the fully developed WRS seepage concentrations represented in the WBM. In the tables below:

- The GWM and WBM flow and mass capture represents the fluxes removed from the model by the proposed seepage capture systems,
- The GWM mass discharge represents the total contaminant mass flux discharging to receiving waters, noting that there is a residual mass storage within the developed plumes. The WBM does not represent the mass storage within the plumes and considers all mass to be discharged to receiving waters once leaving the source. These discharges represent discharges from all WRS sources in the assessed area, including those with and without seepage capture systems.
- The WBM mass removal indicates the modelled percentage of seepage (from catchments modelled as contributing to the seepage capture system only) that the drains would need to remove in order to achieve parity with the groundwater model removal rates.

– The capture efficiency indicates the percentage of seepage (from contributing catchments only) that would need to be removed in order to achieve parity with the groundwater model mass flux to receiving waters.

Table F-2.2 Coronation area seepage capture drains efficiency – long-term projections

Scenario	Basecase	Sensitivity test, high infiltration
Net Percolation Rate (% mean annual rainfall)	5% (32 mm/yr)	20% (128 mm/yr)
GWM Flow Capture (L/s)	1.63	4.82
GWM Mass Discharge, captured + uncaptured (t/y)[2]	409	1,127
GWM Mass Capture (t/y)	233	725
WBM Mass Removal - for mass capture parity (%)	91%	72%
WBM Flow Capture (L/s)	1.60	5.04
WBM Mass Capture (t/y)	231	725
WBM Mass Discharge (t/y)[2]	381	1,393
Capture Efficiency (% percolation)[1]	**85%**	**88%**

[1]. Capture efficiency is adjusted to achieve parity of mass flux discharged to receiving waters between models.
[2]. Applies to all discharges from the area, including those not managed by proposed seepage capture systems. Does not include any discharges to pit lakes.

Assessment indicates that applying a capture efficiency to the seepage capture drains at 85% of net percolation results in the resultant long-term discharge rates matching between the WBM and GWM under the basecase. (This increases to 88% where higher infiltration rates are applied. To conservatively represent these figures in the WBM, potential seepage capture efficiency for WRS seepage is applied as $E_{Coronation\ Area}$ = 80% in the Coronation Area. The remaining 20% of seepage mass flux is represented as basal flow and directly discharged to the next downstream model node.

This assessment applies to the combined capture of the seepage capture drains and discrete seepage capture toe bunds applied to Coronation North WRS and Trimbells WRS.

A 20% net percolation rate is used to assess capture efficiency sensitivity to net percolation rate, however, a range of percolation rates have been applied to the WRSs as documented in Appendix E. The intent is to demonstrate that the applied capture efficiency does not become unconservative for higher infiltration rates.

During earlier phases of plume development, the groundwater modelling suggests that the ratio of captured mass to mass discharged to receiving waters is higher (than the applied 80%), then reduces to a long-term steady state (85%-88% as outlined in Table F-2.2). The capture fraction in the WBM therefore conservatively represents uncaptured basal flows in both the short term and long-term phases.

Differences are observed between total mass fluxes calculated by the surface water model and groundwater model and a couple of key mechanisms can contribute to this.

a. The GWM operates on a grid and contaminant concentrations are applied on this grid, such that the total area of contaminant source may vary from that applied in the WBM.
b. The GW model will assign the concentration of contaminant defined for a cell the moment water enters that cell, i.e. where 'clean' GW flows laterally into a WRS cell it will take on that WRSs defined concentration. In practice that water is unlikely to generate the corresponding mass load where it has not percolated vertically through unsaturated WRS material. Therefore, the GWM can lead to an overestimation in mass load being generated.
c. The GWM simulates the transient storage of contaminants in the ground as the plume develops. A portion of the total basal flow is buffered in this storage and will not be represented in the GWM mass discharge calculation within the simulated model run time.

F-2.2.3.1.2 Golden Bar Mining Area

Groundwater contaminant transport modelling for the Golden Bar area has been undertaken with only the Golden Bar WRS contaminant loading represented. This allows isolation of the contaminant fluxes for the single proposed capture point and the capture efficiency can be determined from the GWM results in isolation. Table F-2.3 outlines the long-term contaminant discharges calculated by the GWM based on modelled contaminant fluxes reporting to each surface water catchment area, including drainage nodes representing the seepage capture location (i.e. the existing Clydesdale silt pond, which is proposed to be converted into a seepage capture bund within the toe of the expanded WRS). Note that the mass fluxes presented at each of the nodes are not cumulative, i.e. the contribution to NB03 does not include mass flowing in stream from GB01, MC02 and GB02.

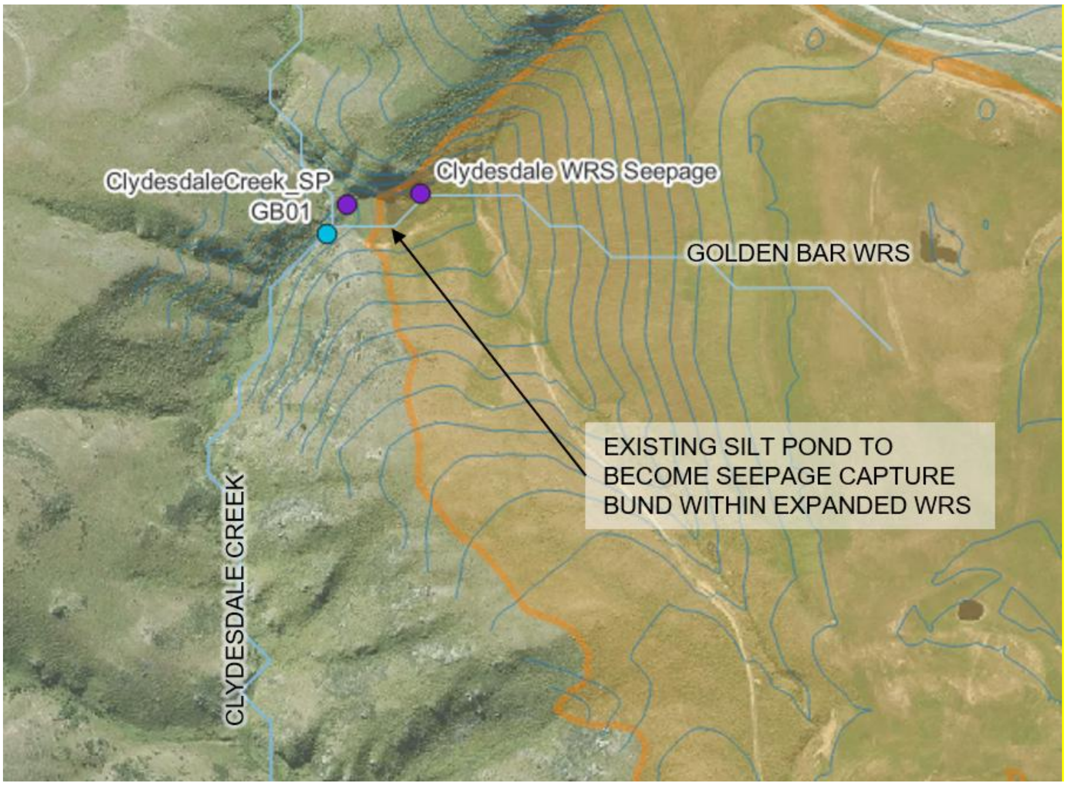

Figure F-2.11 Proposed Golden Bar seepage capture

Table F-2.3 Golden Bar area seepage capture efficiency from GWM – long-term projections

Scenario	Basecase	Sensitivity test, high infiltration
Net Percolation Rate (% mean annual rainfall)	5% (32 mm/yr)	20% (128 mm/yr)
MC02 (t/y)	14.4	45.8
NB03 (t/y)	0.01	0.07
GB01 (t/y)	17.1	92.8
GB02 (t/y)	0.1	1.2
McCormicks Creek (t/y)	0.07	5.4
Clydesdale Creek Capture (t/y)	28.0	65.8
Total (t/y)	59.8	211.0
Total GWM Mass Capture (%)	47%	31%
Capture Efficiency (% Percolation) [1]	**91%**	**61%**

[1]. Capture efficiency is adjusted to achieve parity of mass flux discharged to receiving waters based on the contributing area of WRS in the surface model being 51% of the total WRS area.

Based on the calculated long-term capture efficiency, an assumed capture efficiency of $E_{Clydesdale\ WRS}$ = 85% is applied to the WBM. This capture efficiency is applied to a WRS area of 37.7 ha, while the total modelled area of the Golden Bar WRS is 73.2 ha. The difference of 35.5 ha generates seepage discharging directly to the MC02 model node.

The representation of the Golden Bar WRS as a single feature with uniform contaminant concentrations is inherently conservative, given that the area of the WRS reporting to the capture system has higher average depths than that of the whole WRS. This is shown in MWM (2026a) where the full extent of the Golden Bar WRS has an average height of 39.3 m (as applied to the whole WRS area represented in the WBM), while the sub catchment reporting to the silt pond and proposed seepage capture system has a height of 51.5 m. Hence, the average height of WRS area modelled as not being captured is 13.7 m. For contaminants with concentrations represented as a function of WRS height, this approach will result in a conservatively high modelled uncaptured contaminant load.

F-2.2.4 Location Specific Implementation of Seepage Capture Systems

Table F-2.4 outlines the location specific application of the proposed seepage capture systems and describes how seepage is currently managed at these locations.

Table F-2.4 Seepage capture application

Location / WRS	Capture system	Current operation	Modelled future operation
MTI TSF	Existing seepage capture drains and sumps	Current operational practice to be retained during active mining phase, with water being used within the mine water management system.	Water to be conveyed to the WTP post-closure prior to discharge to the environment. Modelling represents the treated water being discharged to Māori Tommy Gully
SP11	Existing seepage capture drains and sumps	Current operational practice to be retained, with the impoundment being removed entirely during the mining phase.	N/A
TTTSF	Existing seepage capture drains and sumps	Current operational practice to be retained during active mining phase, with water being used within the mine water management system.	Water to be conveyed to the WTP post-closure prior to discharge to the environment. Modelling represents the treated water being discharged to Top Tipperary SP.
FTSF	No existing seepage capture drains, with future drains and sumps to be constructed	There are no current seepage capture systems implemented for FTSF other than released pore water from tails being captured within the TSF impoundment. Tailings decant water is pumped back to the mine water management system.	As the TSF reaches the upper levels (above 480 mRL), seepage will be captured by drains as detailed in EGL (2026a), Drawing No. 10092-031. Captured water will be pumped to the mine water management system during mining. Water to be conveyed to the WTP post-closure prior to discharge to the environment. Note that presented modelling does not include the effects of these underdrains. Rather, seepage from FTSF through the TSF Embankment reports as uncaptured and untreated seepage to IM Pit Lake. This is represented in the pit lake cumulative water balance and water quality projections. In practice, it is expected that the drains will result in a greater overall seepage from FTSF and a reduction in the uncaptured component (i.e. the representation conservatively overestimates TSF seepage to IM Pit). Discharge of this additional flow (not currently represented in WTP discharge) could be to IM Pit Lake, to maintain the projected filling rates, or distributed to off-site discharges where environmental benefits can be realised.
Coronation North WRS	Proposed seepage capture drains to be constructed along the western aspects of the WRS to capture distributed seepage. Proposed toe bund to be constructed above Māori Hen Silt Pond to capture	Currently the greatest discharge of seepage water is to Māori Hen Creek via Māori Hen Silt Pond, with further distributed seepage from the western aspects of the WRS to Coal Creek tributaries.	Modelled operation is to capture this seepage and use it within the mine water management system until the WTP is operational, then return treated water to the Mare Burn catchment.

Location / WRS	Capture system	Current operation	Modelled future operation
	seepage from central and eastern catchments. See Figure F-2.9 for proposed layout and concept design in GHD (2026a)		
Trimbells WRS	Proposed toe bunds to be constructed above the proposed Trimbells Gully Silt Pond and in the 3 minor tributaries contributing to Trimbells Gully to capture seepage. See Figure F-2.9 for proposed layout and concept design in GHD (2026a)	Currently seepage water discharges to Trimbells Gully via Trimbells Gully Silt Pond.	Modelled operation is to capture this seepage and use it within the mine water management system until the WTP is operational, then return treated water to the Trimbells Gully catchment.
Coronation WRS	Proposed toe bund to be constructed above Coronation Silt Pond to capture seepage currently discharging to Camp Creek.	Currently seepage water discharges to a tributary of Camp Creek via Coronation Silt Pond.	Modelled operation is to capture this seepage and use it within the mine water management system until the WTP is operational, then return treated water to the Deepdell Creek catchment.
Deepdell North WRS	Proposed provision for dry-weather seepage capture via existing silt pond discharge.	Currently Deepdell North Silt Pond discharges directly to Deepdell Creek via a decant pipeline from the silt pond. These flow rates are small and the toe of the WRS is well established. Feasibility of constructing a toe bund is to be assessed.	Modelled operation is to capture decant flows from the silt pond during dry periods only and pump to the WTP. Treated water to be released to Deepdell Creek via Māori Tommy Gully.
Golden Point BF	Proposed seepage capture via dewatering bores placed in the backfill keeping the water level in the backfilled Golden Point Pit and Round Hill Pits below the historic Golden Point Adit floor level	Currently the Round Hill Sump is dewatered to below the adit overflow level (~332mRL) using bore pumps. his sump is used for staging of water from GPUG. It is proposed that this operation continues until rendered impractical due to construction of the Golden Point Backfill WRS. Note that this level control has not been consistently achieved over mining operations to date and has resulted in flow discharge through the adit to Deepdell Creek. Modelling assumes that this system is fully functional and prevents discharges from the backfilled Round Hill Pit to Deepdell Creek.	It is proposed that once operational use of the Roundhill Sump ceases, permanent dewatering bores are installed to maintain groundwater levels in the Golden Point and Roundhill Pit voids below the adit overflow level. Water captured is expected to be of poor quality and is modelled as being pumped to the WTP and treated befre being discharged to Deepdell Creek.
Northern Gully WRS	Proposed toe bunds to be constructed at the Northern Gully East and Northern Gully West seepage locations, above the Northern Gully Silt Pond, to capture seepage currently discharging to the pond.	Currently water is pumped from Northern Gully Silt Pond to the mine water management system. Modelling assumes that this system is fully functional and prevents all discharges to Deepdell Creek.	Modelled operation is to capture this seepage and use it within the mine water management system until the WTP is operational, then return treated water to Deepdell Creek upstream from DC07.

Location / WRS	Capture system	Current operation	Modelled future operation
Frasers East WRS	Proposed toe bund to be constructed above Frasers East Silt Pond.	Currently seepage is captured within the Frasers East Silt Pond and used within the mine water management system. This is to continue through the mining phase.	On closure and completion of the water course re-connecting the headwaters of the NBWR across Frasers Pit, a seepage collection bund will be operational, capturing WRS seepage above the Frasers East Silt Pond and pumping to the WTP. Return of treated water will be to NBWR in the region of NBWRGR. Note that it is not considered desirable to discharge near Frasers East WRS, due to the risk of low flow losses from the constructed stream as it is routed across the Frasers Backfill.
Frasers West WRS	See Figure F-2.9 for proposed layout and concept design in GHD (2026a)	Currently seepage from Frasers West is discharged through distributed seepage to NBWR along the western aspects of the WRS. Some seepage and runoff toward the northwest is captured by the Frasers West Silt Pond. Water in the pond is discharged to NBWR. The southern aspect of the WRS discharges to Murphys Creek Silt Pond. Water from the silt pond (combined with surface water runoff) is pumped to an infiltration pond reporting to Frasers Pit or Frasers East Sump for use in the mine water management system. This system is currently run as a contingency measure to reduce contaminant concentrations in Murphys Creek and discharges from the pond have still been taking place. Note that modelling assumes that this system is currently fully functional and restricts all discharges to Murphys Creek.	Modelling represented a seepage collection bund constructed where the toe of the WRS meets Murphys Creek, to enable the concentrated seepage to be captured at this location (with only surface water runoff discharging to the silt pond). Seepage capture drains are to be installed along the western aspects of the WRS to capture distributed seepage and pump it to the WTP. Return of the treated water will be to the NBWR near NBWRGR and Murphys Creek below the existing silt pond.
Golden Bar (Clydesdale) WRS	Proposed conversion of the existing Clydesdale Creek Silt Pond into a toe bund as the proposed WRS design infills the current footprint.	Currently seepage water from Golden Bar WRS is discharged to Clydesdale Silt Pond, before discharging to Clydesdale Creek that feeds into Murphys Creek.	The Clydesdale Silt Pond will be infilled as a result of the MP4 WRS expansion. Modelling represents the infilled pond functioning as a seepage capture bund. Captured seepage is pumped to the WTP for treatment with the treated seepage water be discharged to Murphys Creek reducing long-term permanent infrastructure and energy requirements to pump back to Clydesdale Creek.

F-2.3 Flow Augmentation Dams

Consents are held by OGL for two freshwater flow augmentation dams:

1. Camp Creek Freshwater Dam – Located in the Deepdell Creek catchment, and
2. Coal Creek Freshwater Dam – Located in the Mare Burn Catchment.

The purpose of these dams is to supplement flows the Deepdell Creek and Mare Burn in a manner that reduces contaminant concentrations and/or supplements flow losses within these water courses.

A description of these two dams is provided below, including how they are represented in the WBM.

F-2.3.1 Camp Creek Freshwater Dam

Consent (Consent No. RM10.351.38) is held by OGL "*To discharge water from the Camp Creek Reservoir to Camp Creek for the purpose of operating the Camp Creek Reservoir and supplementing flows in the Deepdell Creek catchment*".

Under the specific conditions of consent relevant to implementation in the surface water modelling:

– The dam shall be fitted with a floating outlet system to ensure the discharge water is from the upper surface of the reservoir.

– A residual flow of 2 litres per second shall be maintained in Camp Creek immediately downstream of the dam embankment site at all times, other than when natural flows upstream of the dam embankment are less than 2 litres per second. When natural flows upstream of the dam embankment are less than 2 litres per second the consent holder shall ensure that there is no reduction in flows in Camp Creek resulting from the exercise of this consent.

– A flushing flow of at least 58 litres per second with a duration of three hours shall be released from the Camp Creek Reservoir downstream into Camp Creek between the months of January and April inclusive. This shall occur:
  - At least three times per year for the first two years following completion of the construction of the Camp Creek dam embankment: and
  - At least two times per year from three to eight years following the completion of the construction of the Camp Creek Dam embankment.

– The discharge of water from the Camp Creek Reservoir for water quality mitigation purposes shall be either at a constant rate or a seasonal rate flow matched rate. If it is to be adopted, the appropriate flow matched rate shall be determined by use of a flow monitoring station located in Deepdell Creek. Prior to construction of the dam embankment, the appropriate discharge flow regime shall be determined based on existing and predicted water quality in Deepdell Creek and the Shag River. The discharge flow regime may be modified as part of the Camp Creek Water Quality Management Plan review and update. Prior to closure of the mine site, the discharge flow regime shall be determined by the consent holder in consultation with the Consent Authority.

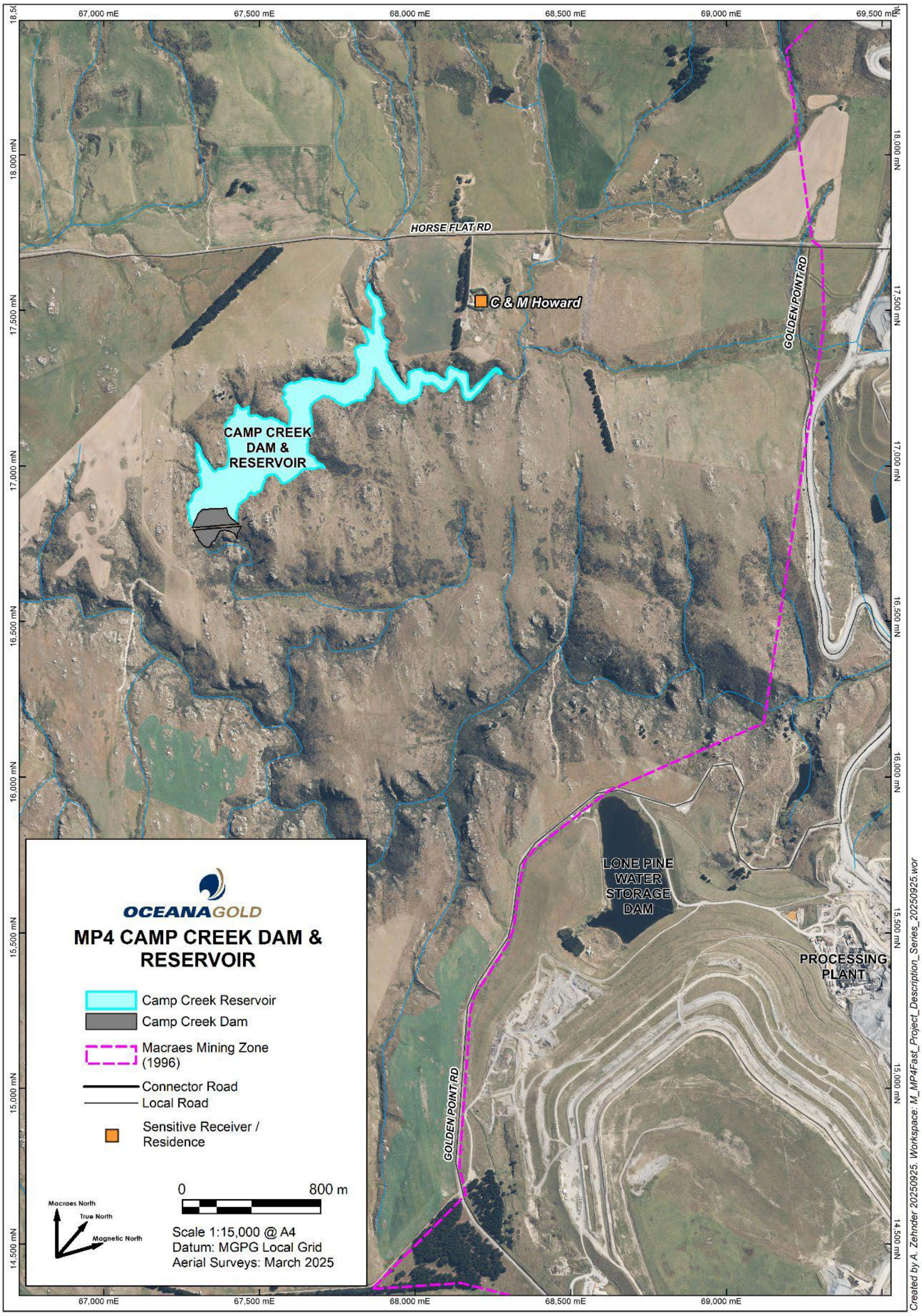

Figure F-2.12 Location of proposed Camp Creek Freshwater Dam

F-2.3.1.1 Proposed Operation

. It is proposed to implement that following operation to the Camp Creek Dam:

– Maintain a minimum discharge to Camp Creek of 2 L/s from a floating decant, unless incoming flows are lower, hence, the natural flow regime would have a lower flow rate.

– A variable discharge rate will be released to Camp Creek below the dam. The discharge will be flow matched to the established flow gauging site at Golden Point in Deepdell Creek, providing increased flow augmentation at low flows as per Figure F-2.15.

– Where the dam is at or above capacity, allow free discharge via a constructed spillway to Camp Creek below the dam.

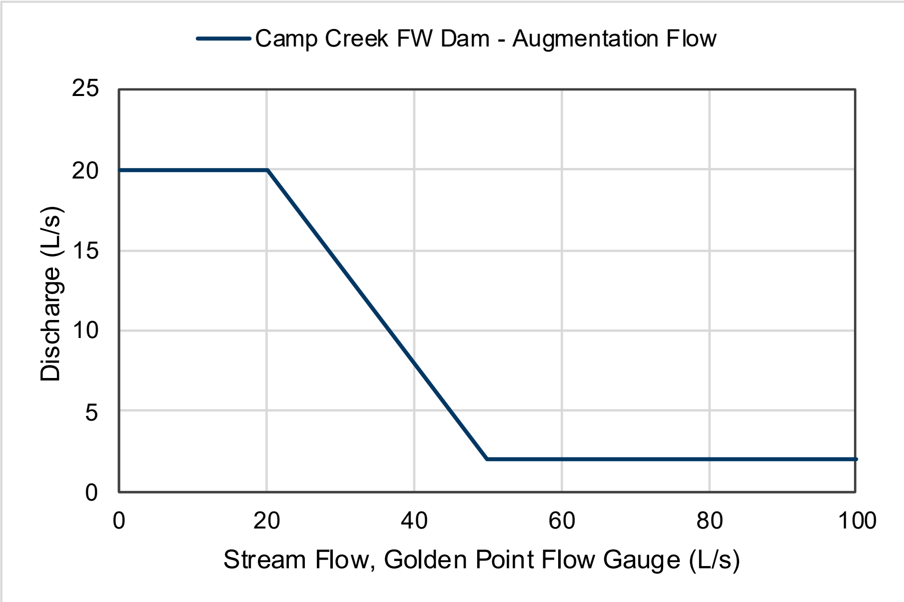

Figure F-2.13 Camp Creek Freshwater Dam rating curve

F-2.3.1.2 Water Balance Model Application

The following assumptions are made to implement the Camp Creek Freshwater Dam in the WBM.

– Flushing events required two to three times a year result in an additional abstraction from the dam of 626 m³ (based on 3 hrs at 3×median flow at DC08). This corresponds to 0.14% of the dam's storage volume, thus, considered negligible in modelling the available dilution capacity so flushing events are not explicitly modelled. However, a dead storage volume of 80,000 m³ (~6% of capacity) is applied to Camp Creek Dam to provision for this purpose (refer to Appendix E).

– Discharge from the dam is based on flows measured at the Golden Point Weir flow gauge. In practice, this would be done by a live link between the gauge and an actuated valve controlling discharge from the dam. Given the Camp Creek Dam discharges above this flow gauge, discharge calculations would include flow averaging and an account of the time delay between the dam discharge and gauging site to determine the non-augmented flowrate at the Deepdell Golden Point gauge. To capture this behaviour in the WBM, the augmentation flow is calculated based on the cumulative daily average flow rate at the DC04 model node from contributing non-mine affected catchments only.

– In practice there will be some level of seepage loss from the dam. This is represented in the WBM modelling with a maximum seepage loss of 2 L/s (Engineering Geology Limited, 2011), with the assumption that this reduces linearly as the dam level reduces. This approach is considered conservative as in practice a portion of the seepage loss from the dam is expected to contribute to base flow in Camp Creek below the dam. If this flow is significant, it can be deducted from the baseflow discharge requirement of 2 L/s.

– It is anticipated that it will be feasible to implement an improved operating regime for this dam after commissioning. This will be based on an understanding of the water quality within the dam and a feasibility assessment of aligning discharge rates with monitoring within Deepdell Creek.
– Discharge controls are placed on the dam from the moment that construction is completed and retained, subject to water availability, as the dam fills.

F-2.3.2 Coal Creek Freshwater Dam

Consent (Consent No. RM16.138.08) is held by OGL "*to discharge water from the Coal Creek Freshwater Dam to Coal Creek for the purpose of operating the Coal Creek Freshwater Dam and supplementing flows in the Coal Creek and Mare Burn catchments*".

Under the specific conditions of consent relevant to implementation in the surface water modelling:

– The consent holder shall fit the dam with a floating outlet system with a discharge pipe installed through the base of the embankment to ensure that the water discharged is from the upper surface of the reservoir.
– A discharge flow of at least 5 litres per second shall be maintained in Coal Creek immediately downstream of the dam embankment site at all times unless the BPO Report provided under RM16.138.02 condition 5 shows a lesser discharge flow will ensure compliance with the water quality parameters set at in which case the discharge flow shall be maintained at that lesser flow rate. The lesser flow rate shall not be less than 3 litres per second.

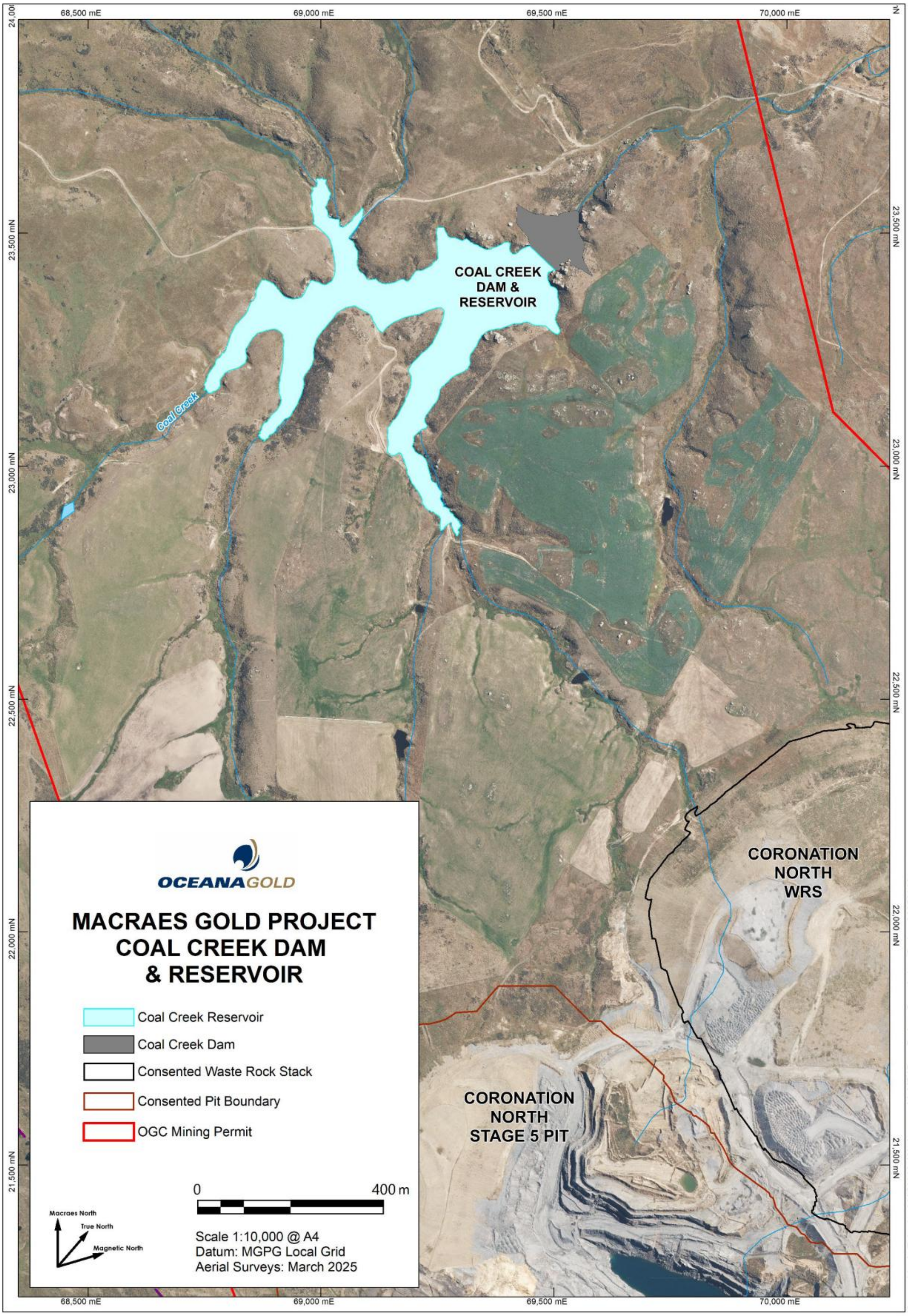

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Figure F-2.14 Location of proposed Coal Creek Freshwater Dam

F-2.3.2.1 Proposed Operation

It is proposed to implement a revised operational approach for the Coal Creek Freshwater Dam to allow a greater length of the Mare Burn to receive the benefits of flow augmentation. This includes:

- Maintain a minimum discharge to Coal Creek of 3 L/s from a floating decant, unless incoming flows are lower, hence, the natural flow regime would have a lower flow rate.
- A variable discharge rate will be discharged to Māori Hen Creek or the Mare Burn above MB01. Practically this would be achieved by establishing:
  - A floating water intake from the surface of the dam,
  - A pressure main (pumped) routed from the dam to the discharge location,
  - The pipe will discharge into an elevated sump or small pond with, then flow over riprap to encourage aeration before joining the stream.
  - The discharge will be flow matched to a flow gauging site on the Mare Burn, providing a higher level of flow augmentation at low flows as per Figure F-2.15.
- Where the dam is at or above capacity, allow free discharge via a constructed spillway to Coal Creek below the dam.

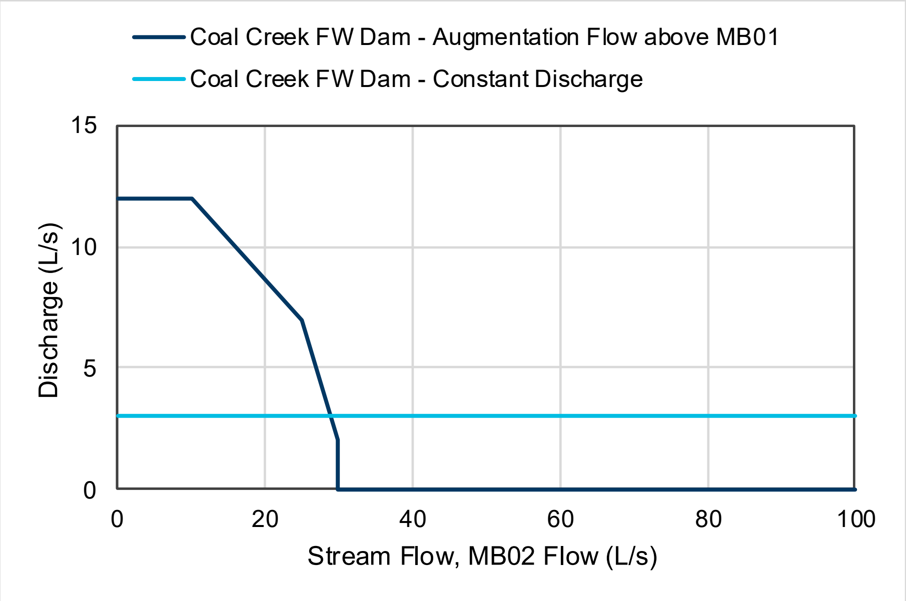


Figure F-2.15 Coal Creek Freshwater Dam rating curve

F-2.3.2.2 Water Balance Model Application

The following assumptions are made to implement the Coal Creek Freshwater Dam in the WBM.

- Flushing events required two to three times a year result in an additional abstraction from the dam of 410 m³ (based on 3 hrs at 3×median flow at MB02). This corresponds to 0.14% of the dam's storage volume, thus, considered negligible in modelling the available dilution capacity so flushing events are not explicitly modelled. However, a dead storage volume of 45,000 m³ (~7% of capacity) is applied to Coal Creek Dam to provision for this purpose (refer to Appendix E).
- Augmentation flow discharge from the dam is to be based on flow monitoring to be established within the Mare Burn. In practice, this would be done by a live link between the flow gauge and variable speed pump installed at the Coal Creek Dam. For modelling purposes, the augmentation flow rating curve is based on the cumulative daily average flow contribution from non-mine affected catchments reporting to MB02. This rating curve would be updated for application once a flow monitoring site is established, likely downstream from MB02 where more favourable topography is present.

- In practice there will be some level of seepage loss from the dam. This is represented in the WBM modelling with a maximum seepage loss of 2 L/s (Engineering Geology Limited, 2016), with the assumption that this reduces linearly as the dam level reduces. This approach is considered conservative as in practice a portion of the seepage loss from the dam is expected to contribute to base flow in Coal Creek below the dam. If this flow is significant, it can be deducted from the baseflow discharge requirement of 3 L/s.
- It is anticipated that it will be feasible to implement an improved operating regime for this dam after commissioning. This will be based on an understanding of the water quality within the dam and a feasibility assessment of aligning discharge rates with electrical conductivity (EC) monitoring within the Mare Burn.
- Discharge controls are placed on the dam from the moment that construction is completed and retained, subject to water availability, as the dam fills.

F-2.3.3 Flushing Flows

Provision for flushing flows is to be allowed for as required to manage periphyton growth.

The details of the proposed flushing arrangements are not yet confirmed, and it is anticipated that these will be refined based on practical testing. The basis for flushing flow provision considers a controlled release of 3×median flow, for 3 hrs at 20-day intervals over 4 summer months (i.e. 6 flushing cycles). Where the median flow is based on the median observed under the current flow regimes for the relevant catchments, it is important to recognise that these flow regimes will change as reinstatement progresses and pit lakes develop at the site. With the installation of additional flow monitoring across the receiving catchments, refined flushing flow definitions will be possible based on residual flow conditions and monitoring of natural flushing events. It is anticipated that this mitigation measure could be automated in the long term.

Table F-2.5 provides a summary of median and Q90 flow statistics for the compliance sites MB02, DC08, MC02, NBWRRF based results from the WBM over future mining phases. These flow rates include the effects of future pit lake overflows, changes in WRS capping and water treatment and discharge arrangements. Table F-2.6 summarises the proposed flushing flows, based on the criteria outlined above and describes the provision for delivering this flow. The primary mechanism will be to utilise the discharge flow control systems that will be included in the construction of the Camp Creek and Coal Creek dams. Where flushing flows are delivered from existing silt ponds as staging points, it is proposed that discharge from the WTP be routed to the pond, enabling a slow fill, followed by a controlled release. The existing silt ponds will likely require retrofitting of discharge systems to allow for this function.

To provide for the flushing flows from the Camp Creek and Coal Creek dams in the WBM, the annual flushing volume is assigned as a dead storage, such that it would be available at any time following replenishment if required. The water balance can be satisfied for the remaining flushing points by delivering a portion of seepage flow captured from FTSF and treated through the WTP to the staging point. Note that all seepage from FTSF is represented as reporting to Innes Mills Pit lake untreated in the current modelling scenarios.

Table F-2.5 Flow metrics for flushing flow provisions

Metric	Phase	MB02	DC08	MC02	NBWRRF
Median Flow (L/s)	Mining Ph.A	30	48	15	16
	Mining Ph.B	35	51	14	14
	Closure	29	51	15	20
	Long Term	29	65	15	20
Summer low flow Q90 (L/s)	Mining Ph.A	7.0	12	3.6	3.3
	Mining Ph.B	25	30	4.9	3.2
	Closure	18	29	2.6	4.9
	Long Term	19	26	2.9	5.2

Table F-2.6 Flushing flow provisions

Catchment	Flow (L/s)[1]	Volume (m^3)	Provision
Mare Burn (MB02)	87	940	Water stored in Coal Creek Dam and pumped to temporary staging points in Māori Hen and Trimbells Gully silt ponds, with controlled release (returned treated water may also be used)
Deepdell Creek (DC08)	153	1,660	Water stored and released from Camp Creek Dam, with potential for returned treated water to be discharged from Māori Tommy Silt Pond as a secondary discharge
Murphys Creek (MC02)	45	490	Water stored and released from Murphys Creek Silt Pond, or an alternative small pond should the water quality in the silt pond not improve substantially following construction of the seepage capture toe bund and pumping of the WRS seepage back to the mine water management system
Waikouaiti River North Branch (NBWRRF)	60	650	Water treated and pumped to Frasers West Silt Pond for discharge.

[1]. Flow rates calculated based on 3×medain flow modelled for the closure phase as defined in Table F-2.5.

Modelling has applied a dead storage volume of 80,000 m^3 to Camp Creek Dam and 45,000m^3 to Coal Creek Dam to retain provision for flushing flows outlined in Table F-2.6 (refer to Appendix E).

F-2.4 Waste Rock Stack Construction Methodology

F-2.4.1 Existing Practice

Current WRS construction practice at Macraes Mine focusses on creating water retaining structures (i.e. restricting rainfall runoff and thereby promoting infiltration of rainfall). The purpose of this is to prioritise erosion and sediment control, protecting receiving waters from sediment laden runoff prior to establishment of surface cover systems. The draw-back of this approach is that it increases infiltration rates, subsequently increasing contaminant loads generated within the WRSs. Currently observed features of WRS construction that contribute to increasing infiltration rates include:

- Capping has been left incomplete,
- Top areas being reinstated while maintaining flat or dished surfaces, causing localised surface ponding (see Figure F-2.16 below),
- Windrows being retained preventing water shedding, and
- Construction benches with reverse slopes retaining runoff from slopes as seen on Northern Gully WRS, Frasers West WRS and a localised area on Frasers East WRS.

Where these features occur elevated infiltration rates can persist. An assessment of seepage rates based on available site data is presented in Appendix E, Section 2.2.4.

Two recently reestablished WRSs have been capped with a more naturalised landform, with rounded profiles and a generally more water shedding profile. These are the Frasers East WRS and Deepdell East WRS, and infiltration rates are expected to be improved on these stacks. However, to date there is no performance monitoring that can verify the outcomes of this capping.

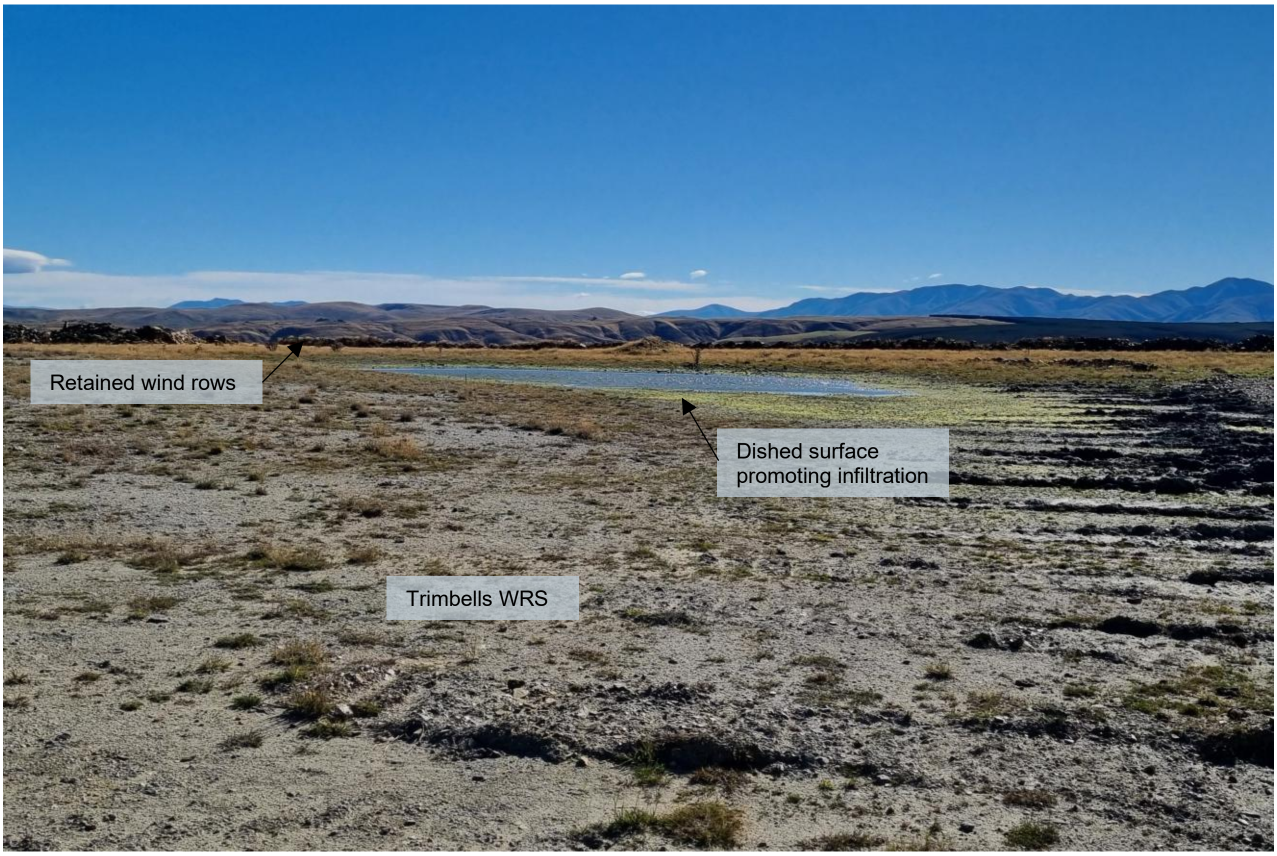


Figure F-2.16 Trimbells WRS – Partial rehabilitation showing infiltration promoting surface

F-2.4.2 Proposed Improvements

Modelling of WRS hydrology is undertaken with the understanding that WRS construction methodology is to be revised considering the following:

3. Exposed (non-reestablished) areas will be reduced through construction sequencing allowing earlier rehabilitation,
1. Completed WRS surfaces will be designed to promote water shedding, and
2. Erosion protection measures will be installed such that the surface integrity of the WRS is retained long-term.

In addition to these measures,

3. Localised contouring of existing rehabilitated WRS surfaces will be undertaken to promote runoff and reduce infiltration.

With the improvements in WRS construction and reestablishment to be implemented, modelling has assumed that long-term mean infiltration rates will reduce to about 5% of mean annual rainfall (approximately 32 mm/yr).

OGNZL is committing to also implementing improved management practices associated with WRS construction. These will see; less exposed (un-rehabilitated) WRS area, and a greater emphasis on developing water shedding systems compared with current practice. This is expected to reduce WRS seepage rates (during the active mining phase), however, the effects have not been quantified nor included in the WBM. This will offer an improvement to the modelled outcomes.

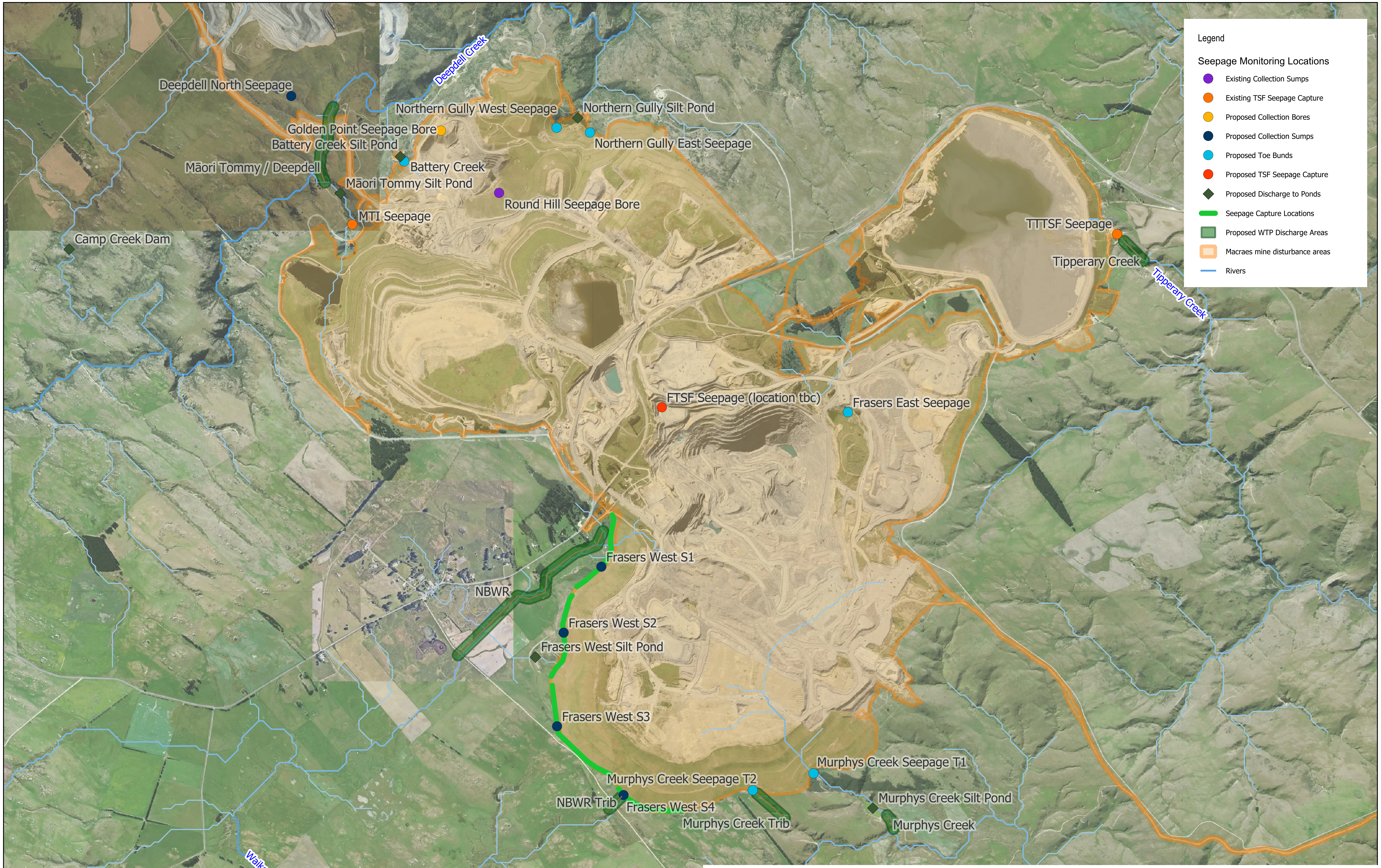
F-2.5 Passive Water Treatment

Passive Water Treatment (PWT) is not included in the model as a water quality mitigation tool. However, studies and field trials are being conducted at site with the aim of expanding the array of mitigation options available for implementation through site closure. Where PWT technology is proven to be a viable mitigation tool for long-term water quality management, it could be applied to supplement or replace other options outlined in this document. Passive treatment systems applicable to the Macraes Operation are discussed in Verum Group (2022), Christenson (2022), Verum Group (2025) and MWM (2026h).

Attachments

Attachment 1

Seepage Capture and WTP Discharge Locations



Data Disclaimer
Whilst every care has been taken to prepare this map, GHD make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Paper Size ISO A3
0 500 1,000 m
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Map Projection: New Zealand Transverse Mercator 2000
Horizontal Datum: NZGD2000
Grid: New Zealand Transverse Mercator 2000 (NZTM2000)

GHD

OceanaGold (New Zealand) Limited
Macraes Phase 4
Fast Track Approvals Project

Central Mining Area
Seepage Capture and Discharge

Project No. 12682240
Revision No. 0
Date. 21/08/2026

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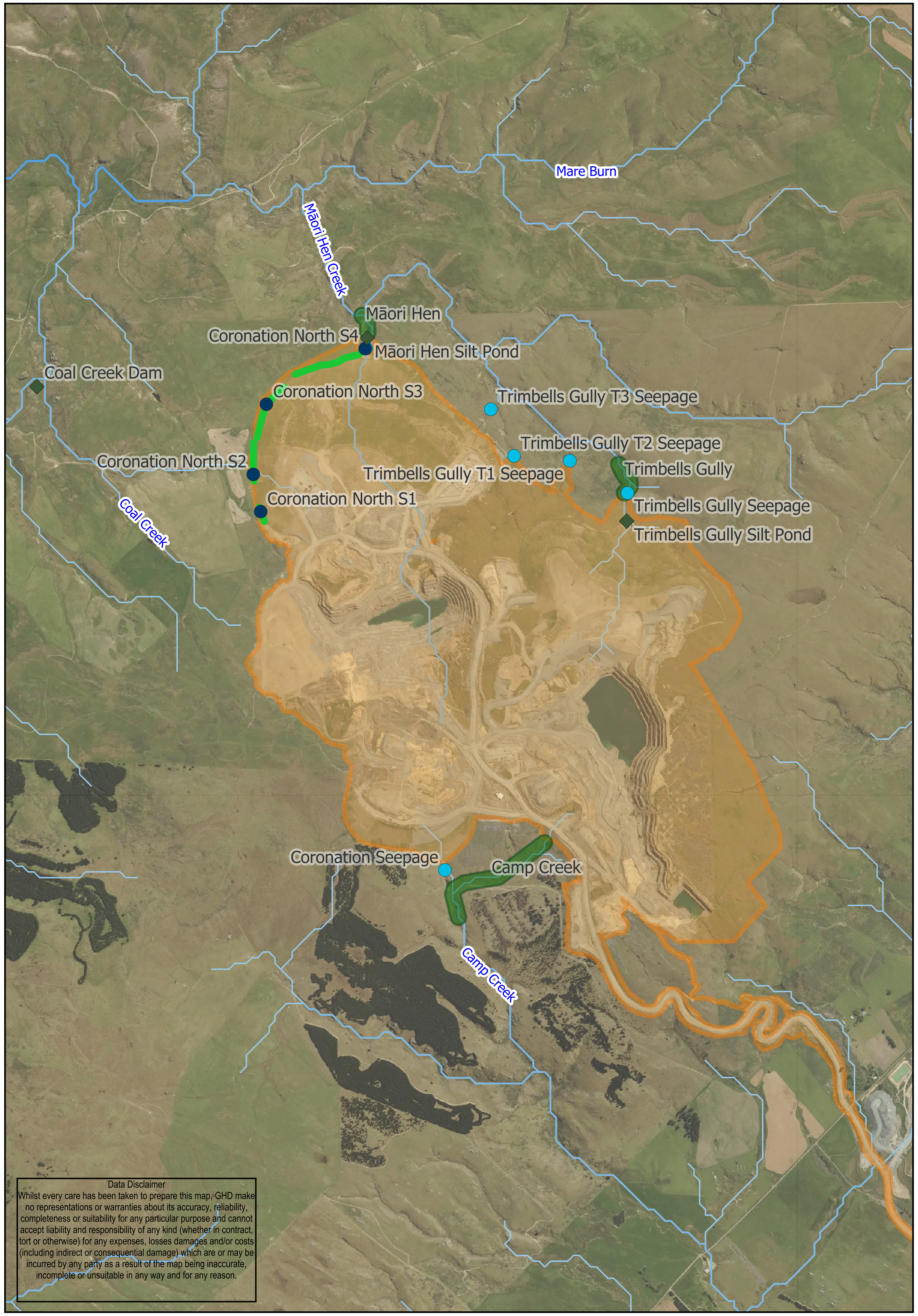

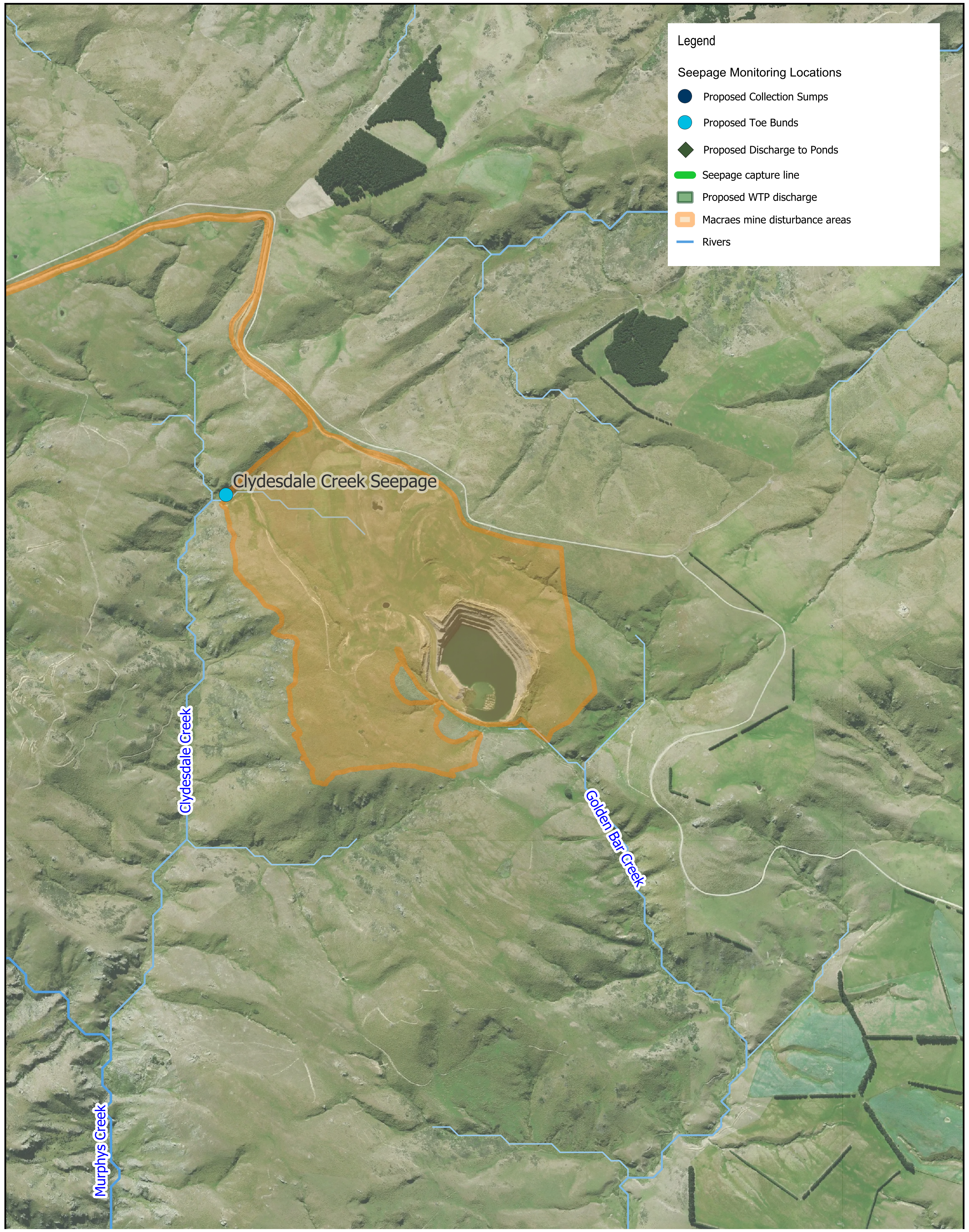

Paper Size ISO A3

0 250 500 m

N

Map Projection: New Zealand Transverse Mercator 2000
Horizontal Datum: NZGD2000
Grid: New Zealand Transverse Mercator 2000 (NZTM2000)

GHD

OceanaGold (New Zealand) Limited
Macraes Phase 4
Fast Track Approvals Project

Coronation Mining Area
Golden Bar Mining Area
Seepage Capture and Discharge

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