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GEOTECHNICAL WATER RESOURCES PAVEMENTS

GeoSolve Ref: 240480.03
3 December 2025

Otago Regional Council
Phillip Laing House
Dunedin 9016
Attention: Shay McDonald

Surface Water and River Engineering Assessment Memo
Bendigo-Ophir Gold Project Fast-Track Application Assessment

In accordance with our Agreement by email correspondence on 17 November 2025, we have undertaken an assessment of the proposed Bendigo-Ophir Gold Project Fast-Track Application, specifically the technical scope shown on Figure 1 below. Our investigation has comprised a site inspection and review of the Substantial Application documents, primarily those listed in GeoSolve's Completeness Assessment letter report provided to ORC on 7 November 2025 (ref: 240480.03) as well as others which were found to be cross referenced by those reports or otherwise relevant to River Engineering issues.

TECHNICAL REVIEWS – SCOPE

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Scope:

- Geotechnical stability – pits, underground mine, TSF, ELFs
- Natural hazards – landslides, earthquakes, flooding
- Whether the activities will exacerbate any existing natural hazards, or whether existing hazards will affect activities
- Any modelling in relation to the above
- Assessment of structures in rivers, in relation to natural hazards but also hydrological impacts.
- Erosion and sediment control

Please consider the conditions that are relevant to ORC, Central Otago District Council, and both councils jointly.

Figure 1: GeoSolve's technical review scope as provided by ORC

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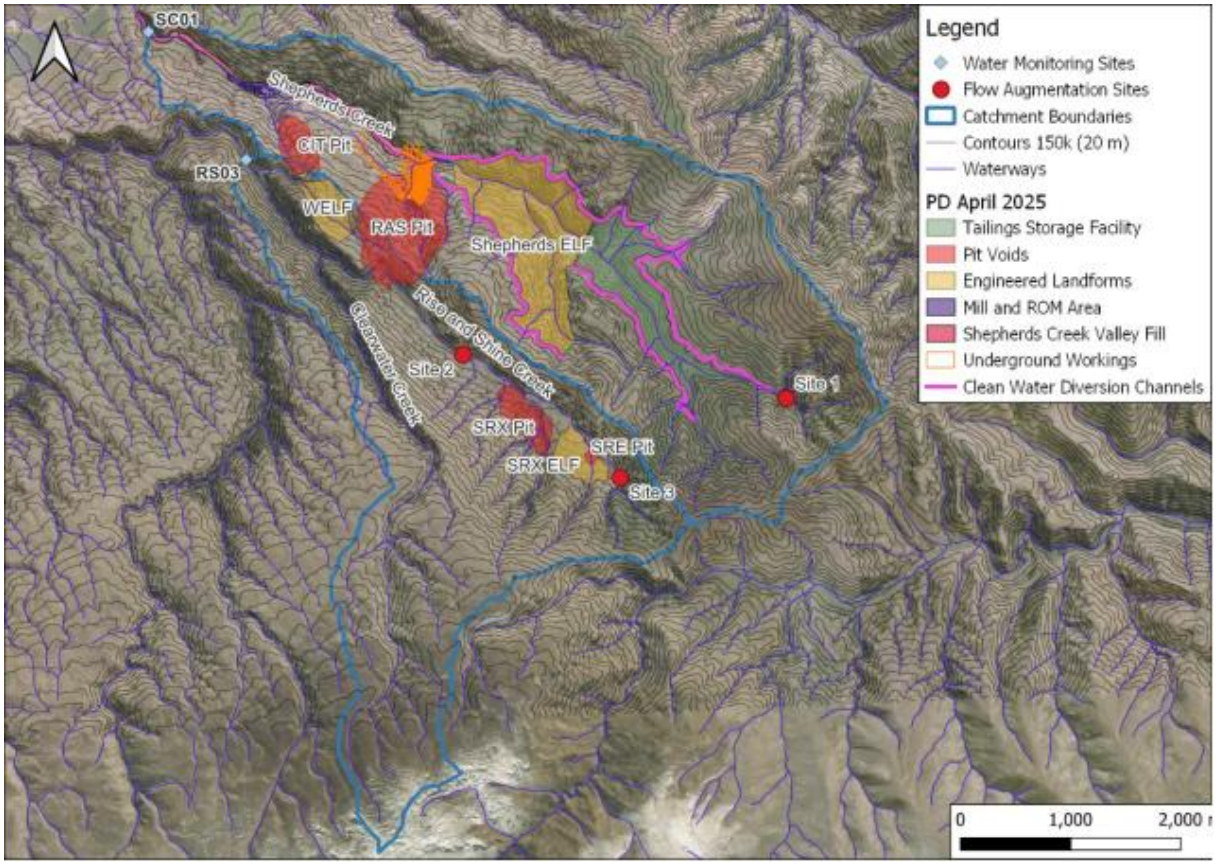

Figure 2: Site plan and proposed features as per provided document B.43

River Engineering Assessment

Key Issues with the Proposal

GeoSolve has been asked to assess potential Key Issues with the Proposal, why these are important, how significant they are (quantified, if possible), and how these might be addressed.

Two of the primary documents related to River Engineering are *B.04 Komanawa Kōmanawa Limited - Surface Water and Catchment Existing Environment Effects Assessment*, and *B.24 Engineering Geology Limited - Rise and Shine Pit- Creek Diversion Technical Report*.

A Key Issue identified from a River Engineering perspective is that diversions of Shepards Creek and 'Srex tributaries' of the Rise and Shine Creek channels are proposed, but not described in detail. In contrast, the proposed Rise and Shine Creek diversion is described in detail by document B.24.

A summary of the proposed diversions from GeoSolve's understanding of the provided documents is presented as Table 1 below.

Table 1: Summary of proposed diversions understood from provided documents

Watercourse / Area	Type of Diversion	Proposed Purpose
Rise and Shine Creek (diversion details provided)	Full engineered diversion around the RAS Open Pit using either: Option 1 – detention bund + channel; Option 2 – open channel	Maintain baseflow; prevent pit flooding; avoid mixing catchments
Shepherds Creek (**diversion details not provided**)	Clean water diversion channels divert headwater flows around operational area	Maintain zero-discharge mine regime; prevent excess inflows into mine areas
SREX tributaries (**diversion details not provided**)	Three diversion channels: East, Central, and West around Srek pit and ELF	Keep clean water out of mine footprint; reduce sedimentation

A list of details that <u>are</u> provided for the Rise and Shine Creek Diversion, but <u>are not</u> provided for the other proposed diversions:

- Channel diversion / realignment path design details
- Engineering drawings
- Channel lengths, gradients and alignments
- Proposed construction methodology
- Erosion control or armouring details specific to the channel
- Hydraulics / flood design calculations to support channel sizing

It is important that these details be provided in order to demonstrate that the proposed diversions can and will be designed and constructed appropriately.

Other issues identified include:

- That it is considered/calculated by Kōmanawa Solutions Limited in document B.04 that '*Overall, surface water flows in both arms of the Shepherds and Bendigo catchments would increase*'. This implies that the magnitude of flood flows downstream would be increased by the mining activities.
    - **It appears that the difference in flood magnitude of an extreme event would be minimal, possibly negligible, however it is requested that this is confirmed and justified by the applicant/their engineering representative**.
- Although document B.04 is titled '*Surface Water and Catchment Existing Environment Effects Assessment*' it appears to focus more on groundwater and aquifer effects than surface water (e.g. flood potential) and catchment effects (e.g. the proposed tailings dam).

  - **It requested that Kōmanawa Solutions Limited or another engineering representative of the applicant assess and confirm that the proposed Shepards Creek diversion channel is capable of conveying potential 100 year ARI (1% AEP) flood flows, and the mitigation of potential consequences of overtopping (e.g. back-scour and channel re-routing) if they are under-capacity. If the diversion channels are to be left as-constructed post-closure, assurance of their ongoing performance is required.**
  - GeoSolve understands that the proposed tailings dam has already had a Potential Impact Classification assessment undertaken as per the NZSOLD guidelines, and that a High PIC has been allocated, which appears appropriate.

- It is noted that GeoSolve has not assessed document B.04 from a hydrogeology or ecology/environmental perspective (as per the agreed scope).
  - GeoSolve understand that E3 Scientific are assessing those elements, and recommend that this document B.04 is assessed by E3 Scientific from that perspective.

- It is noted that it is estimated by Kōmanawa Solutions Limited in document B.04 that it will take 50-60 years for the tailings dam (and underground mining works) to fill and begin to spill/reconnect with the original downstream flowpaths.
  - **It is considered that this estimate is likely to have a wide margin of error, and recommended that any decisions made based on this estimate (e.g. regarding dam safety, contaminant transport, monitoring and maintenance etc) acknowledge and include that margin of error. It is requested that the applicant confirms this has/will be performed, including details.**
  - It is queried, if the upper catchment flow of Shepards Creek is to spend 50-60 years filling the tailings dam, how Kōmanawa Solutions Limited have concluded that '*Overall, surface water flows in both arms of the Shepherds and Bendigo catchments would increase*'. That may be the case once the tailings dam has filled, however **if the flows in Shepards Creek are to be reduced for approximately 50-60 years this is likely to have an effect on downstream ecology. Effects on ecology are outside the scope of GeoSolve's assessment, however it is recommended that the potential ~50-60 year reduction in downstream surface water flows is clarified to and understood by those undertaking the ecological assessments, if this has not already been made clear.** This appears to partially be addressed by document B.43**.**
  - Document B.04 references the Tailings Storage Facility (TSF) dam design documents prepared by Mine Waste Management (document B.06, including appendices documents B.06 A-C), and GeoSolve has searched these documents for references to the tailings dam. Those documents show that there will be an underdrain bypass pipe under the tailings dam (see Figure 3 below), and it is unclear whether this has been taken into account in Kōmanawa Solutions' estimate of the 50-60 years it will take for the tailings dam to fill. **It is recommended that Kōmanawa Solutions and Mine Waste**

Management's design & calculation works for the tailings dam are confirmed to be co-ordinated, as this will also affect factors such as dam safety, contaminant transport, monitoring and maintenance and more. It is requested that the applicant confirms this has/will be performed, including details.

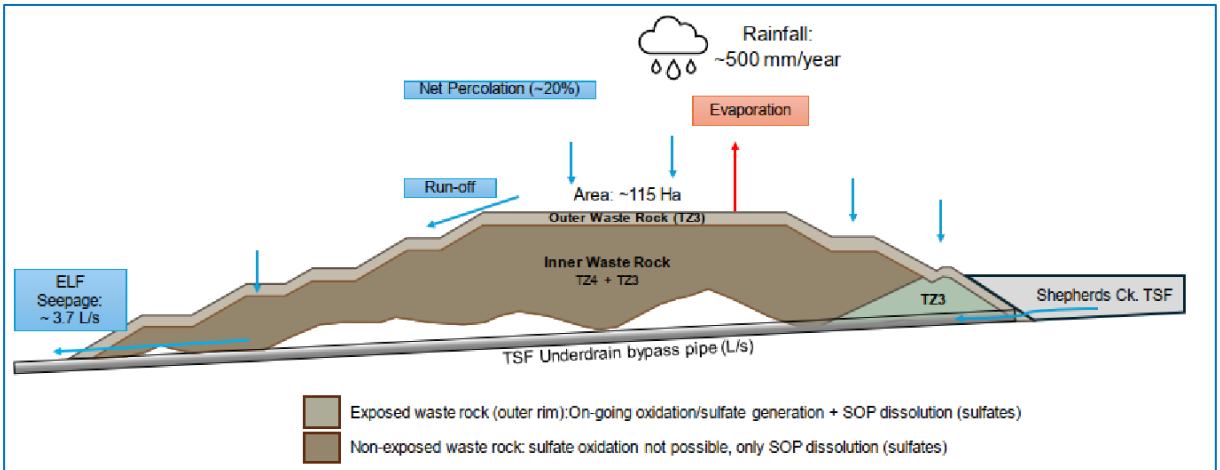

Figure 19. Conceptual (and schematic) water balance and material distribution for the Shepherds ELF.

Figure 3: Underdrain bypass pipe as shown on page 25 of Appendix L (pdf page 156) of document B.06C

- The Shepards Silt Pond has also been assessed in terms of Potential Impact Classification as a dam. Document *B.23 - Engineering Geology Limited - Shepherds Silt Pond Technical Report (EGL 2025d)* details that assessment, and concludes that it is a Low PIC dam. GeoSolve has reviewed Engineering Geology's assessment, which finds the assessed damage level to be minimal, the Population at Risk (PAR) to be between 11-100, and the Potential Loss of Life (PLL) to be 1 (rounded up to the nearest whole number from 0.5142), as shown on Figure 4 below. This was then compared to the NZSOLD Dam Safety guidelines, and following the process in Table 2.6 on Page 29 of Module 2 those input values appear to result in a Medium PIC, as shown on Figure 5 below. **GeoSolve therefore consider the Shepards Silt Pond to be a Medium PIC dam rather than a Low PIC, and recommend that appropriate steps are taken to address that potential impact classification and associated design/construction/monitoring and maintenance requirements**.

Table A7. Summary of PAR and Potential Loss of Life for Rainy Day Breach Scenario

Breach Scenario	Item	PAR	Potential Loss of Life	Damage				Potential Impact Classification (PIC)
				Community	Cultural	Critical and Major Infrastructure	Natural Environment	
Rainy Day Base Flood (PMP – 1 hr)	Buildings	8.10	0.0008	-	-	-	-	-
	Roads & Bridges	1.75	0.5072					
	Farmlands	0.08	0.0000					
	Summary	9.94	1 (0.5080)					
Rainy Day Breach with Base Flood (PMP – 1 hr)	Buildings	38.10	0.0056	Minimal	Minimal	Minimal	Minimal	Low PIC
	Roads & Bridges	1.85	0.5086					
	Farmlands	0.11	0.0001					
	Summary	40.06	1 (0.5142)					
	Incremental Summary	**30**	**0** (0.01)					

Figure 4: Table A7, Appendix A of Engineering Geology Limited's Shepherds Silt Pond Technical Report (pdf page 62)

Table 2.6: Determination of Potential Impact Classification (PIC)

Assesseddamagelevel	Population at Risk (PAR)				Potential Loss of Life
	0	1 to 10	11 to 100	100+	
Catastrophic	High	High	High	High	No persons
	N/A[1]	High	High	High	One person
	N/A[1]	High	High	High	Two or more persons
Major	Medium	Medium	High	High	No persons
	N/A[1]	Medium	High	High	One person
	N/A[1]	High	High	High	Two or more persons
Moderate	Low	Low	Medium	Medium	No persons
	N/A[1]	Medium	Medium	Medium	One person
	N/A[1]	High	High	High	Two or more persons
Minimal	Low	Low	Low	Low	No persons
	N/A[1]	Medium	Medium	Medium	One person
	N/A[1]	High	High	High	Two or more persons

Notes:
1. Not applicable. Population at risk is zero therefore no Potential Loss of Life.

Figure 5: Table 2.6 from NZ Dam Safety Guidelines (Module 2, pdf page 28)

- The RAS diversion channel design by Engineering Geology Limited (document B.24) appears appropriate, however it is considered that **Option 2 is preferable, being the larger diversion channel without a bund. Of the two variants of Option 2, it is considered that a rip-rap lined channel is preferable to a concrete-lined channel**. It is noted that the hydrological calculations appear to be on the conservative side (predicting comparatively higher flood flows), but the hydraulic/Manning's n calculations appear to be on the less conservative side (predicting comparatively shallower flow depth).

- **Overall the channel sizing appears appropriate, however it is noted that Engineering Geology Limited have stated '*a smaller channel with higher flows is likely to be achievable following detailed design*'. Due to the relatively conservative hydrological calculations appearing to balance out the relatively un-conservative hydraulic calculations, GeoSolve recommended that a smaller channel is not implemented at detailed design.**
- It is considered that selecting Option 2 (with rip-rap) will reduce the post-closure monitoring and maintenance requirements, however it is still recommended that details regarding proposed monitoring and maintenance after closure of the mine are provided, to ensure that the flowpaths remain in the appropriate locations to avoid contaminant transport.

- GeoSolve has also partially reviewed Engineering Geology Limited's (EGL) *Erosion and Sediment Control Report* (document B.26) from a river engineering perspective, noting that other aspects such as ecology impacts from sediment transport are to be reviewed by others. In general the main conclusion is that an overall Erosion and Sediment Control Management Plan is required, as well as site-specific ESCPs for each individual working area. EGL conclude that design standards exist for preparing ECSPs, and that Resource Consent conditions for implementation of ESCPs are an appropriate management strategy. GeoSolve consider that in general this appears appropriate. It is noted however, that one of the resources that EGL has referenced (shown as Figure 6 below) has been used as justification for the 10 year ARI (10% AEP) storm recommended for design of sediment management controls.
  - **There is a high chance that a greater than 10 year ARI storm will occur in the operational life of the mine (due to the proposed operational period being >10 years), and we recommend that a higher 50 year ARI (2% AEP storm) is used in the design of sediment management features and infrastructure that are to exist for the operational life of the mine (further details in bullet point below Figure 6).**
  - **It is noted that Figure 6 (Table 6) below, points out that permanent stormwater controls require higher standards. EGL have sized the Rise and Shine diversion channel to a 100 year ARI (1% AEP) storm, which appears appropriate, and it is recommended that the Shepards Creek diversion channel is also sized to a 100 year ARI (1% AEP) storm, as well as any other permanent proposed stormwater/flowpath infrastructure.**

TABLE 6: DESIGN CRITERIA OF TEMPORARY EROSION AND SEDIMENT CONTROLS

Controls requiring sizing	Disturbed Areas < 12 months (i.e. generally during site establishment until stabilised)	Disturbed Areas 12 to 24 months (i.e. generally during site establishment until stabilised)	Disturbed Areas > 24 months (i.e. semi-permanent measures during operation)
Clean and dirty water diversion bunds and channels	Size for 1 in 2 year rainfall event. Passing peak flows for critical duration with freeboard allowance.	Size for 1 in 5 year rainfall event. Passing peak flows for critical duration with freeboard allowance.	Size for 1 in 10 year rainfall event. Passing peak flows for critical duration with freeboard allowance.
Culvert and ford crossings	Size for 1 in 2 year rainfall event. Passing peak flows.		
Sediment retention ponds and bunds.	Size for 1 in 2 year rainfall event using ICEA (Australasia) Type C Sediment Basin for peak flows. Size emergency spillway for 10 year ARI flow as a minimum.	Size for 1 in 5 year rainfall event using ICEA (Australasia) Type C Sediment Basin for peak flows. Size emergency spillway for 50 year ARI flow as a minimum.	Size for 10 year ARI event using ICEA (Australasia) Type C Sediment Basin for maximum peak flow. Size emergency spillway for 100 year ARI flow as a minimum.

***Notes:**
1. Estimation of run-off flow and specific sizing of diversions and culverts required.
2. Freeboard allowance shall be 150mm when flows are less than 20 l/s and otherwise 300 mm unless specific calculation for energy head undertaken.
3. Refer to ICEA (Ref. 3) Type C Sediment Basin using "Appendix B – Sediment Basin Design and Operation" Ref. 2
4. Under design flow conditions sediment retention ponds or decanting earth bunds shall be capable of capturing and holding at least 90% of material larger than 0.045mm in equivalent diameter.
5. Sediment retention ponds and decanting earth bunds shall have a minimum 1 month sediments storage from runoff under average annual conditions.
6. Table is not for the design of permanent stormwater controls. Permanent stormwater controls may require higher design standards.

Figure 6: Table 6 from EGL's Erosion and Sediment Control report (pdf page 26)

- GeoSolve has also reviewed Matakanui Gold Limited's Erosion and Sediment Control Management Plan (document G.14) from a river engineering perspective, and found that the same storm return period displayed in Figure 6 (Table 6) above has been referenced as a design criterion. **The same recommendation is made in this case, that a 50 year ARI storm is used for sediment management features and infrastructure that are to exist for the operational life of the mine. It is considered that this is appropriate based on the comparison of the storm return period and proposed operational lifetime of the mine (~13.3 years of operations, 50 year ARI storm) being a similar ratio to that shown in Figure 6/Table 6 above (~2 years of operations, 10 year ARI storm)**.

- GeoSolve have also reviewed Hydro Geochem Group's BOGP Flow Augmentation Strategy (document B.43) from a River Engineering perspective. The main proposal is to augment the flow of the main flowpaths with bore water from Bendigo aquifer until '*an appropriate time post-closure, once anticipated creek flow increases have occurred*'. **From a river engineering perspective it is not considered a Key Issue to augment those flows**. It is noted however:
  - The anticipated creek flow increases are likely to have a significant margin of error in terms of estimated timing, and assumptions about when the bore water augmentation of the flow paths can be shut off should acknowledge this.
  - The augmentation will not affect tributaries, resulting in potential ecological effects in those locations. It is recommended that that is clarified with those undertaking the ecological assessments if that has not already been communicated to them, and that an ecologist review document B.43.
  - **The data and assumptions regarding flow rates and timings during the mines operations and post-closure period appear to differ from the information presented in Kōmanawa Solutions Limited's report document B.04, and it is**

recommended that the reports are co-ordinated prior to final design decisions being made based on them.

- **It is recommended that the flow augmentation should be shut off during heavy rainfall events/flood flows**.

Applicability

This report has been prepared for the sole use of our client, Otago Regional Council, with respect to the particular brief and on the terms and conditions agreed with our client. It may not be used or relied on (in whole or part) by anyone else, or for any other purpose or in any other contexts, without our prior review and written agreement.

Report prepared by:	Report reviwed by:
	
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