

**Before the Expert Panel appointed  
under the Fast-track Approvals Act 2024**

**Under**

the Fast-track Approvals Act 2024 (**Act**)

**And**

**In the Matter of**

an application for approvals by  
Matakanui Gold Limited to establish,  
operate, rehabilitate and ultimately  
close an open pit and underground gold  
mining operation known as the Bendigo-  
Ophir Gold Project

**Statement of Evidence of  
Eric Torvelainen on behalf of  
Matakanui Gold Limited in response to  
Section 53 Feedback  
Engineered Landforms**

Dated: 17 April 2026

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**lane neave.**

## INTRODUCTION

1. My name is Eric Torvelainen.
2. I hold a Bachelor of Engineering (Civil) with Honours from the University of Canterbury. I am a Member of Engineer New Zealand, New Zealand Geotechnical Society, New Zealand Society of Earthquake Engineering, and New Zealand Society on Large Dams. I am the New Zealand representative on the Tailings Dams & Waste Lagoons Technical Committee for the International Committee for Large Dams. I am currently employed as Director of Engineering Geology Ltd (**EGL**) and have held that position since 2022.
3. I have been engaged in the fields of geotechnical and earthquake engineering in a professional capacity for the past 17 years. I have 9 years' direct experience designing engineered landforms (**ELF**) and tailings storage facilities (**TSF**). I am involved in the design, construction and review of the majority of active ELFs and TSFs at gold mining operations in New Zealand.
4. This statement is given as part of Matakanui Gold Limited's (**MGL**) response to comments on the Bendigo-Ophir Gold Project (**BOGP**) made under Section 53 of the Fast-track Approvals Act 2024 (**FTA**). This statement responds to specific comments raised by:
  - (a) Otago Regional Council (**ORC**);
  - (b) New Zealand Fish and Game;
  - (c) Environmental Defence Society Incorporated; and
  - (d) Adjacent landowners.
5. My original findings cover ELFs and are provided in full in the following reports and management plans filed with the Substantive Application:
  - (a) B.20 Engineering Geology Limited - Site-Specific Seismic Hazard Study Report (EGL 2025a).
  - (b) B.22 Engineering Geology Limited - Site Geotechnical Factual Report (EGL 2025c) (3 Parts).
  - (c) B.23 Engineering Geology Limited - Shepherds Silt Pond Technical Report (EGL 2025d)
  - (d) B.24 Engineering Geology Limited - Rise and Shine Pit - Creek Diversion Technical Report (EGL 2025e)

- (e) B.25 Engineering Geology Limited - Process Plant and Infrastructure Geotechnical Report (EGL 2025f)
  - (f) B.26 Engineering Geology Limited - Erosion and Sediment Control Report (EGL 2025g)
  - (g) B.27 Engineering Geology Limited - Shepherds, Western and Srex Engineered Landforms and Come In Time Pit Backfill Technical Report (EGL 2025h)
  - (h) G.14 Erosion and Sediment Control Management Plan
  - (i) G.15 Engineered Landform Management Plan
  - (j) G.17 Pond and Reservoir Management Plan
2. Other relevant reports that my findings rely on include:
- (a) B.03 Kōmanawa Solutions Limited - Groundwater Existing Environment and Effects Assessment (Kōmanawa 2025b)
  - (b) B.04 Kōmanawa Solutions Limited - Surface Water and Catchment Existing Environment and Effects Assessment (Kōmanawa 2025c)
  - (c) B.06 Mine Waste Management Limited - Mine Impacted Water Overview Report (MWM 2025)
  - (d) B.33 Pattle Delamore Partners - Assessment of Environmental Effects from the Discharge of Contaminants into Air (PDP 2025)
3. I have prepared this statement in the limited time available for MGL to respond to comments under the FTA. If the Panel requires elaboration on any of the matters raised in this statement, I am available to provide further information on request.
4. Although this is not an Environment Court proceeding my confirmation of compliance with the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2023 is included in Substantive Application Document A0.2B.

## **SPECIFIC RESPONSE TO COMMENTS**

5. I have responded to commenters for the key topics related to ELFs. Under the topic of ELFs my evidence covers the civil and geotechnical engineering aspects of:
- (a) ELFs (rock stacks and valley infills);
  - (b) erosion and sediment controls (**ESC**); and

- (c) stream and surface water diversions.

### **Otago Regional Council**

6. ORC has invited MGL to address various matters in its response to comments. I address matters relevant to my expertise as follows.

***Paragraph 163(a) – “For every proposed diversion channel in Shepherds Creek catchment or Rise and Shine Creek catchment (except the Rise and Shine Diversion Channel discussed in Report B.24) that will be onsite for two years or more:***

***i. channel diversion / realignment path design details***

***ii. engineering drawings***

***iii. channel lengths, gradients and alignments***

***iv. proposed construction methodology***

***v. erosion control or armouring details specific to the channel***

***vi. hydraulics / flood design calculations to support channel sizing”***

7. I list the diversion channels that will be onsite for more than two years.

***Shepherds Catchment:***

- (a) North TSF Clean Water Diversion Channel (**North TSF CWDC**);
- (b) South TSF Clean Water Diversion Channel (**South TSF CWDC**);
- (c) North ELF Stream Diversion (**North ELF SD**) ;
- (d) South ELF Stream Diversion (**South ELF SD**);
- (e) Shepherds ELF Clean Water Diversion Channel (**Shepherds ELF CWDC**);
- (f) Shepherds Service Corridor Stream Diversion (**Shepherds Service Corridor SD**); and
- (g) TSF Reinstated Shepherds Creek.

*Rise and Shine Catchment:*

- (a) SRX ELF Clean Water Diversion Channels (**SRX ELF CWDC**);
  - (b) SRX Clean Water Diversion Channels (**SRX CWDC**);
  - (c) SRX ELF Dirty Water Diversion Channel (**SRX ELF DWDC**); and
  - (d) Rise and Shine Stream Diversion (**RAS SD**).
8. These are also shown the figure in Part C of the Substantiative Application under Project Map C.36, apart from SRX ELF DWDC. In response to the comment an additional technical letter outlining the proposed details for these channels mentioned above is included as **Attachment 1** to this statement of evidence. The SRX ELF DWDC is shown on Figure 2 in Attachment 1.

***Paragraph 163(b) – “For each sediment management device (e.g. sediment retention pond, silt pond, sump) in Shepherds catchment or Rise and Shine Creek catchment that will be onsite for two years or more:***

***i. Justification for the rainfall event used in the design of the device”***

9. There are only two sediment retention devices onsite that are required to function for more than two years. I provide discussion to justify their design rainfall event.

*Shepherds Silt Pond*

10. Shepherds Silt Pond is positioned at the toe of Shepherds ELF. The silt pond is required for the management of sediment laden water off Shepherds ELF, and area between the ELF and the RAS Open Pit. The catchment area is 179 ha. This catchment assumed that the North ELF SD and Shepherds ELF CWDC are functioning (see comments on diversion channel performance below).
11. The original proposed design basis for decanting of sediment laden water in the Substantive Application was for a 1 in 10 year storm event (for all storm durations) for this silt pond. The Annual Exceedance Probability (**AEP**) is the same as design level for silt ponds for all other major gold mines in New Zealand. ORC and their consultant Geosolve have indicated they would like to see this higher and have indicated that a 1 in 20 year basis is appropriate. I understand their concern with a 1 in 10 year level, as it will likely to be exceeded in the mine life of 14 years. If this occurs the concern is that notable sediment could be released from this silt pond. My experience at Macraes is that much of the sediment drops out on the ELFs and there is little sediment in the silt ponds and downstream of the outlets. This is partially because at Macraes the ELFs external surfaces are progressively

rehabilitated and also due to the water management on the running surfaces of the ELF. The ELFs at the BOGP will be progressively rehabilitated. Given the terrain and schist rockfill at BOGP is similar to Macraes I therefore consider there is a low risk that there will be notable sediment released downstream of the silt pond if the capacity of the design basis for the silt pond was exceeded. However, one of the objectives at the BOGP is to shed water off the running surfaces and hence the situation could be different to Macraes.

12. EGL have checked the capacity of space allowed for the Shepherds Silt Pond and confirm that a 1 in 20 year design basis can be achieved within the existing silt pond footprint for the Project. Given the large area of the ELF and that this is a new site and the ability to accommodate the change, I am satisfied with the proposal to update the design basis for sediment retention for Shepherd Silt Pond to a 1 in 20 year event covering all storm durations. This requirement is set out in the G.14 Erosion and Sediment Control Management Plan. I understand the management plans will not be updated as part of this comment response package and will instead be updated following expert conferencing. If ORC considers this requirement should be included in the proposed consent conditions this can be discussed further in the anticipated conditions workshops.
13. A 1 in 20 year storm event means there is an approximately 5% chance each year that a storm event will not be fully contained and water will spill over the auxiliary spillway weir (which is designed for a 1 in 1000-year event) as a shallow sheet flow. In this situation detention times will be shorter than normal and higher sediment concentrations could be discharged. Such discharges would be for a very short period, and the additional sediment load would be small in comparison with the downstream receiving waters (water courses). In final closure all surfaces of areas reporting to the Shepherds Silt Pond will be rehabilitated and the silt pond will no longer be required.

#### *Western ELF Silt Pond*

14. The Western ELF is only operational for a short period during the mine life i.e. around 2 years or less. I consider that it is appropriate that the design basis for sediment retention is 1 in 10 years.
15. I note that the proposed water quality limits at compliance points SC01 and RS03 (in Shepherds Creek and Rise and Shine Creek, respectively) generally protect downstream users from offsite effects and MGL must meet these. If erosion and sediment control (**ESC**) devices were found to be inadequate and caused a non-compliance the ESC measures would be increased. If erosion and sediment control (**ESC**) is noncompliant additional measures will be implemented. This could include minimising erosion generating areas, installation of curtains or baffles to reduce

short circuiting, or chemical treatment (flocculants). It is also important that the silt pond is maintained by regular removal of sediment to maintain the design capacity.

***Paragraph 163(c) – “For every diversion channel and sediment management device, where the selected design size allows for / anticipates uncontrolled overtopping during a storm event of a given magnitude, an assessment of the frequency of overtopping and the potential adverse effects from (and potential mitigation options for):***

***i. Erosion and scour***

***ii. Aggradation and reduction in diversion channel capacity***

***ii. Channel re-routing***

***iii. iv. Potential for seepage to daylight further downslope when channels are cut into rock fill, and consequential scour / erosion / instability”***

16. Where a storm exceeds the design basis for a diversion channel the risk is that channel containment is lost (i.e. water diverts uncontrolled from the channel). The effect of this depends on the channel location within the wider site. For the Shepherds Silt Pond some additional sediment may be released into the Shepherds Service Corridor SD (as previously mentioned). However, I do not believe this would be of notable volume that could cause an aggradation issue. Generally, the channel will be narrow such that any natural aggradation will flush. During operation this can be monitored and if this is an issue, improvements can be made prior to closure. For each diversion channel onsite for longer than 2 years I describe the consequence of overtopping below.

### ***Shepherds Catchment***

17. North TSF Clean Water Diversion Channel (**North TSF CWDC**):
- (a) The North TSF CWDC is design to pass peak flows in a 1 in 10-year, 24-hour to 72-hour duration storm. The primary purpose of this diversion channel is to divert base flows from springs on the northern slopes. This diversion channel could be compromised in flood by overtopping or a local slip in the cut face. The consequence is that the flow diverts into the TSF. The TSF inflow design flood allows for this by assuming that all diversion channels around the TSF fail in an extreme rain event i.e. the design of the TSF allows for water to be safely managed in the impoundment.

18. South TSF Clean Water Diversion Channel (**South TSF CWDC**):
- (a) The South TSF CWDC is a nominal diversion channel to minimise flows into the TSF for water balance purposes if required. There is a very small amount of base flow on this side of the catchment and the catchment areas are much less. This diversion channel could be compromised in flood by overtopping or a local slip in the cut face and the TSF inflow design flood allows for this i.e. the design of the TSF allows for water to be safely managed in the impoundment.
19. North ELF Stream Diversion (**North ELF SD**):
- (a) The North ELF SD was originally designed to pass peak flows in a 1 in 10-year, 24-hour to 72-hour duration storm. Its purpose is to divert clean water around the Shepherds ELF and the Shepherds Silt Pond. This diversion channel could be compromised in flood by overtopping or a local slip in the cut face. The consequence is that the flow diverts onto the ELF surface and routes through the silt pond. This additional flow would push the silt pond outside its design basis. Given the function of the diversion channel is linked to the performance of the silt pond performance we proposed that the North ELF SD design basis is increased to be the same. I propose that the North ELF SD design basis is increased to 1 in 20-year event and covers all possible durations storms. This requirement is set out in the G.14 Erosion and Sediment Control Management Plan. I understand the management plans will not be updated as part of this comment response package and will instead be updated following expert conferencing. If ORC considers this requirement should be included in the proposed consent conditions this can be discussed further in the anticipated conditions workshops.
- (b) In closure this diversion channel shall be design for a 1 in 100-year event for all storm durations. This diversion channel could be compromised in flood by overtopping or a local slip in the cut face however it will be constrained by the profile of the ELF and adjacent natural slope i.e. flows will always be maintained along the channel alignment even if the capacity of the channel is exceeded.
20. Shepherds ELF Clean Water Diversion Channel (**Shepherds ELF CWDC**):
- (a) To match the North ELF SD, I propose the design basis is increased to be a 1 in 20 year event and covers all possible storm durations. As per previous comments this will be included in the updated management plans to be provided following expert conferencing. Initially flows exceeding this will spill to the Shepherds ELF and report through the Shepherds Silt Pond. The pipe

across the TSF is proposed to only be 1 in 10 year 24 hour to 72 hour duration storm. Flows exceeding the pipe will spill to the TSF.

- (b) In closure this diversion channel shall be design for a 1 in 100 year event for all storm durations. This diversion channel could be compromised in flood by overtopping or a local slip in the cut face however it will be constrained by the profile of the ELF and adjacent natural slope i.e. flows will always be maintained along the channel alignment even if the capacity of the channel is exceeded. In closure this channel discharges to the capped tailings surface.

21. South ELF Stream Diversion (**South ELF SD**):

- (a) During operation this will be a dirty water diversion channel. This will be managed by operations as it will be constantly changing as the ELF is developed.
- (b) In closure this diversion channel will be along the contact of the ELF and the natural slopes. It shall be designed for a 1 in 100 year event for all storm durations. This diversion channel could be compromised in flood by overtopping or a local slip in the cut face however it will be constrained by the profile of the ELF against the natural ground i.e. flows will always be maintained along the channel alignment even if the capacity of the channel is exceeded.

22. Shepherds Service Corridor Stream Diversion (**Shepherds Service Corridor SD**):

- (a) This shall be designed to a 1 in 100 year event for all storm durations. The consequence of flows spilling out of the channel is low as the valley infill is constructed out of rockfill. The exceedances will be rare and short lived and likely of shallow depth with low velocities as the valley infill is relatively wide. Some of the ecological design features will introduce steps in the profile of the Shepherds Service Corridor SD and potential for local re-routing during extreme rainfall events, so there is need for detailed assessment to check this during detailed design.

23. TSF Reinstated Shepherds Creek:

- (a) In closure the surface flows from the gullies above the TSF will be re-established across the tailings surface. Shallow surface channels will be created. These will be design for a 1 in 100 year flow. The rehabilitated tailing surface will be erosion protected across the whole surface in case of greater flooding.

*Rise and Shine Catchment*

24. SRX ELF Clean Water Diversion Channels (**SRX ELF CWDC**):

- (a) The SRX ELF CWDC is design to pass peak flows in a 1 in 10 year, 24 hour to 72 hour duration storm. This diversion channel could be compromised in flood by overtopping or a local slip in the cut face. If this occurs flows will spill out of the channel and contact the upstream edge of the ELF and water will divert into the dirty water diversion channel and report to the SRX pit..

In closure this will need to be upgraded this channel will need to be upgraded to pass 1 in 100 year event covering all storm durations.

25. SRX Clean Water Diversion Channel (**SRX CWDC**):

- (a) The SRX CWDC is design to pass peak flows in a 1 in 10 year, 24 hour to 72 hour duration storm. This diversion channel could be compromised in flood by overtopping or a local slip in the cut face. If this occurs flows will spill into the SRX pit.

26. SRX ELF Dirty Water Diversion Channel (**SRX ELF DWDC**):

- (a) This is the primary diversion for dirty water runoff. It diverts flows to SRX pit for management in-pit. If the diversion channel capacity is exceeded it will spill to Rise and Shine Creek. Immediately downstream is a wetland. Due to the presence of the wetland I proposed that the design basis shall be 1 in 50 year event covering all durations. As per previous comments this will be included in the updated management plans to be provided following expert conferencing.

27. Rise and Shine Stream Diversion (**RAS SD**):

- (a) This is a permanent diversion to remain in closure. It shall be designed for a 1 in 100 year event covering all storm durations. If the diversion channel capacity is exceeded, flows will spill and be attenuated in RAS Pit.

***Paragraph 163(d) – “For every temporary diversion channel, the consequences of disestablishing the diversions. For example, the potential consequences of introducing variable gully flows to the surface of the TSF, which is an artificial flat surface.”***

28. At final closure, diversion channels will be dis-established above the TSF and surface flows from the gullies will flow across the rehabilitated tailings surface. The tailings will be capped with a rehabilitation layer (0.3m brown rock, 0.2m topsoil).

Where tailings are soft or additional protection of the tailings is required, extra rockfill thickness will be placed. Discharge of tailings can achieve an approximate 1 in 150 slope or flatter. Further it will settle as a function of the depth of the tailings. Both the tailings beach slope and the settlement profile allow the surface to be profiled to manage surface water flows. The tailings will settle most where they are thickest. This means the shallow channels would naturally form above previous gully alignments. Therefore, shallow channels will be created following these alignments. Together with appropriate erosion protection (at the contact with the gullies) and the across the surface, the capping will be at low risk of rerouting. The closure wetland is proposed to be located over the areas of greatest settlement so all flows natural go to this point and there will be a shallow outlet channel cut to the outlet channel around the ELF.

***Paragraph 166 – “As a reference point for the Applicant’s response, ORC’s current position – based on the advice of GeoSolve – is that:***

***a) any erosion and sediment control measure that is to exist for the operational life of the mine should be sized to a 20-year ARI (5% AEP) storm unless appropriate scour mitigation cannot be established downslope of the erosion or sediment control measure in which case a 50-year ARI (2% AEP) is appropriate; and***

***b) any permanent erosion and sediment control measure should be designed to a 100-year ARI (1% AEP) storm.”***

29. I have proposed updates to the design basis for the permanent erosion and sediment control measures above in my comments. I believe they are consistent with ORC’s position.

***Paragraph 169 – “ORC considers this to be an important matter to be worked through. As above, ORC and its expert advisors are willing to participate in any conferencing (or similar process, as may be directed by the Panel) as needed to develop appropriate consent conditions.”***

30. I have recommended changes to the design basis for the Shepherds Silt Pond and the North ELF Stream Diversion and consider these are appropriate to address the erosion and sediment control effects from the Shepherds Engineered Landform. I am available for conferencing online to confirm appropriate updates to the management plans and consent conditions.

**Paragraphs 338 – 340 – “Proposed consent proposes a turbidity limit to apply at SC01 and RS03 of 5 NTU, with this only to be applicable during baseflow conditions (specifically when river flow is below the median).**

**Having the limit only apply to baseflow conditions does not control sediment inputs during rainfall events, when the sediment ponds will actually be operating. It simply requires that the discharge not result in sufficient sediment deposition to increase baseflow resuspension rates. Furthermore, it allows for conspicuous changes in visual clarity when the discharge is operating and it poses a compliance risk to the Applicant as by the time the proposed limit is exceeded the discharge would have occurred and cannot be prevented, and remediation would likely require instream works to remove sediment from the stream bed.**

**An end-of-pipe total suspended solids (TSS), paired with a narrative instream limit, is a better approach to managing sediment pond discharges on the site than the turbidity limit proposed in consent conditions.”**

31. I support the proposed approach by Dr Greer to have end-of-pipe total suspended solids (**TSS**) limit for discharges from silt pond or sediment retention devices (up to the design storm limit) with a conspicuous visual clarity assessment instream. I proposed this is added to the management plan or a consent condition. As per previous comments this will be included in the updated management plans to be provided following expert conferencing.

***Paragraph 117 — GeoSolve has reviewed EGL's assessment and do not agree that the Shepherds silt pond is a low Potential Impact Classification (PIC) dam; GeoSolve state based on current information the PIC should be medium or high based on population at risk and potential loss of life for the Sunny Day Breach Scenario.***

***Paragraph 124 - In summary, ORC does not have any residual concerns about the likelihood of instability of the Shepherds silt pond. The current disagreement about the PIC relates solely to the consequences of the failure, not the likelihood. It would be helpful to resolve the PIC matter via this fast-track process; however, if this cannot be done in an efficient manner, or if the required detailed design information is not available at this time, ORC is of the view that this need not delay the process of deciding this application.***

32. It is possible that the final detailed design of Shepherds Silt Pond is Medium or High. However, it is equally likely in detailed design the dam is buttressed by the Shepherds Service Corridor infill more than that assumed in the application and the PIC remains low, or could even be buttressed so it is not a large dam. The whole process of classification of large dams, PIC assessment, and dam design is addressed by Building Act (2004) and Building (Dam Safety) Regulations 2022. I recommend that this item can be managed through the building consent process.

## **Adjacent Landowners**

### **Ross Hanan**

*Page 2 – “There are serious surface water problems, with inadequate sludge, silt and sediment storage, and treatment and disposal analysis.”*

33. Removal of sediment ponds is a regular maintenance activity for earthmoving operations. Sediment from the silt ponds will be excavated, transported, and placed either in Shepherds Tailings Storage Facility or Shepherds ELF. The sediment in silt ponds will be from the ELF surface and so return this to the ELFs or TSF is normal practice.

*Page 12 – “A silt pond breach could extend to the Clutha/Mata-Au.”*

34. Dam breach assessment is hypothetical to assess the potential consequences. These are then used to set the design criteria to mitigate the risk to a generally acceptable level. A dam like Shepherds Silt Pond that is designed, constructed, and operated in accordance with current industry practice and statutory requirements

(Building Act (2004) and the Building (Dam Safety) Regulations 2022) has an acceptably small likelihood of breaching.

*Page 12 – “Sediment Ponds are also modelled on a one in ten-year rainfall event. This is inadequate, especially in an uncertain climate change affected environment.”*

35. The major permanent silt ponds ( $\geq 2$  years during operations) include Shepherd Silt Pond and Western ELF. Discussion is provided above in response to ORC comments on the design level for sediment retention for these ponds.

### **New Zealand Fish and Game**

*Intense rainfall that overwhelms sediment ponds is unlikely to receive adequate settling or treatment.*

36. I agree rain events greater than the design level for sediment retention will mean reduced detention times and this risks a higher sediment load. However, sediment retention ponds will still function, just at a reduced efficacy. When this occurs watercourse will be in flood when there are naturally higher amounts of sediment transported in the water courses. A notable silt pond (a large dam) is provided to manage disturbed area of Shepherds ELF. The discharge point is also to the stream diversion which is onsite. This is kilometres long and any sediment discharge can be easily cleaned up if it were to occur. There is no wet connection from Shepherd Creek to the Lindis. It is my opinion that the risks are low.

### **Environmental Defence Society Incorporated**

*Seepage through the base of the tailings storage facility, ELFs and waste rock stacks is likely, given that there are no liners proposed and the potential for contamination of shallow groundwater and spring-fed streams is high.*

*Liner should be recommended.*

37. The Shepherds Engineering Landform (which takes the majority of the mined overburden rock) is located in a deep constrained valley within schist rock. Importantly this means groundwater in the schist rock ridges naturally flows to the valley floor. This means that the natural characteristic of the site and proposed layout provides natural containment and the ability to effectively manage seepage from Shepherds Engineering Landform, with appropriate mitigations and controls. Seepage cutoff is provided at the toe of the ELF. It is important to note the Shepherds ELF is located 3.5 km upstream of the aquifers in the outwash gravel terraces (i.e. 3.5 km of constrained rock valley separates the ELF and the aquifers). This is a long distance and provides ample opportunity to effectively collect seepage.

It is my opinion that the natural characteristics and proposed seepage cutoff at the toe of the ELF provides adequate containment and effective seepage collection, and a liner would provide little additional benefit.

A handwritten signature in black ink, appearing to read "E. Torvelainen", is positioned above the printed name.

**Eric Torvelainen**

**17 April 2026**

## **APPENDIX 1: Attachment 1 BOGP EGL Diversions Letter**

EGL Ref: 9702

Matakanui Gold Limited  
Via email

16 April 2026

**Attention:** Cheryl Low

**MATAKANUI GOLD LIMITED  
BENDIGO-OPHIR GOLD PROJECT - FAST TRACK APPROVALS ACT  
RESPONSE TO SECTION 53 COMMENTS  
STREAM AND SURFACE WATER DIVERSIONS LETTER**

## **1.0 INTRODUCTION**

Engineering Geology Limited (EGL) has been engaged by Matakanui Gold Limited (MGL) to provide civil engineering assessment and design services for the surface water and stream diversions for the Bendigo-Ophir Gold Project (BOGP).

This letter summarises the preliminary sizing and details for the proposed diversions that will be operate for more than 2 years within the BOGP and the permanent stream diversion of Shepherds Creek.

This preliminary design letter has been prepared to support an application for resource consent under the Fast Track Approval Act 2024. Detailed design will be undertaken prior to construction.

## **2.0 PROPOSED CLEAN SURFACE WATER AND STREAM DIVERSION CHANNELS**

### **2.1. General**

The site is located in the Dunstan Mountains, 20 km northeast of Cromwell in sub-catchments of the Clutha River and Lindis River. The site location is shown on Figure 01.

The site surface water diversions are primarily situated in the Shepherds Creek (SC) and Rise and Shine (RAS) catchments. Shepherds Creek is a tributary of the Lindis River. Rise & Shine Creek flows into Clearwater Creek and into Bendigo Creek, which are all tributaries of the Clutha River. There is no wet connection of tributaries with the rivers, as base flows infiltrate the outwash gravel terraces and enter the Ardour

and Bendigo Aquifers. The proposed site layout and locations of diversions are shown on the attached Figure 02 for the site operational stage and Figure 03 for site closure.

Diversion channels that will be onsite for more than two years are listed below:

#### Shepherds Catchment

- North TSF Clean Water Diversion Channel (North TSF CWDC)
- South TSF Clean Water Diversion Channel (South TSF CWDC)
- North ELF Stream Diversion (North ELF SD)
- South ELF Stream Diversion (South ELF SD)
- Shepherds ELF Cleanwater Diversion Channel (Shepherds ELF CWDC)
- Shepherds Service Corridor Stream Diversion (Shepherds Service Corridor SD)
- TSF Reinstated Shepherds Creek

#### Rise and Shine Catchment

- SRX ELF Clean Water Diversion Channels (SRX ELF CWDC)
- SRX Clean Water Diversion Channels (SRX CWDC)
- SRX ELF Dirty Water Diversion Channel (SRX ELF DWDC)
- Rise and Shine Stream Diversion (RAS SD)

### **2.2. North TSF Clean Water Diversion Channels (North TSF CWDC)**

The North Clean Water Diversion Channel (NCWDC) runs along the northern side of Shepherds TSF and ends at the TSF crest. Its primary purpose is to divert base flows from springs on the northern slopes above Shepherds TSF around the facility. The length of the channel is approximately 3,865 m and is proposed to be in place throughout the operation of BOGP.

The North TSF CWDC will be formed by cut into rock. In closure, the North TSF CWDC will be decommissioned and water will flow from natural gullies onto the rockfill capped TSF surface, eventually flow to the North ELF SD on the north side of Shepherds ELF. In closure flows off the rehabilitated TSF surface will be attenuated with controlled by either a culvert or weir with flood detention provided over the TSF capped surface. This only occur in rare rainfall events.

### **2.3. South TSF Clean Water Diversion Channel (South TSF CWDC)**

The South TSF Clean Water Diversion Channel (South TSF CWDC) is proposed along the southern side of Shepherds TSF and ends at the TSF Embankment in operation only if detailed water balance requirements require this catchment to be diverted. If this diversion is not constructed, run-off water from these slopes will discharge to the TSF. The length of the channel is approximately 4560 m.

Flows from the South TSF CWDC will be piped across the TSF embankment crest to the North ELF SD. This pipe will be raised progressively with the TSF during operation.

If constructed, the South TSF CWDC will be formed by cut in rock.

In closure, the South TSF CWDC will be decommissioned.

#### **2.4. North ELF Stream Diversion (North ELF SD)**

The North ELF Stream Diversion (North ELF SD) runs along the northern side Shepherds ELF and ends just downstream of Shepherds Silt Pond. Its purpose is to divert clean water around the Shepherds ELF and Shepherds Silt Pond. The length of the channel is approximately 2190 m and is proposed to be in place throughout the operation of BOGP.

The North ELF SD will be formed by cut in rock. In closure it will be rehabilitated and form a permanent stream diversion.

The final level of Shepherds ELF is proposed to be raised to match the level of the channel cut in rock.

#### **2.5. Shepherds ELF Dirty Water Diversion (South ELF DWD)/ South ELF Stream Diversion (South ELF SD)**

The Shepherds ELF Dirty Water Diversion (ELF DWD) is proposed to the south of Shepherds ELF to divert dirty run-off water from the ELF to the Shepherds Silt Pond for treatment. This diversion channel likely be formed in cut and fills along haul roads and will be approximately 2770 m in length.

The ELF DWD is proposed to be in place throughout the operation of BOGP. The South ELF Stream Diversion (South ELF SD) will be established in closure.

#### **2.6. Shepherds ELF Clean Water Diversion Channel (Shepherds ELF CWDC)**

The Shepherds ELF Clean Water Diversion Channel (Shepherds ELF CWDC) is proposed above the Shepherds ELF and takes flows from the top of Jean Creek. It ends at the TSF Embankment. The length of the channel is approximately 700 m and its purpose is to divert clean run-on water around the Shepherds ELF.

Flows from the Shepherds ELF CWDC will be piped across the TSF embankment crest to the North ELF SD in operation. This pipe will be raised progressively with the TSF in operation.

The Shepherds ELF CWDC is proposed to be in place throughout the operation of BOGP and will be formed by cut in rock.

The Shepherds ELF CWDC will be rehabilitated and will remain in place in closure with flows passing on to the rehabilitated TSF capping.

#### **2.7. Shepherds Service Corridor Stream Diversion (Shepherds Service Corridor SD)**

The Shepherds Service Corridor Stream Diversion (Shepherds Service Corridor SD) takes flows from the North ELF SD. It extends downstream of Shepherds Silt Pond and ends at the Shepherds Gorge. The total length is approximately 3100 m.

The Shepherds Service Corridor will fill the valley floor with 6 to 25 m of rockfill. The stream diversion over this length will therefore be formed in rockfill.

Past the process plan the realigned sections will either be constructed in fill or within natural alluvial soils.

Through the gorge at the bottom of the valley the stream diversion will need to be formed against both fill and rock to pass this narrow feature.

Shepherds Service Corridor SD will be established in operation and will remain in place in closure. Rehabilitation requirements for stream uplift are determined by others.

## **2.8. SRX Clean Water Diversion Channel (SRX CWDC) and SRX ELF Clean Water Diversion Channel (SRX ELF CWDC)**

The SRX Clean Water Diversion Channel (SRX CWDC) is proposed above the SRX Open Pit and its purpose is to divert clean run-off water around SRX open pit to discharge to Rise and Shine Creek.

The SRX ELF Clean Water Diversion Channel (SRX ELF CWDC) is located east of the SRX CWDC. Its purpose is to divert clean run-off water around SRX ELF and SRX East (SRE) Open pit to Rise and Shine Creek.

The SRX and SRE Open Pits are expected to operate for 12 to 15 months towards the latter stages of mine operation. The SRX CWDC and SRX ELF CWDC will be constructed before the commencement SRX Open Pit, SRX East Open Pit excavation and SRX ELF construction. It is anticipated these diversions will remain in place for more than 2 years during mine operations. The length of SRX CWDC and SRX ELF CWDC is approximately 730 m and 1300 m and the channels will be formed through cut into rock.

The SRX CWDC will be decommissioned in closure.

The SRX ELF CWDC will be rehabilitated and will remain in place in closure.

## **2.9. SRX ELF Dirty Water Diversion (SRX ELF DWD)**

The SRX ELF Dirty Water Diversion (SRX ELF DWD) is proposed north of the SRE Open Pit and SRX ELF to divert dirty run-off water from SRE and SRX ELF to discharge to the SRX Open Pit. This diversion channel will be formed through cut into rock and will be approximately 900 m in length.

The SRX ELF DWD will be established prior to the construction of SRE and SRX ELF which will operate for approximately 12 to 15 months. This means the DWD will be in place for up to 2 years following which it will be decommissioned in closure.

## **2.10. Rise and Shine Stream Diversion (RAS SD)**

Clean water will be diverted around the Rise and Shine pit via the Rise and Shine Stream Diversion (RAS SD) in operation and will remain in place in closure.

Design details for the RAS SD are summarised in a separate Rise and Shine Pit – Creek Diversion Technical Report (Ref.5).

## **3.0 DESIGN OBJECTIVES AND CRITERIA**

### **3.1. Design Objectives**

The design objectives during operation for clean water diversions is to manage clean surface runoff for a design storm; at closure, they are decommissioned or converted to permanent stream diversions.

Design objectives for permanent stream diversions is to manage clean runoff while meeting freshwater ecology objectives. They are to be designed to remain functional at closure with minimal rehabilitation or maintenance.

Dirty water diversions and sediment controls manage runoff from disturbed areas and haul roads during operation to prevent uncontrolled sediment discharge for a design storm event.

### **3.2. Design Criteria**

#### **3.2.1. Design Events**

Design storm events for diversions and permanent creek realignments are summarised in Table 1 below.

**TABLE 1: SUMMARY OF DESIGN RAINFALL EVENT CRITERIA FOR DIVERSIONS**

<b>Feature</b>	<b>Channel Capacity Design AEP and Duration - Operation</b>	<b>Channel Capacity Design AEP and Duration - Closure</b>	<b>Comment</b>
North TSF CWDC	1 in 10-year, 24 to 72-hour storm	N/A decommissioned in closure	Flows in excess of design capacity will occupy freeboard before spilling to TSF
North ELF SD	1 in 20-year, all durations	1 in 100-year storm, all durations	Flows in excess of design capacity will occupy freeboard before spilling to Shepherds ELF  Permanent stream diversion in closure
Shepherds ELF CWDC	1 in 20-year, all durations	1 in 100-year storm, all durations	Flows in excess of design capacity will occupy freeboard before spilling to TSF  Permanent stream diversion in closure
South TSF CWDC	Nominal based on site water balance requirements	N/A decommissioned in closure	The requirement for this diversion is subject to the outcomes of the water balance model, and may not be needed.
Pipe across TSF Crest	1 in 10-year, 24 to 72-hour storm	N/A decommissioned in closure	
Shepherds Creek SD	1 in 100-year storm, all durations	1 in 100-year storm, all durations	Permanent stream diversion
Process Plant CWDC	1 in 100-year storm, all durations	1 in 100-year storm, all durations	Potential to decommission in closure
RAS SD	1 in 100-year storm, all durations	1 in 100-year storm, all durations	Permanent stream diversion
SRX CWDC	1 in 10-year, 24 to 72-hour storm	N/A decommissioned in closure	Flows in excess of design capacity will occupy freeboard before spilling to SRX Open Pit
SRX ELF CWDC	1 in 10-year, 24 to 72-hour storm	1 in 100-year storm, all durations	Permanent diversion in closure
Dirty water diversions – Shepherds ELF DWD Becomes South ELF SD in closure	Nominal, to be managed on site.	1 in 100-year storm, all durations	Design criteria managed nominally in operation due to constantly changing conditions.  Permanent diversion in closure
Dirty water diversions –SRX ELF DWD	1 in 50-year storm, all durations	N/A decommissioned in closure	Wetlands are present below SRX ELF

<b>Feature</b>	<b>Channel Capacity Design AEP and Duration - Operation</b>	<b>Channel Capacity Design AEP and Duration - Closure</b>	<b>Comment</b>
Shepherds Silt Pond	1 in 20-year storm, all durations	N/A decommissioned in closure	Not a diversion. Design event summarised here for context
Western ELF Silt Pond	1 in 10-year storm, all durations	N/A decommissioned in closure	Not a diversion. Design event summarised here for context

## **4.0 DESIGN METHODOLOGY AND RESULTS**

### **4.1. Hydraulic Assessment**

Design flows have been assessed at various locations for the purpose of diversion channel sizing. Section locations were selected to account of varying gradients and catchment sizes. A summary of the design section locations is presented in Figure 06.

The design flows have been assessed using rainfall depths obtained from the NIWA High Intensity Rainfall System (HIRDS) version 4, for RCP8.5, for period 2031 to 2050 in operation, and for the period 2081-2100 in closure. This is the most extreme climate change scenario. This has been used for the assessment of design flows throughout operation and in closure. A summary of the rainfall depths adopted are presented in Table A1 and A2.

Equivalent runoff coefficients have been assessed using the Curve Number Method as referenced in Auckland Council's TP108 (Ref. 2), and a summary is presented in Table A3.

Rainfall runoff has been assessed with a unit hydrograph approach, and flood routing undertaken using the HEC-HMS modelling programme (Version 4.12). The peak flow and associate section gradient estimates are summarised in Table A4.

### **4.2. Channel Dimensions and Erosion Protection**

The preliminary assessment of channel sizing and freeboard has been undertaken using a combination of the methods described in the 'Design of Roadside Channels with Flexible Linings' by Kilgore & Cotton (2005) (Ref. 3) and 'The Diversion Channel' by The Catchment & Creeks Pty Ltd (2010) (Ref. 6).

A summary of channel sizes, depths and freeboard is presented in Table A5 and A6.

A preliminary assessment of the required erosion protection has been undertaken using the design peak flows and the range of channel slopes anticipated along each alignment. Preliminary riprap sizing has been determined using the methodology outlined in Kilgore & Cotton (2005) (Ref. 3). A Mannings's n of 0.065 has been adopted for riprap.

Indicative armour rock sizes for various channel slopes and widths are provided in Table A6.

## **5.0 CHANNEL DETAILS – OPERATION**

### **5.1. Channels in Rock Cut**

#### **5.1.1. Typical Detail**

The typical cross section details for channels to be primarily formed in rock cut is presented in Figure 05. Cuts are proposed to be formed into slopes of TZ3 schist rock, except SRX and SRX ELF CWDC which will be formed in

TZ4 schist. Cut slope angles will be determined subject to ground conditions, and stability will be assessed using a construction observation approach.

### **5.1.2. Erosion Protection**

Channels formed through cut into rock is inherently resistant to erosion. Armour rock or shotcrete will be used in locations where velocities could result in erosion of bare earth surfaces.

### **5.1.3. Base Flow, Substrate and Seepage**

The following channels are designed to convey the Shepherds Creek base flow:

- North TSF CWDC
- North ELF SD

Sections of the channel with persistent underlying rock defects may require a low permeability lining to reduce seepage and loss of base flow. This can comprise compacted site-won alluvium, a geosynthetic clay liner (GCL) or a combination of both materials.

Under flood flow conditions, most of the water will be conveyed through the channel over a short duration, and seepage is not considered a significant risk. As a result, low permeability lining is required only on the channel bed.

## **5.2. Channels in Rock Fill**

### **5.2.1. Typical Detail**

Typical cross section details for channels to be formed in rock fill is presented in the attached Figure 04. This is primarily relevant to the Shepherds Service Corridor SD.

### **5.2.2. Base Flow and Substrate**

The Shepherds Service Corridor SD is designed to convey the Shepherds Creek base flow. Armour rock will be infilled with smaller sized gravels to mimic naturally occurring substrate onsite. This will provide a suitable surface for ecological rehabilitation of the stream, including riparian planting.

Where space permits, the channel will be widened to allow for shallower side-slopes, riparian planting and other ecological enhancement features.

EGL anticipates a smaller channel will be shaped within the channel bed to convey base flow. This will be sized for the average estimated Shepherds Creek flow rate of approximately 18 l/s during operations (based on operations water balance model results Ref. 4).

### **5.2.3. Seepage**

The base flow across the channel floor is likely to be lost as seepage into the underlying fill without specific detailing of the channel. Where the channel is constructed in fill, it will be lined with a Zone A low permeability layer or GCL across the channel floor. This liner can be constructed using suitable site-won materials or geosynthetic materials where appropriate.

Under flood flow conditions, most of the water will be conveyed through the channel over a short duration, and seepage is not considered a significant risk. As a result, low permeability lining is required only on the channel bed.

## **6.0 CHANNEL DETAILS – CLOSURE**

### **6.1. General**

In closure, the following diversion channels and related elements will be decommissioned:

- North TSF CWDC
- South TSF CWDC
- Pipe across TSF Crest
- SRX CWDC
- SRX ELF DWD

Other diversion channels will be converted from stormwater diversions in operation to permanent stream diversions in closure. Their capacities will be reassessed to convey 1 in 100-year storm peak flows. These are:

- North ELF SD
- Shepherds ELF CWDC
- SRX ELF CWDC

Remaining diversion channels will be established as permanent stream diversions during the operation phase, and do not require an update in design capacity or specific rehabilitation in closure. These are:

- Shepherds Creek SD
- RAS SD

### **6.2. Decommissioning**

Channel decommissioning will involve removal of any channel structures (pipes, culverts, weirs etc.), and cutting of channel side slopes at natural gullies to allow run-off water to flow onto rehabilitated surfaces below before reporting to permanent stream diversions.

### **6.3. Conversion to Permanent Stream Diversions**

The conversion of stormwater diversions to permanent stream diversions involves locally re-sizing and/or reprofiling channels to accommodate closure design flood flows and meet closure ecological objectives.

Rehabilitation of the channel surface may also be required. This could include the addition of engineered substrate to facilitate planting. Details would be similar to that provided in Section 5.2.2.

## **7.0 REVIEW OF CHANNEL OVERTOPPING, AGGRADATION, RE-ROUTING RISKS**

### **7.1. Overview**

Where a storm exceeds the design basis for a diversion channel the risk is that channel containment is lost (i.e. water diverts uncontrolled from the channel). The effect of this depends on the channel location within the wider site. EGL has undertaken a preliminary review of the risk of overtopping, aggradation, and re-routing for channels that will be present onsite for greater than 2 years.

In operation, there is an opportunity to repair damage to temporary or permanent diversion channels as the result of overtopping or erosion.

In closure, permanent stream diversions will be aligned within natural or constructed valleys, such that it lies within the local low point and flows be maintained along the channel alignment even if the capacity of the channel is exceeded.

A smaller base flow channel can be established where practicable to maintain a constant flow and reduce risk of aggradation.

Erosion protection of surfaces adjacent to channels may be required at the Shepherds ELF and Shepherds Service Corridor valley infill to reduce risk of channel re-routing.

### **7.2. Shepherds Catchment**

#### **7.2.1. North TSF Clean Water Diversion Channel (North TSF CWDC) and South TSF Clean Water Diversion Channel (South TSF CWDC)**

These diversion channels could be compromised in flood by overtopping or a local slip in the cut face. The consequence is that the flow diverts into the TSF. The TSF inflow design flood allows for this by assuming that all diversion channels around the TSF fail in an extreme rain event i.e. the design of the TSF allows for water to be safely managed in the impoundment.

#### **7.2.2. North ELF Stream Diversion (North ELF SD)**

This diversion channel could be compromised in flood by overtopping or a local slip in the cut face. The consequence is that the flow diverts onto the ELF surface and routes through the silt pond.

In closure this diversion channel could be compromised in flood by overtopping or a local slip in the cut face; however, it will be constrained by the profile of the ELF and adjacent natural slope i.e. flows will always be maintained along the channel alignment even if the capacity of the channel is exceeded.

#### **7.2.3. Shepherds ELF Clean water Diversion Channel (Shepherds ELF CWDC)**

Initially flows exceeding the design event for the Shepherds ELF CWDC will spill to the ELF and report through the Shepherds Silt Pond. Flows exceeding the pipe across the Shepherds TSF crest will spill to the TSF.

In closure, this diversion channel will be converted to a permanent stream diversion and discharge directed to the capped tailings surface of Shepherds TSF. This channel could be compromised in flood by overtopping or a local slip in the cut face; however, it will be constrained by the profile of the Shepherds ELF and adjacent natural slope i.e. flows will always be maintained along the channel alignment even if the capacity of the channel is exceeded.

#### **7.2.4. South ELF Stream Diversion (South ELF SD)**

During operation this will be a dirty water diversion channel. This will be managed by operations as it will be constantly changing as the Engineered Landform is developed.

In closure this diversion channel will be along the contact of the Shepherds ELF and the natural slopes. This diversion channel could be compromised in flood by overtopping or a local slip in the cut face; however, it will be constrained by the profile of the ELF against the natural ground i.e. flows will always be maintained along the channel alignment even if the capacity of the channel is exceeded.

#### **7.2.5. Shepherds Service Corridor Stream Diversion (Shepherds Service Corridor SD)**

The consequence of flows spilling out of the channel is low as the valley infill is constructed out of rockfill. The exceedances will be rare, short lived and will likely result in overflows from the channel of shallow depths with low velocities due to the relatively wide valley infill. Some of the ecological design features could introduce steps in the profile and potential for local re-routing, which should be considered in detailed design.

#### **7.2.6. TSF Reinstated Shepherds Creek**

In closure the surface flows from the gullies above the TSF will be re-established across the tailings surface. Shallow surface channels will be created. These will be designed for a 1 in 100-year flow. Erosion protection is proposed across the whole tailings surface in case of greater flooding.

### **7.3. Rise and Shine Catchment**

#### **7.3.1. SRX ELF Clean Water Diversion Channels (SRX ELF CWDC)**

This diversion channel could be compromised in flood by overtopping or a local slip in the cut face. If this occurs, it will flow to the pit via the SRX ELF DWDC.

#### **7.3.2. SRX Clean Water Diversion Channel (SRX CWDC)**

This diversion channel could be compromised in flood by overtopping or a local slip in the cut face. If this occurs flows will spill into the SRX Open pit.

#### **7.3.3. SRX ELF Dirty Water Diversion Channel (SRX ELF DWDC)**

Exceedance of this diversion channel capacity will result in spill to RAS Creek. Immediately downstream is a wetland. Due to the presence of the wetland, this diversion channel is sized for 1 in 50-year event covering all durations to reduce likelihood of design exceedance.

#### **7.3.4. Rise and Shine Stream Diversion (RAS SD)**

This is a permanent diversion to remain in closure. If the diversion channel capacity is exceeded flows will spill and be attenuated in the RAS Pit.

### **8.0 CONSTRUCTION METHODOLOGY**

Channels in cut in rock are proposed to be progressively constructed from low to high elevations. This includes:

- North TSF CWDC
- North ELF SD
- South TSF CWDC
- Shepherds ELF CWDC
- SRX CWDC; and
- SRX ELF CWDC

Fill from the rock excavation will be placed locally downslope of the channel and will be used to form any access roads required. Cut slope angles and stability will be confirmed using a construction observation approach.

Shepherds Service Corridor SD is the only channel in fill and is proposed to be progressively constructed from high to low elevations commencing at the Shepherds Silt Pond. The stream diversion will be established in sections towards the Process Plant. Temporary stream diversions will be used around active construction areas to convey base flow to lower undisturbed creek sections before switching to the permanent alignment. This will include pipes and surface channels.

### **9.0 DETAILED DESIGN**

EGL recommends detailed design be undertaken prior to construction by a suitably qualified and experienced professional. Detailed design should include the following:

- Hydraulic channel design, including design flows, channel capacity, and freeboard.
- Assessment of back-scour and channel re-routing risks from overtopping.

- Channel and bank protection design, including sizing, location, and extent of any rock armouring, vegetation, or structural protection.
- Channel geomorphological assessment, demonstrating long-term channel stability to avoid unintended channel re-routing or avulsion.
- Design of ecological enhancement elements.
- Detailed Design Documentation including Design Report, Design drawings, Specification, Construction Monitoring Schedule. Drawings to include plan view, long-sections, and cross-sections at sufficient intervals to illustrate channel form, gradients, and structural elements.

EGL recommends all diversions that are proposed to operate for more than 2 years and permanent stream diversions be constructed in accordance with the approved Detailed Design Documentation. On completion, a Construction Completion Report documenting the as-built channel and protection measures and any variations shall be completed and reviewed by a suitably qualified and experienced professional.

## 10.0 APPLICABILITY


Your Sincerely  
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### Attachments

#### References

#### Tables

#### Figures

Figure 01 Locality Plan

Figure 02 Surface Water and Stream Diversions, Operational Stage - Site Plan

Figure 03 Surface Water and Stream Diversions, Closure Stage - Site Plan

Figure 04 Stream Diversion in Rockfill – Typical Detail

Figure 05 Cleanwater Diversion in Rock – Typical Detail

Figure 06 Summary of Design Sections

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## **TABLES**

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- Table A1 Design Rainfall Depth Duration Frequency, RCP8.5 for the Period 2031-2050
- Table A2 Design Rainfall Depth Duration Frequency, RCP8.5 for the Period 2081-2100
- Table A3 Summary of Equivalent Runoff Coefficients in Operation Stage
- Table A4 Summary of Peak Flow Estimates and Erosion Protection
- Table A5 North TSF Clean Water Diversion Channel Geometry Sizing (for sections cut in rock)
- Table A6 Diversion Channel Geometry Sizing (for sections lined with armour rock)

**TABLE A1. Design Rainfall Depth Duration Frequency, RCP8.5 for the Period 2031-2050 (Unit: mm)**

AEP	Duration (hr)									
	0.17	0.33	0.5	1	2	6	12	24	48	72
<b>1 in 2</b>	3.9	5.7	7.1	10.4	14.9	25.6	34.9	46.3	59.2	67.1
<b>1 in 10</b>	7.4	10.5	12.8	18.2	25.4	41.9	55.6	71.6	89.2	99.6
<b>1 in 20</b>	9.28	13	15.8	22.1	30.7	49.7	65.3	83.2	103	114
<b>1 in 100</b>	14.9	20.4	24.5	33.5	45.4	71.0	91.1	113.0	137.0	149.0

**TABLE A2. Design Rainfall Depth Duration Frequency, RCP8.5 for the Period 2081-2100 (Unit: mm)**

AEP	Duration (hr)									
	0.17	0.33	0.5	1	2	6	12	24	48	72
<b>1 in 2</b>	4.69	6.81	8.48	12.3	17.7	29.6	39.7	51.7	65.1	73.2
<b>1 in 10</b>	8.92	12.6	15.4	21.9	30.5	49	64.1	81	99.4	110
<b>1 in 20</b>	11.2	15.6	19.1	26.7	36.8	58.4	75.4	94.3	115	126
<b>1 in 100</b>	18.1	24.7	29.7	40.6	54.7	83.8	106	129	153	166

**TABLE A3. Summary of Equivalent Runoff Coefficients in Operation Stage**

Return Period (AEP)	Duration (hr)	Rainfall Depth (mm)	Curve Number (CN)		Runoff Depth (mm)			Equivalent Runoff Coefficient		
			Undisturbed <sup>(1)</sup>	ELF <sup>(2)</sup>	Undisturbed	ELF	Silt pond surface	Undisturbed	ELF	Silt pond surface
1 in 10	1	18.2	86	74	5	2	18.2	0.25	0.10	1.0
	2	25.4	86	74	8	4	25.4	0.33	0.16	1.0
	6	41.9	86	74	20	11	41.9	0.47	0.26	1.0
	12	55.6	86	74	30	19	55.6	0.54	0.34	1.0
	24	71.6	86	74	44	29	71.6	0.61	0.40	1.0
	48	89.2	86	74	59	41	89.2	0.66	0.46	1.0
	72	99.6	86	74	68	49	99.6	0.69	0.49	1.0
1 in 20	1	22	86	74	7	3	22	0.30	0.13	1.0
	2	30.7	86	74	12	6	30.7	0.38	0.19	1.0
	6	49.7	86	74	25	15	49.7	0.51	0.31	1.0
	12	65.3	86	74	38	25	65.3	0.59	0.38	1.0
	24	83.2	86	74	54	37	83.2	0.65	0.44	1.0
	48	103	86	74	72	52	103	0.70	0.50	1.0
	72	114	86	74	82	60	114	0.72	0.53	1.0
1 in 100	1	33.5	86	74	14	7	33.5	0.41	0.21	1.0
	2	45.4	86	74	22	13	45.4	0.49	0.28	1.0
	6	71	86	74	43	28	71	0.61	0.40	1.0
	12	91.1	86	74	61	43	91.1	0.67	0.47	1.0
	24	113	86	74	81	60	113	0.72	0.53	1.0
	48	137	86	74	103	79	137	0.75	0.58	1.0
	72	149	86	74	115	89	149	0.77	0.60	1.0

Note:

- (1) CN of 86 is adopted for undisturbed area, assuming the cover type is pasture, grassland, or range-continuous forage for grazing **Hydrologic Soil Group C** under **poor cover hydrologic condition**.
- (2) CN of 74 is adopted for ELF area, assuming the cover type is pasture, grassland, or range-continuous forage for grazing **Hydrologic Soil Group C** under **good cover hydrologic condition**.

**TABLE A4. Summary of Peak Flow Estimates**

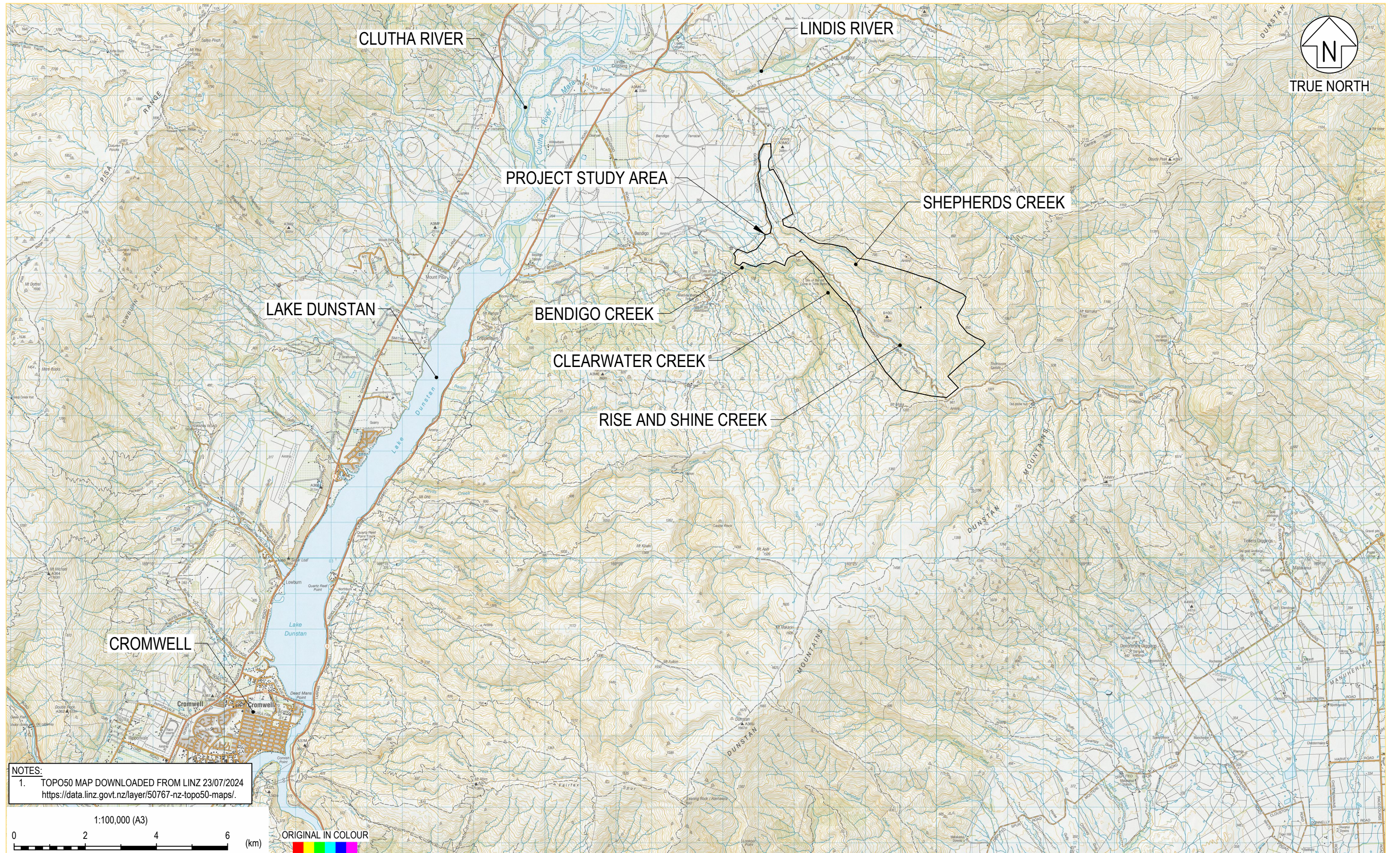
	<b>Gradient (H:1V)</b>	<b>Channel Side Slope (H:1V)</b>	<b>Channel Design Flow (m<sup>3</sup>/s)</b>	<b>Design Return Period (AEP)</b>	<b>Assessed Catchment Area (ha)</b>
<b>North TSF Clean Water Diversion Channel</b>					
S0 – 1	400	1	1.35	1 in 10	122.9
S0 – 2	400	1	1.8	1 in 10	163.4
S1	200	1	3.8	1 in 10	350.6
<b>North ELF Stream Diversion</b>					
S2 – 1	200	1	6.2	1 in 20	586.3
S2 – 2	15	1	6.6	1 in 20	618.0
S2 – 3	160	1	7.0	1 in 20	643.9
<b>Shepherds Service Corridor Stream Diversion</b>					
S3 – 1	12	2.5	17.6	1 in 100	964.6
S3 – 2	18	2.5	17.6	1 in 100	964.6
S4	30	2.5	20.4	1 in 100	1049.7
<b>Shepherds ELF Clean Water Diversion Channel</b>					
Channel	13	1	1.3	1 in 20	47.8
<b>SRX Diversion Channels</b>					
SRX Clean Water Channel 1	8	1	0.49	1 in 10	45.3
SRX Clean Water Channel 2	27	1	0.69	1 in 10	63.0
SRX ELF Clean Water Channel 1	5	1	0.03	1 in 10	3.1
SRX ELF Clean Water Channel 2	17	1	0.96	1 in 10	88.1
Join SRX and SRX ELF channel	4	1	0.72	1 in 10	66.1
SRX ELF dirty water diversion	17	1	0.35	1 in 50	14.5

**TABLE A5. Clean Water Diversion Channel Geometry Sizing (for sections cut in rock)**

	Channel Bottom Width (m)	Channel Water Depth (m)	Adopted Freeboard (m)	Total Channel Depth (m)
<b>North TSF Clean Water Diversion Channel Section</b>				
S0 – 1	0.5	1.05	0.15	1.20
S0 – 2	0.8	1.05	0.15	1.20
S1	1.5	1.05	0.15	1.20
<b>North ELF Stream Diversion</b>				
S2 – 1	2.6	1.05	0.15	1.20
S2 – 2	0.8	0.90	0.30	1.20
S2 – 3	2.6	1.05	0.15	1.20
<b>Shepherds ELF Clean Water Diversion Channel</b>				
Channel	0.5	0.80	0.30	0.60
<b>SRX Diversion Channels</b>				
SRX Clean Water Channel 1	0.50	0.30	0.30	0.60
SRX Clean Water Channel 2	0.60	0.40	0.30	0.70
SRX ELF Clean Water Channel 1	0.50	0.05	0.30	0.35
SRX ELF Clean Water Channel 2	0.60	0.40	0.30	0.70
Join SRX and SRX ELF channel	0.50	0.30	0.30	0.60
SRX ELF dirty water diversion	0.50	0.30	0.30	0.60

**TABLE A6. Shepherds Service Corridor Stream Diversion Channel Geometry Sizing (for sections lined with armour rock)**

Diversion Channel Section	Channel Bottom Width (m)	Channel Water Depth (m)	Adopted Freeboard (m)	Total Channel Depth (m)	Riprap D <sub>50</sub> (mm)	Riprap Thickness (m)
S3 – 1	3.0	1.05	0.30	1.35	400	0.75
S3 – 2	3.0	1.10	0.30	1.40	300	0.60
S4	3.0	1.35	0.30	1.65	300	0.60



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FIGURE 01

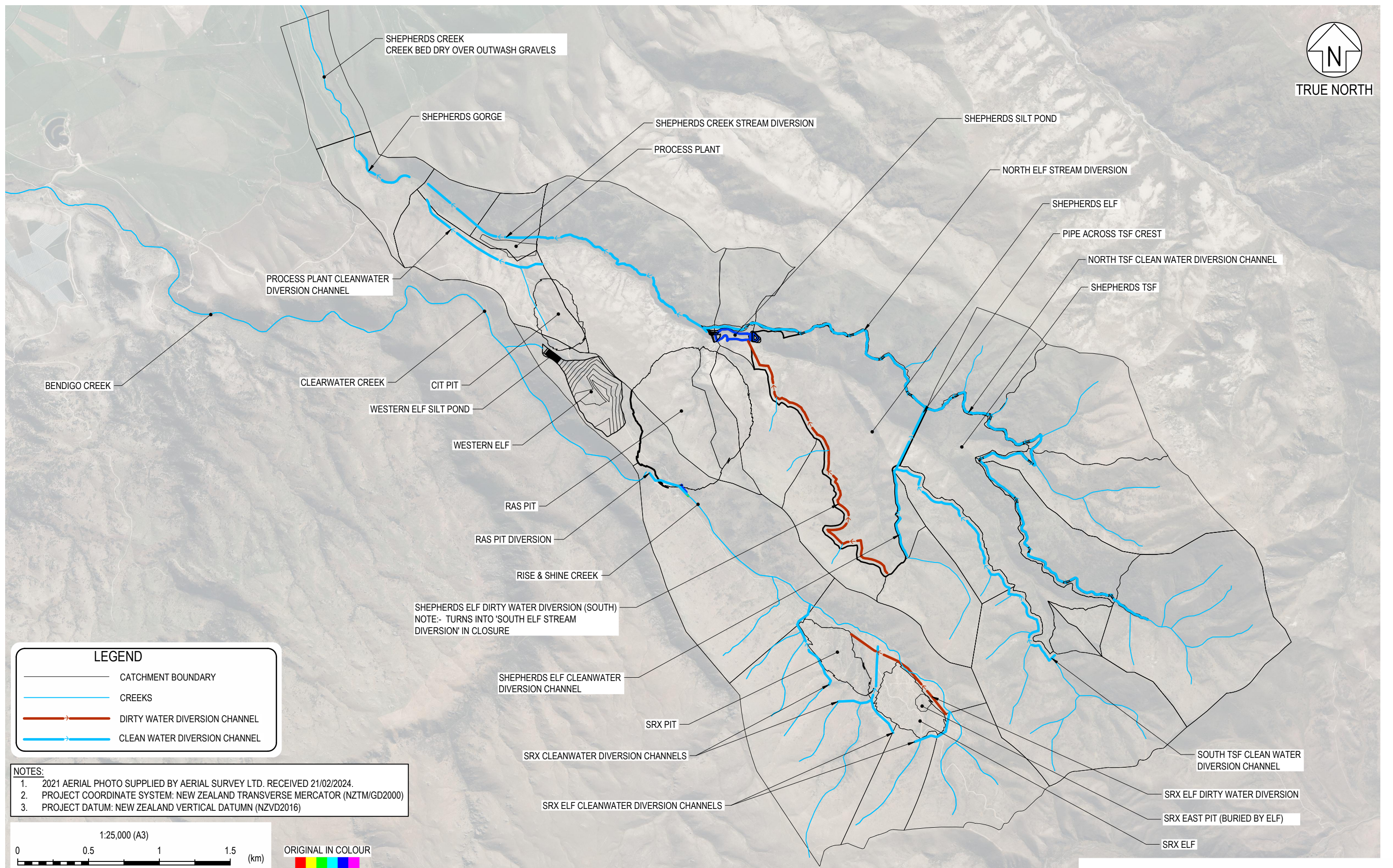


**BENDIGO-OPHIR GOLD PROJECT  
 SHEPHERDS CREEK & RISE & SHINE AREA  
 CLEAN WATER AND STREAM DIVERSIONS  
 LOCALITY PLAN**

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TRUE NORTH



**LEGEND**

- CATCHMENT BOUNDARY
- CREEKS
- DIRTY WATER DIVERSION CHANNEL
- CLEAN WATER DIVERSION CHANNEL

- NOTES:**
1. 2021 AERIAL PHOTO SUPPLIED BY AERIAL SURVEY LTD. RECEIVED 21/02/2024.
  2. PROJECT COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM/GD2000)
  3. PROJECT DATUM: NEW ZEALAND VERTICAL DATUM (NZVD2016)

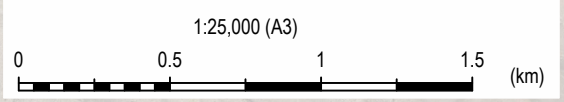


FIGURE 02



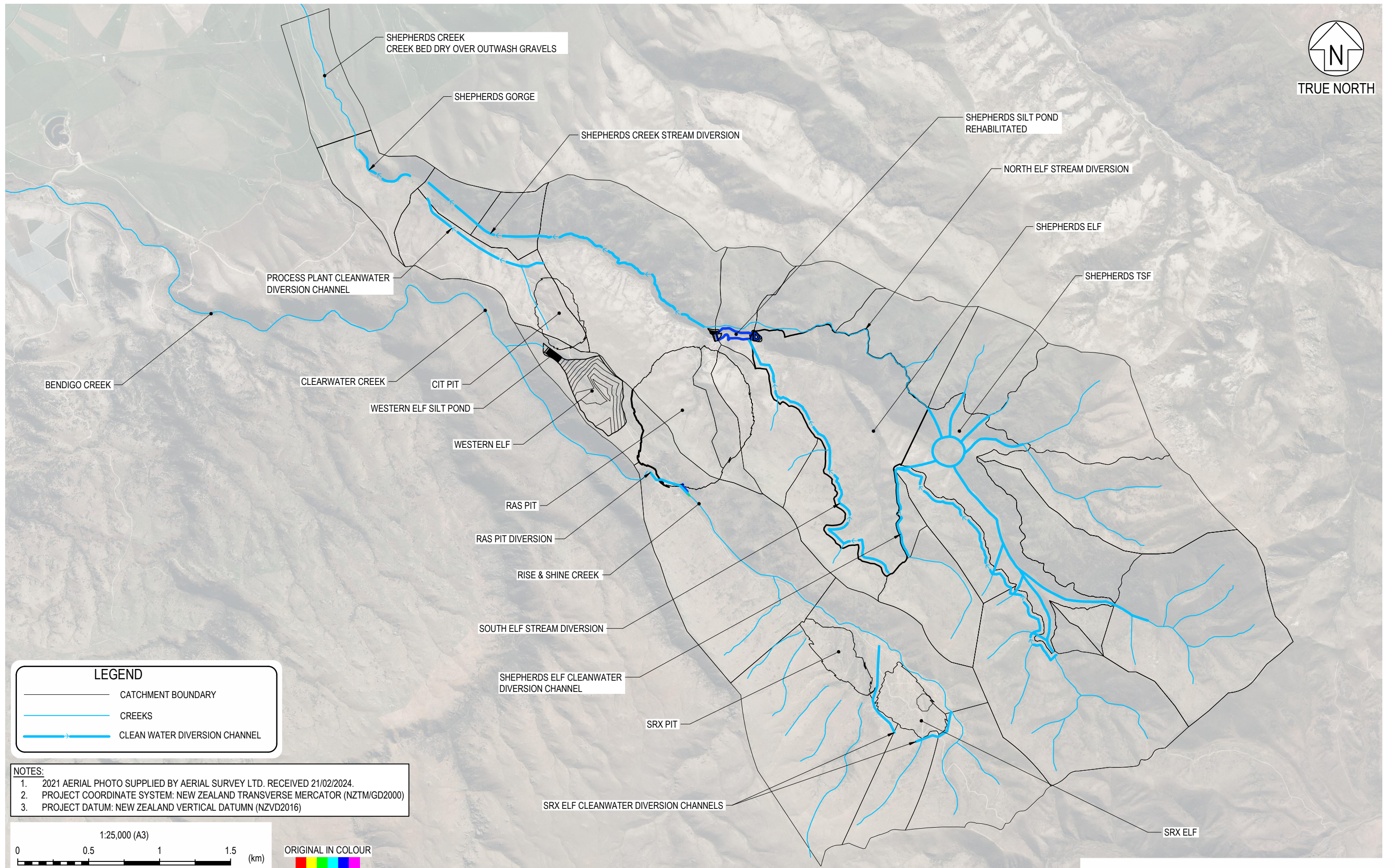
**BENDIGO-OPHIR GOLD PROJECT  
SHEPHERDS CREEK & RISE & SHINE AREA  
SURFACE WATER AND STREAM DIVERSIONS  
OPERATIONAL STAGE - SITE PLAN**

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TRUE NORTH



**LEGEND**

- CATCHMENT BOUNDARY
- CREEKS
- CLEAN WATER DIVERSION CHANNEL

- NOTES:**
1. 2021 AERIAL PHOTO SUPPLIED BY AERIAL SURVEY LTD. RECEIVED 21/02/2024.
  2. PROJECT COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM/GD2000)
  3. PROJECT DATUM: NEW ZEALAND VERTICAL DATUM (NZVD2016)

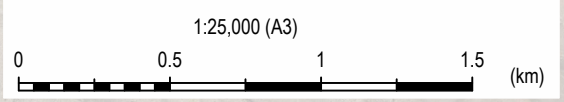


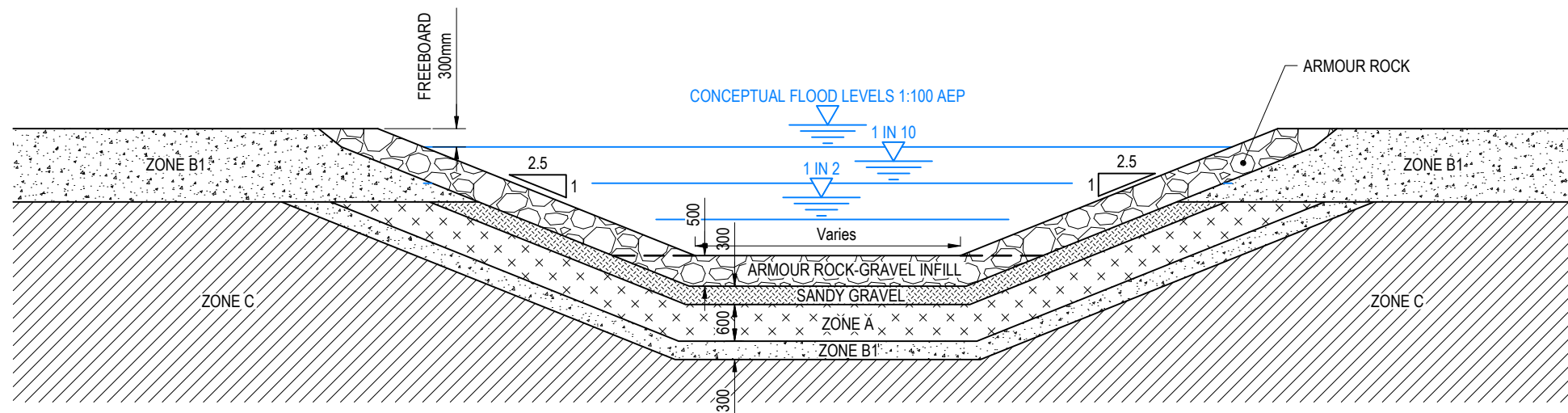
FIGURE 03



**BENDIGO-OPHIR GOLD PROJECT  
SHEPHERDS CREEK & RISE & SHINE AREA  
SURFACE WATER AND STREAM DIVERSIONS  
CLOSURE STAGE - SITE PLAN**

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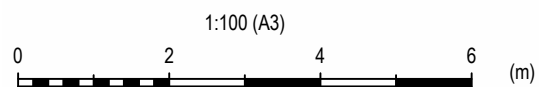
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**A** DETAIL - SHEPHERDS CREEK STREAM DIVERSION TYPICAL DETAIL  
 FIG03 SCALE (A3) - 1:100

LEGEND	
	ZONE A
	ZONE B1
	ZONE C
	SANDY GRAVEL
	ARMOUR ROCK-GRAVEL INFILL

NOTES:  
 1. ALL DIMENSIONS IN MILLIMETRES UNLESS NOTED OTHERWISE.



ORIGINAL IN COLOUR

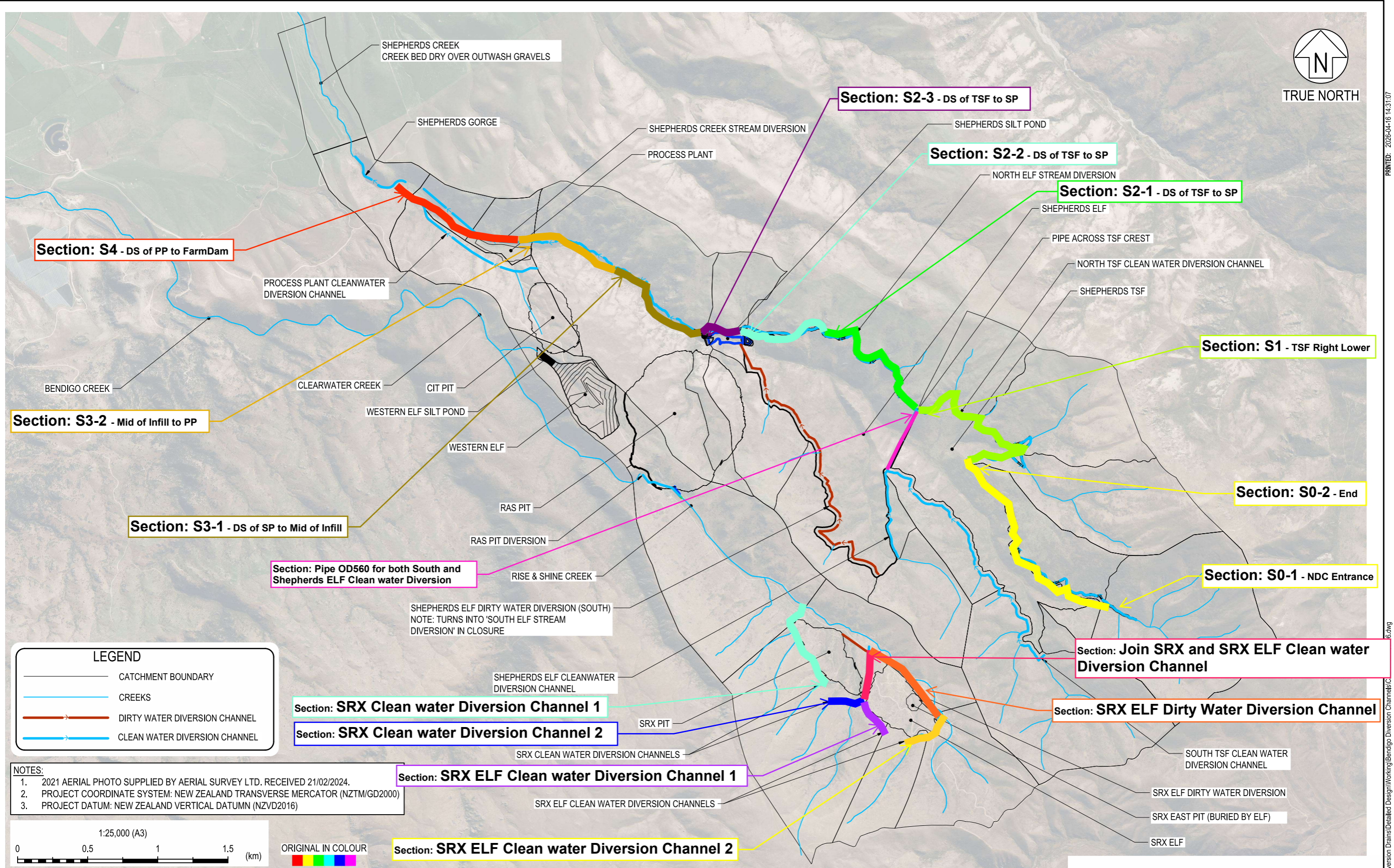
FIGURE 04

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**LEGEND**

- CATCHMENT BOUNDARY
- CREEKS
- DIRTY WATER DIVERSION CHANNEL
- CLEAN WATER DIVERSION CHANNEL

- NOTES:**
1. 2021 AERIAL PHOTO SUPPLIED BY AERIAL SURVEY LTD. RECEIVED 21/02/2024.
  2. PROJECT COORDINATE SYSTEM: NEW ZEALAND TRANSVERSE MERCATOR (NZTM/GD2000)
  3. PROJECT DATUM: NEW ZEALAND VERTICAL DATUM (NZVD2016)

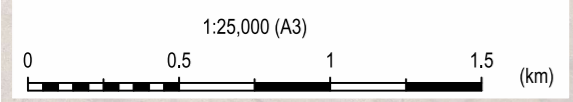


FIGURE 06



BENDIGO-OPHIR GOLD PROJECT  
SHEPHERDS CREEK & RISE & SHINE AREA  
SURFACE WATER AND STREAM DIVERSIONS  
OPERATIONAL STAGE - SITE PLAN

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