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MEMORANDUM

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Cc:	
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Document Title:	BOGP MWSF Seepage Risk Assessment

As an agreed action following the site visit and workshop held with representatives of Otago Regional Council (ORC) on 24 and 25 March 2026, Hydro Geochem Group Limited (HGG) was engaged by Matakanui Gold Limited (MGL) to prepare this memo to review and assess the risk of seepage migration from surface Mine Waste Storage Facilities (MWSFs) of the Bendigo-Ophir Project (BOGP) towards downstream receptors.

This document is intended to support the Assessment of Environmental Effects as part MGL's BOGP Fast Track Act Application.

BACKGROUND

The BOGP includes development of four surface MWSFs (Figure 1, see Attachment A):

- Tailings Storage Facility (TSF).
- Shepherds Engineered Landform (ELF).
- Western ELF.
- SREX ELF.

Without mitigation, generation of Acid and Metalliferous Drainage (AMD) seepage from these MWSFs has the potential negative impact downstream receptors. As such, design of these MWSFs includes seepage collection systems, which are described further in a separate section of this memorandum.

This memorandum assesses the operation and residual risk of MWSF seepage bypassing seepage collection systems by considering the following controlling factors:

- Hydrogeological setting, including sources, pathways, and receptors.
- Seepage collection systems included in the MWSF design.
- Adaptive management, including performance monitoring and contingency measures.

The remaining sections of this memorandum discuss these factors to assess the risk of MWSF seepage reporting to downgradient receptors.

HYDROGEOLOGICAL SETTING

Topography and Drainage

The BOGP is situated within the Shepherds and Clearwater Creek catchments of the Dunstan Mountains. The valley bottom creek channels are deeply incised into the schist bedrock terrain. Both creeks drain to the Clutha River system. All MWSFs are positioned within the creek catchments.

Hydrogeology

Three main hydrostratigraphic units are present at the BOGP:

- Valley bottom alluvium (aquifer).
- Weathered bedrock (aquifer).
- Fresh bedrock (aquitard).

Hydrostratigraphic units details are summarised in Table 1.

Table 1: Hydrostratigraphic unit details.

UNIT	DESCRIPTION[b]	PERMEABILITY	THICKNESS[b] AND DISTRIBUTION
Valley bottom alluvium	Typically unconsolidated, variable weathered gravels with interbeds of sands, silts and clays. This unit was generally observed in the site-specific geotechnical investigations as being located in the valley floor and comprising clays, silts, sands and gravels derived from parent materials upstream of the deposition location.	Primary porosity (pore space). Range between 10^{-6} to 10^{-5} m/s based on material description[a].	Typically <5 m depth. Constrained to valley bottom floor.
Weathered bedrock	Weathering profile of schist bedrock. Locally weathered to a silty gravel, consisting of fines from weathered micas with more competent schist blocks from less micaceous zones of the original rock.	Primary (where extensively weathered) and secondary porosity (fracture flow). Geometric mean of site-specific testing (n=7): 5×10^{-6} m/s[b]	Varies by landscape position. Thinnest in valley flows (few meters), thickest on valley flanks (up to 20 m thick). Project wide.
Fresh bedrock	Permian to Triassic era undifferentiated pelitic and psammitic schist and greenschist sequences.	Secondary porosity (fracture flow). Geometric mean of site-specific testing (n=29): 10^{-7} m/s[bc] Permeability reduces with depth.	>100 m thick. Project wide.

Sources:

a) *Freeze and Cherry (1979).*
b) *EGL (2025a).*
c) *KSL (2025a).*

Groundwater Flow Regime

Based on available data reported in KSL (2025) and EGL (2025a), the following observations are made, typical of valley settings:

- Groundwater levels are deepest on the valley flanks (approximately 25 m below ground level[bgl]) and shallowest in the valley bottoms (<2 m bgl).
- Lateral hydraulic gradients in fresh bedrock are relatively steep, ranging between 0.2 and 0.5 m/m. This suggests a relatively low hydraulic conductivity setting.
- Vertical gradients are typically downwards on valley flanks and upwards in valley bottoms, although variability does exist locally.

Based on these observations, it can be interpreted that at the BOGP, pre-mining groundwater generally flows from topographic highs (e.g., valley flanks) to topographic lows (e.g., local creeks); termed topographically driven flow. During mining and post-closure, pit and underground dewatering may alter this flow pattern locally, but at the scale of the BOGP, topographically driven flow will remain the dominant condition.

Figure 2 (see Attachment A) shows this conceptually for the Shepherds ELF, with any ELF seepage flowing either (i) along the original ground surface or (ii) along shallow weathered bedrock, both reporting to the valley bottom. Once at the valley bottom, seepage will migrate along the valley bottom towards seepage collection systems. Figure 3 (see Attachment A) shows this down valley seepage migration along the Shepherds Creek Valley. The same concepts apply to the Western ELF and SREX ELF in the adjacent catchment.

Potential Source-Pathway-Receptor

Based on the interpreted hydrogeological system described above, potential seepage migration from the MWSFs is summarised in a Source-Pathway-Receptor framework in Table 2. Unmitigated seepage pathways follow a similar pattern migrating along shallow groundwater systems towards potential surface and groundwater receptors. Seepage collection systems and contingency measures are planned to mitigate the risks of seepage migration from MWSFs.

Table 2: MWSF seepage SPR summary.

SOURCE	PATHWAY	POTENTIAL RECEPTOR
TSF seepage	Shallow groundwater system (alluvium and weathered bedrock)	Shepherds Creek. Ardgour aquifer groundwater users.
Shepherds ELF seepage	Shallow groundwater system	Shepherds Creek. Ardgour Aquifer groundwater users.
Shepherds Valley Fill seepage	Shallow groundwater system	Shepherds Creek. Ardgour aquifer groundwater users.
Western ELF seepage	Shallow groundwater system	Clearwater Creek Bendigo Aquifer Groundwater users.
SREX ELF seepage	Shallow groundwater system	Rise and Shine Creek[1]

[1]Note: Any shallow seepage migration not discharging to Rise and Shine Creek would report to RAS Pit.

Groundwater Travel Times

Groundwater travel times provide an indication of how long bypass must occur before it would reach a certain down valley location. Shorter travel time durations (e.g., less than a year) provide a higher risk (all else being equal) than longer durations. Screening level travel time estimates for potential seepage migration from MWSFs to surface water compliance locations are reported in Table 3 (assuming no seepage interception mitigation). Estimates suggest travel times for the larger MWSFs (i.e., Shepherds ELF and TSF) is on the order of a few decades, while 4 to 10 years for smaller MWSFs. Note that travel times to down gradient aquifers would be greater than shown here given the further travel distance.

Table 3: Screening level travel time estimates.

SOURCE	END POINT	DISTANCE	TRAVEL TIME
Shepherds ELF	SC01	3,300 m	26 years
TSF	SC01	4,800 m	38 years
Shepherds Valley Fill	SC01	1,000 m	8 years
Western ELF	RS03	500 m	4 years
SREX ELF	RAS Pit	1200 m	10 years

Note: travel time calculations are based on an average linear velocity of 126 m/year, derived by adopting the following parameter values: K=10^{-5} m/s, a hydraulic gradient of 0.04 m/m (approximate slope of Shepherds Creek), and an effective porosity of 0.1.

SEEPAGE COLLECTION SYSTEMS

Primary[1] seepage collection systems are included in the designs of the MWSFs to minimise the potential for seepage reporting to the receiving environment. Table 4 summarises the elements of these systems (see EGL, 2025b and 2025c for further details).

Table 4: MWFS primary seepage collection system elements.

MWSF	MAX FOOTPRINT (ha)	PRIMARY SEEPAGE COLLECTION SYSTEM
Shepherds ELF	111	• Toe underdrainage system. • Low permeability toe bund (termed Zone A by EGL). • Seepage collection sump.
TSF	61	• Tailings Underdrainage. • Embankment Chimney drain. • Upstream Cutoff drain. • Low permeability core (termed Zone A by EGL). • Collected water piped to Shepherds ELF seepage collection sump.
Shepherds Valley Fill	11	Subsurface drains collect seepage at Run of Mine Pad and Process Plant. Water conveyed to collection point for management.
Western ELF	17	• Underdrainage system. • Collection sump.
SREX ELF	16	Seepage collection at toe of ELF via perimeter drain cut to rock to be directed to collection point management.

[1] The term primary is used in this document to differentiate between seepage collection systems that are 'part' of the facility (e.g., underdrains, chimney drains, cutoff drains, etc.), and those that are contingency measures to intercept unacceptable seepage bypass of primary systems.

The hydrogeological conditions underlying the MWSFs are favourable for high proportions[2] of seepage collection with the systems proposed. Only minor seepage is expected to bypass collection systems in the valley. Groundwater performance monitoring along key potential seepage migration pathways is proposed to ensure any seepage bypass remains at levels that pose a low risk to downgradient receptors. If performance monitoring identifies unacceptable levels of seepage bypass, contingency seepage interception systems (SIS) will be employed. Industry standard SIS components could include one or a combination of:

- Shallow rock filled interception drains (<5 m deep) to intercept near surface pathways.
- Interception wells to intercept deeper groundwater pathways.
- Lower permeability cut off walls to enhance hydraulic control of seepage interception.

In the author's experience, the examples described above have been successfully used to control seepage migration from MWSFs at many mine sites globally. Examples where these have been employed (or identified as selected contingencies) include the Faro Mine Complex and Myra Falls in Canada, Resolution Copper in the USA, and McArthur River in Australia, among many others not publicly available. Further unnamed examples are provided in Fortuna et al. (2021).

The constrained migration pathways within the valley bottom will also allow implementation of secondary / contingency SISs if for some reason the primary collection systems do not perform as intended. In other words, there are multiple opportunities to collect migrating seepage prior to it leaving the upland valleys (if it were to bypass primary collection systems).

From an offsite seepage migration potential risk, the Shepherds ELF seepage collection sump is the most important collection system given it is down valley of the largest MWSFs at the BOGP (Shepherds ELF and TSF) which will contribute the highest load for most potential constituents of concern (PCOC, see MWM, 2025 for example). The conceptual operation of this seepage collection system is shown conceptually in Figure 4 (see Attachment A), where:

- The combination of the low permeability toe bund and underdrain are anticipated to collect the majority of seepage.
- Potential bypass of primary seepage collection systems is monitored for in standpipe piezometers installed in alluvium, weathered bedrock, and fresh bedrock.
- Contingency SIS options are shown that could be employed to intercept seepage that bypasses primary collection systems.

The same concept of performance monitoring informing the need for secondary / contingency SIS measures is proposed for other MWSFs at the BOGP. These smaller MWSF pose a lower risk given their smaller size. The Western ELF is in an incised gully and cutoff is possible at the toe. At the SREX ELF perimeter cutoff can be achieved in rock along the downstream. Subsurface drains will collect Shepherds Creek Valley fill seepage.

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[2] *In the author's experience, collection of a high proportion of seepage from MWSFs is more challenging where they either reside (i) over thicker (e.g., >10 m thick) high permeability aquifers, or (ii) across flatter terrain with less (or no) hydrodynamic containment concentrating seepage to valley bottoms.*

PERFORMANCE MONITORING

Groundwater performance monitoring is proposed (MGL, 2025) at the BGOP. A number of the groundwater monitoring locations have been purposefully selected to monitor for potential bypass from primary seepage collection systems, including:

- Immediately downstream from each of the MWSFs, to provide an early warning of potential bypass. Data collected from these locations will screen for the potential need for contingency measures.
- Adjacent to SC1 and RS03 (surface water compliance sites in Shepherds Creek and Clearwater Creek catchments, respectively). Shallow groundwater monitoring at these locations will allow an understanding of the magnitude of surface and subsurface PCOC load migration off site.

At each monitoring location proposed, they key hydrogeological units identified as potential pathways will be monitored (where present): valley bottom alluvium and/or weather bedrock. Where appreciable saturated thicknesses of each unit is present, nested standpipe individually screening each unit will be installed. Given its higher risk profile, fresh bedrock will also be monitored at the Shepherds Seepage Collection Sump to provide certainty that even lower likelihood pathways (e.g., low K fresh bedrock) are monitored.

Regular interpretation (i.e., annually or more frequently) of routine groundwater sampling (i.e., quarterly) at performance monitoring locations will allow for identification in increasing trends (e.g., breakthrough curves) that may be associated with potential bypass. In the author's professional experience, sulfate and nitrate are often the first PCOCs to be seen break through from seepage migrating from MWSFs. This is due to their conservative transport properties under most conditions. The breakthrough of metals for example is often delayed due to natural attenuation processes. Baseline monitoring indicates sulfate concentration in surface and groundwater to be approximately 15 mg/L or less compared with seepage source terms that are expected to be 10 to 100 time greater (MWM, 2025). In other words, there will likely be a strong signal to noise ratio allowing early detection. Nitrate is expected to have a similar ratio favourable to detecting potential bypass.

CONCLUSIONS

In summary, the risk of seepage migration off the BOGP site to down valley receptors is considered to be low due the following controlling factors:

- The hydrogeological setting and placement of MWSFs within constrained valleys will act to concentrate seepage in valley bottoms, enabling relatively easy collection.
- Primary seepage collection measures are proposed to collect a high proportion of seepage within the MWSFs themselves.
- Groundwater performance monitoring is proposed along key potential seepage migration pathways as close to MWSFs as practicable to allow early warning of bypass risks.
- With constrained valleys that make up the BOGP, potential seepage migration pathways provide redundancy to the seepage collection strategy as they provide for multiple opportunities to implement proven secondary / contingency seepage interception system measures to enhance seepage collection (if performance monitoring indicates they are required).

RECOMMENDATIONS

Despite the interpreted low risk, the following forward works recommendations are made to verify our assessments and support the detailed design of primary seepage collection systems:

- Complete further field characterisation to advance understanding of alluvium and weathered bedrock conditions at primary seepage collection system locations, including:
  - Groundwater levels.
  - Hydraulic conductivity.
  - Thickness and spatial distribution.
- Complete seepage modelling of primary seepage collection systems to improve confidence that high levels of collection are likely.
- Install groundwater performance monitoring and begin sampling as early as practicable to confirm pre-mining groundwater quality conditions of potential seepage migration pathways.

MGL have commissioned workstreams to complete these proposed forward works.

CLOSING REMARKS

Please do not hesitate to contact Ryan Burgess at +64 21 284 3999 or ryan.burgess@hydrogeochem.com.au should you wish to discuss our memorandum in greater detail.

Attachments: Attachment A – Figures

REFERENCES

Engineering Geology Ltd (EGL), 2025a. Bendigo-Ophir Gold Project Site Geotechnical Factual Report. Prepared for Matakanui Gold Limited. Document reference: 9702. Dated 8 August 2025.

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ATTACHMENT A – FIGURES

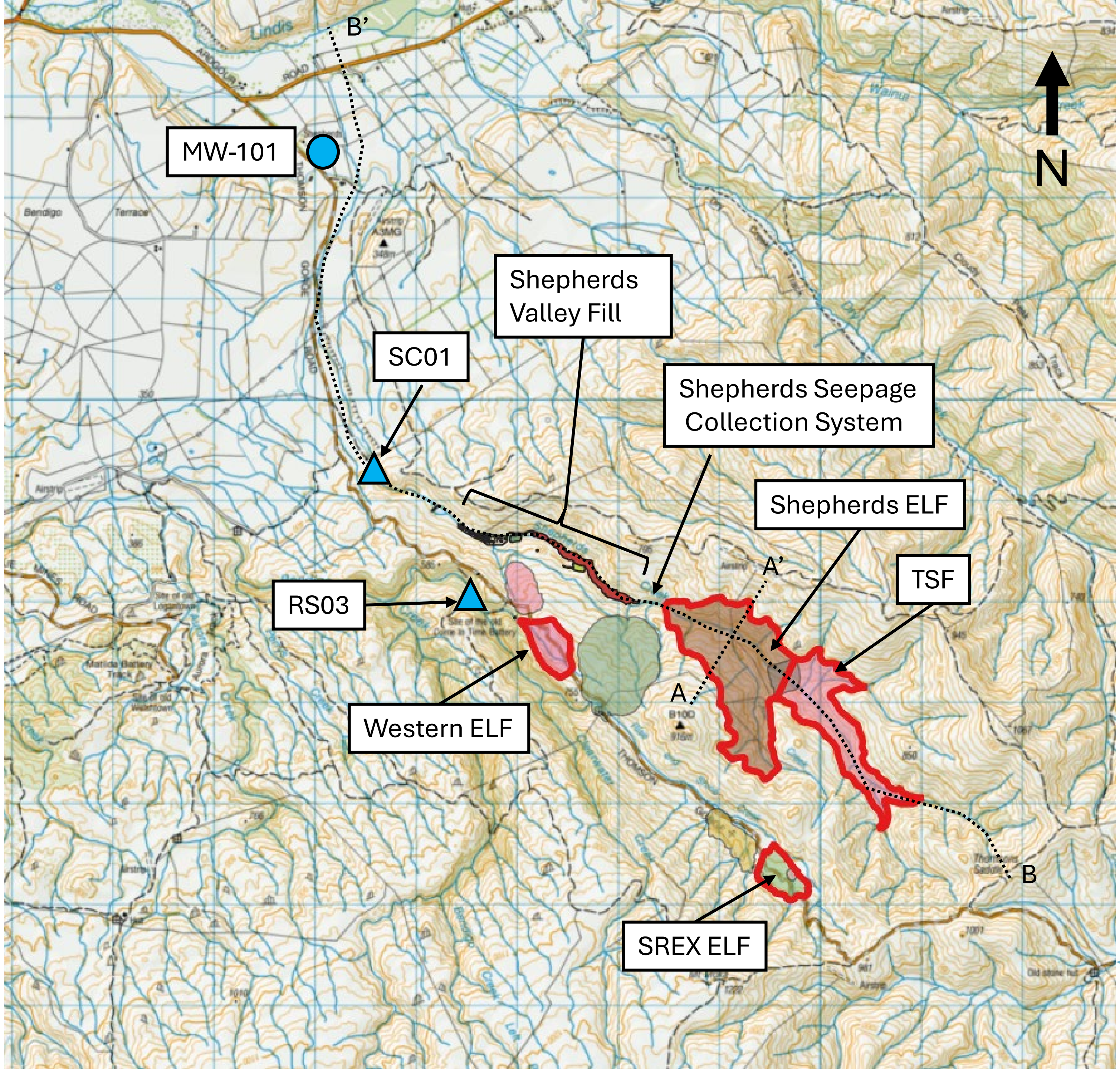

Figure 1

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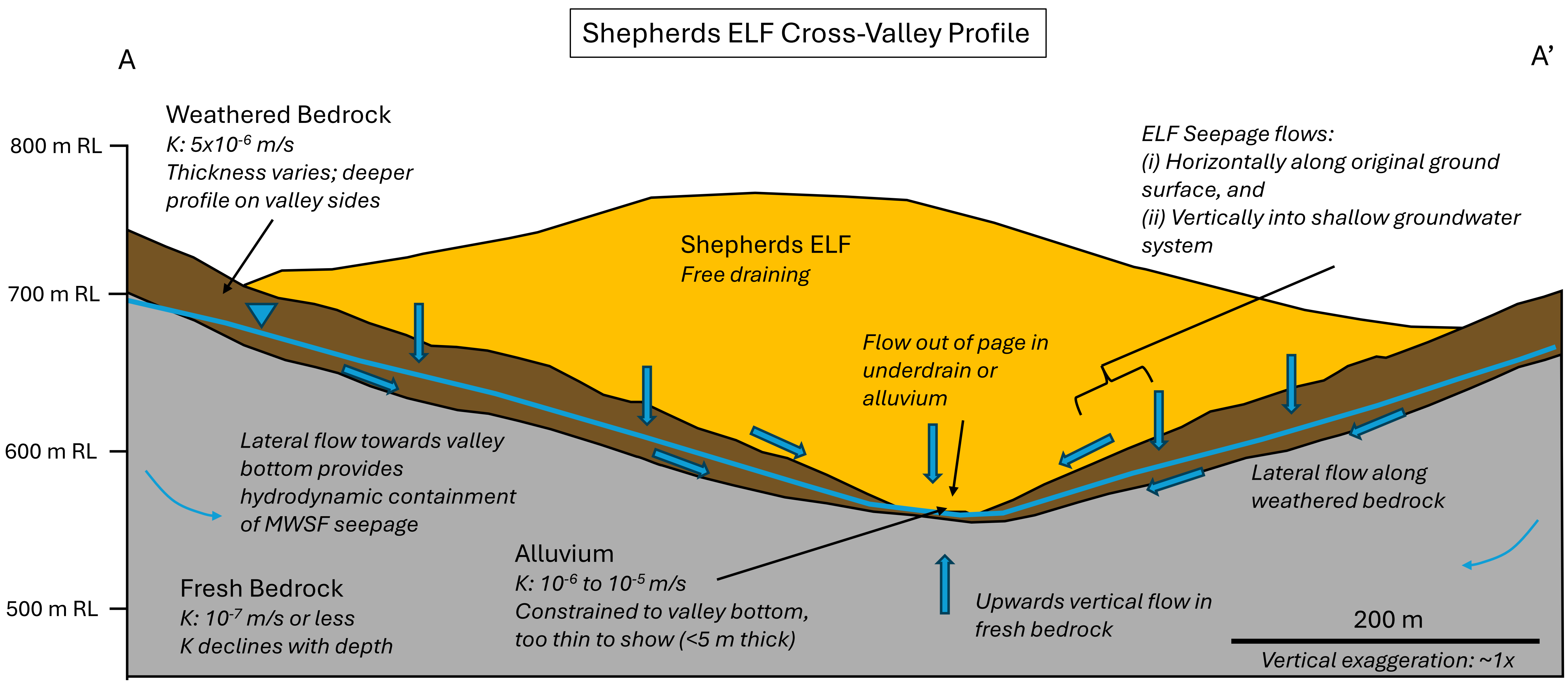

Figure 2

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Shepherds Creek Valley Bottom Profile

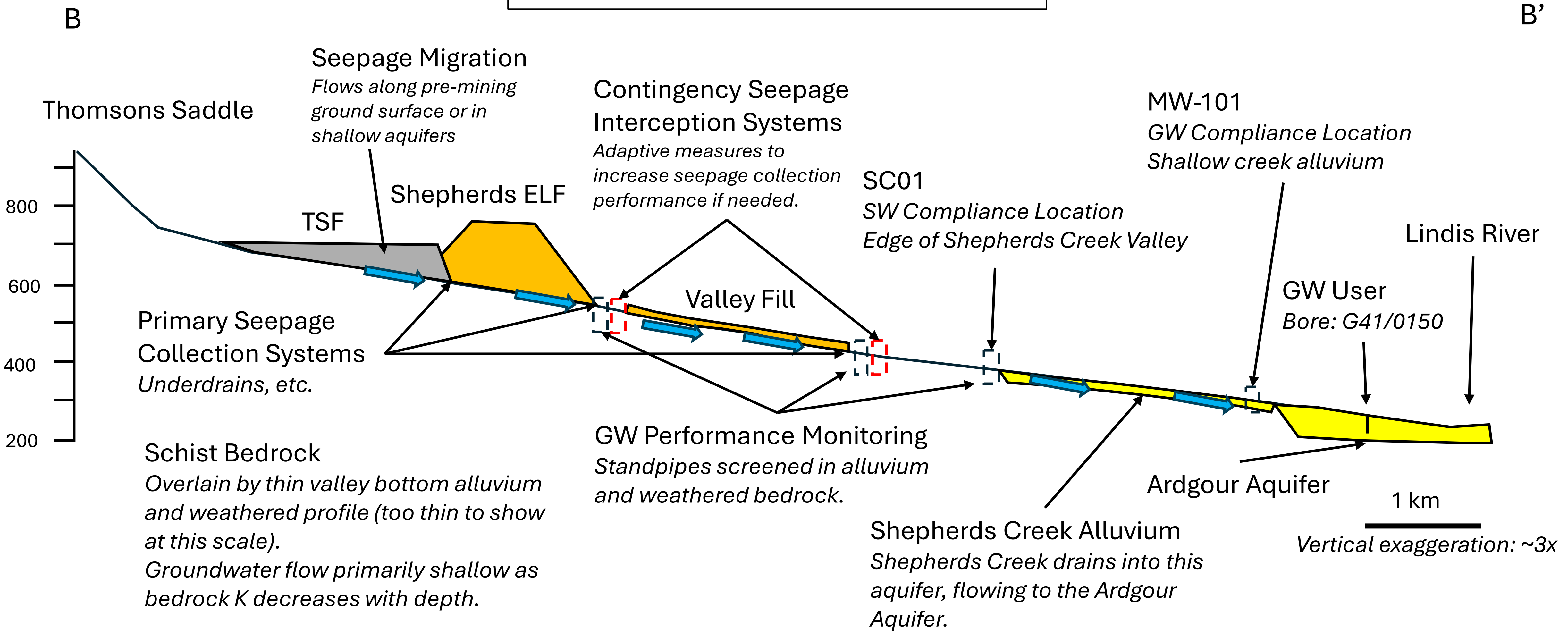

Figure 3

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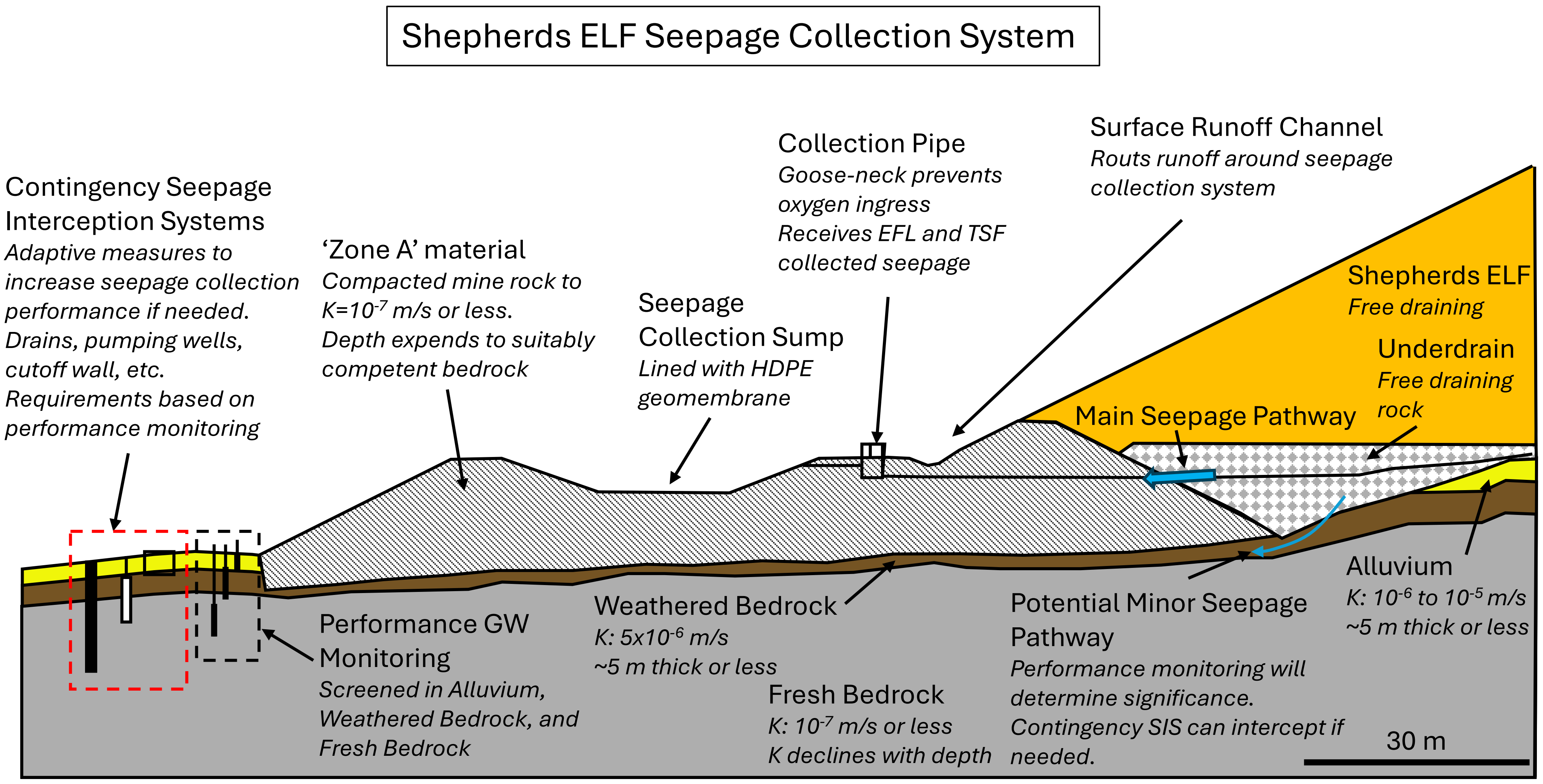

Figure 4

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