PITEAU ASSOCIATES

Geotechnical and Water Management Consultants

EAGLE GOLD HEAP LEACH FACILITY AND CYANIDE MANAGEMENT REVIEW

Prepared for

ENERGY, MINES & RESOURCES, YUKON GOVERNMENT

JULY 2022

PROJECT 4667

Piteau Associates Engineering Ltd
Suite 300 – 788 Copping Street
North Vancouver, BC, Canada V7M 3G6
TEL: +1.604.986.8551
www.piteau.com

RECORD OF AMENDMENTS

This report has been issued and amended as follows:

Issue	Description	Date	Prepared by	Reviewed by
1	Draft for EMR review	May 17, 2022	Mark E. Smith, P.Eng. Chief Advisor, Geotechnical	Krishna Sinha Corporate Consultant
2	Draft for VGC review	(varies by technical memo[1])	Mark E. Smith, P.Eng. Chief Advisor, Geotechnical	Krishna Sinha Corporate Consultant
3	Final to EMR	July 31, 2022	Mark E. Smith, P.Eng. Chief Advisor, Geotechnical	Krishna Sinha Corporate Consultant

[1] Only the draft technical memos (Appendices A to E) were issued to VGC for comment, not the main report as it is a summary of those memos and does not present new information.

1 INTRODUCTION

The Eagle Gold mine is owned and operated by Victoria Gold Corp (VGC) and is located in central Yukon, approximately 375 kilometers north of Whitehorse and near the town of Mayo. Construction of the heap leach facility (HLF) began in 2017 and first gold production occurred in 2019. The project uses conventional open pit mining and cyanide heap leaching in an impounding valley-fill configuration to produce a target of 2,406,000 troy ounces of gold over an expected 13-year operating life. The nominal ore crushing rate is 29,500 tonnes per day (tpd). Ore is stacked on the heap for approximately 275 days per year and leaching continues for 365 days. Eagle Gold is operating under authority of Water Use License QZ14-041-01 (WUL) and Quartz Mining License QML-0011 (QML), collectively referred to herein as “Licenses.”

As requested by Yukon Energy, Mines & Resources (EMR), Piteau Associates Engineering Ltd. (Piteau), has completed a review of various documents related to the operations of the HLF and cyanide management. This review was conducted in phases from January to July 2022, with each phase focused on a set of related documents. The results of each review phase have been documented in a total of five separate technical memos, which were published on the following subjects:

- In-heap Pond pumping test procedure;
- Water balance modeling;
- Cyanide Management Plan (CMP);
- Heap Leach Facility (HLF) Operation, Maintenance and Surveillance (OMS) Manual; and,
- HLF Contingency Water Management Plan (CWMP) and Emergency Response Plan (ERP).

This report was prepared by Mark E. Smith with assistance of Dr. Krishna Sinha, both of Piteau. This report presents only a summary of those technical memos along with tables of recommendations. For more detail, the reader is referred to Appendices A through E, which contain the complete technical memos. Section 3 presents a brief background on each of the five technical memos, and Tables 4.1 through 4.5 summarize the recommendations.

2 BACKGROUND

During the initial two years of operation Eagle Gold experienced a variety of issues related to construction, commissioning, and early-stage operations, ranging from relatively minor issues to reportable cyanide spills and inadequate storage capacity in the ponds. One outcome of these events was the engagement of Piteau by EMR.

As required by the WUL, VGC obtained a variety of reports of external reviews and updates of prior studies, including:

- Annual water balance modeling updates;
- Annual inspection reports from the HLF Engineers of Record (EOR);
- Annual physical stability assessments;
- Review of the cyanide management plan; and,
- Performance review of HLF Phase 1.

These reports helped inform the Yukon Government on a variety of aspects of the project. They also provided significant input for the Piteau review. The licenses also required the preparation and submittal of certain studies, plans and manuals, the review of some of which was the key objective of the Piteau work. These are:

- Annual Water Balance Modeling Report, Forte Dynamics, 25 March 2021;
- Water Balance Modeling for the Eagle Gold Mine Proposed HLP Facility, Final Design, The Mines Group, 16 Jan. 2019;
- Cyanide Management Plan, Strata Gold Corporation, March 2019;
- Summary Audit Report, Review of the Cyanide Management Plan and Implementation, Forte Dynamics, 2 Feb. 2021;
- Five Spill Reports for spills occurring in July 2020, March 2021, June 2021, and July 2021;
- In-heap Pump Testing Procedure, Forte Dynamics, Rev. 0, 21 Feb. 2020;
- Heap Leach Facilities Operation, Maintenance, and Surveillance Manual, Victoria Gold Corp, Jan. 2020;
- HLF Contingency Water Management Plan, Victoria Gold Corp, Jan. 2020; and,
- Heap Leach and Process Facilities Emergency Responses Plan, Strata Gold Corporation., May 2019.

In addition, there were several historic reports provided by EMR. These included the Phase 1 and 2 heap leach facility design reports, the Phase 1 construction report, the original (pre-construction) water balance modeling, the two key licensing documents (QZ14-041-1 and QML-0011), and a variety of inspection and spill reports. In all, these documents total about 9,000 pages. Detailed review of these was not within the scope of this review; however, they were used as references to support Piteau's reviews, which resulted in the five technical memos.

3 TECHNICAL MEMOS

Each technical memo is summarized in this section and the recommendations reproduced in Tables 4.1 through 4.5. The technical memos are included as Appendices A through E.

3.1 In-heap Pond Pumping Test Procedure

This procedure was prepared by Forte Dynamics and is required by WUL Clauses 67 and 68. The purpose of this test is to determine the available storage within the In-heap Pond by obtaining direct measurements of the available porosity within the granular material (crushed stone) filling the pond. The review found that the procedure is generally sound but needs some refinement to produce reliable results.

The specific recommendations are summarized in Table 4.1 and the technical memo is presented in Appendix A. As of July 2022, the test procedure has been revised and the pump test performed. Piteau has not reviewed the results of that testing.

3.2 Water Balance Modeling

Water balance modeling was performed for the heap leach facility as part of final design, then updated annually starting with operations in July 2019. The original water balance model was based on a spreadsheet model prepared by The Mines Group. The annual updates have been prepared by Forte Dynamics and are based on a GoldSim model. GoldSim is a good platform for heap water balance modeling and is successfully used on many other gold projects around the world. One advantage of GoldSim over other platforms is that it can also model a wide range of process factors and be easily integrated into operations.

This review focused on the Forte model prepared in 2021 for operations during 2020 as it was the most recent at the time of review. Just as the technical memo was being finalized, the 2022 model update (for 2021 operations) was published, and that was quickly reviewed principally from the perspective of assessing the total available volume in the ponds as compared to the Desired Available Storage (DAS). However, this was not a detailed review.

The water balance review identified some discrepancies in key model inputs, including the DAS and solution flow to and discharged from the Events Pond. The review also found that the modeling had not reasonably forecast the pond volumes and the potential for infringement on the DAS for the springs of 2020, 2021 and 2022, suggesting that the inputs may be incomplete and that the model requires calibration.

The specific recommendations are summarized in Table 4.2 and the technical memo is presented in Appendix B.

3.3 Cyanide Management Plan

This review included the Cyanide Management Plan (CMP) prepared by Strata Gold Corporation as well as the Summary Audit Report (Forte Dynamics) and Spill Reports (VGC) for cyanide solution spills which occurred during the 13-month period ending in July 2021. The CMP was also compared to the International Cyanide Management Code (Code). As the Forte audit report notes in Section 1, the CMP was developed prior to commissioning of the project and has been in place unchanged since then, even though the permits require annual internal review and updating of the CMP. As such, the CMP is somewhat dated and out of sync with actual operations. The Piteau review found some important inconsistencies between actual management practices on site, the requirements on the CMP, the Code, and industry practices.

The specific recommendations are summarized in Table 4.3 and the technical memo is presented in Appendix C.

3.4 Operation, Maintenance and Surveillance Manual

The OMS Manual is required by WUL Clause 103, and Clause 111, states that "The Licensee must comply with the monitoring programs and studies in the EMSAMP and in the HLF OMS Manual." The OMS is a solid manual with some very good detail. Some portions are light on specifics, and, in a few places, it is incomplete or has gaps between the OMS Manual and both the CWMP and the ERP. The linkage between the OMS Manual and the CWMP and ERP is unclear and the OMS Manual lacks specific triggers for implementation of either the CWMP or ERP, even where such triggers are required by the WUL (see for example WUL Clause 48). Clarified or improved linkages between the OMS and other plans are needed. Further, there are provisions of the OMS Manual which are not being implemented, including (a) generally keeping the Events Pond dry and halting any transfers into the HLF when the DAS volume is not available (Table 6.3-1, Sections 7.9 and 9.2.2), and (b) using manual control of the LDRS pumps rather than level-activated pumps. Critically, there are some issues of non-compliance with the WUL requirements, including regular and extended encroachment in to the Desired Available Storage.

The specific recommendations are summarized in Table 4.4 and the technical memo is presented in Appendix D.

3.5 HLF Contingency Water Management and Emergency Response Plans

The Heap Leach Facility (HLF) CWMP is required according to WUL Clause 102. The ERP is required by QML Schedule B. Overall, both plans form good frameworks and are consistent with the level of detail expected for early operations. The CWMP was last updated in January 2020, a few months following initial gold production. The ERP was last revised in early 2019, prior to completion of construction and commissioning of the HLF. Both plans lack some important as built and operational details, and during the first years of operation the site has likely adapted some of the early plans and procedures to accommodate conditions on the ground. In addition, during the 13 months ending July 2021 the site reported four cyanide-related spills and performed investigations into each, and has been the subject of actions by the Yukon Government related to non-compliance with the WUL requirements related to DAS. Further, in the 2021 annual HLF

Inspection Report[2] the Engineer of Record listed six required and three recommended updates to the OMS. Taken together, this is compelling evidence that it is time to update the plans, addressing those issues as well as the areas specifically discussed in the technical memo.

The specific recommendations are summarized in Tables 4.5a and 4.5b, and in the technical memo presented in Appendix E.

4 RECOMMENDATIONS

This section summarizes the recommendations as presented in the technical memos.

Table 4.1: Summary of Recommended Actions for In-heap Pump Test Procedure

Topic	Recommended Actions
Minimum pond level	1. The test methodology should reflect the minimum pond level (elevation) as set forth in WUL Clause 68.
Test only pre-wetted zones	2. The test should be performed in a manner to ensure that the ore within the recovery portion of the test (testing Protocol B) is at or near field capacity before the start of the test.
Recovery time	3. Sufficient recovery time should be allowed between each test (Protocol A + B) to ensure that steady state conditions are reestablished.
Test precision	4. The test method should be revised to give better precision. This may include some combination of longer test duration and greater flow rate to produce larger changes in pond levels. Alternatively, the effective porosity could be taken as the mean value less 1 or 2 standard deviations.
Drawdown cone	5. The effect of such drawdown on the tested volume should be estimated, and a tolerance on the final measurement be determined (e.g., +/-x% porosity), or verified mathematically that this effect is negligible.
Variation over depth	6. The test should be repeated over a range of pond elevations so that variability in the ore with depth is considered.
Test acceptance criteria	7. Test acceptance criteria should be included in the test method to confirm the validity of the results. For example, the results of each test could be required to be within an acceptable range from the mean value or with an acceptable standard deviation.

[2] Forte Dynamics, Inc., "2020 Annual Inspection of Eagle Gold HLF," 19 March 2021.

Table 4.2: Summary of Recommended Actions for HLF Water Balance Modeling

Topic & Tech. Memo Section No.	Recommended Actions
DAS (2.1.1)	2.1a: Future water balance modeling reports should use the same DAS volumes as set in the WUL and HLF CWMP.
DAS Forecasting (2.1.2)	2.1b: The annual water balance modeling should include all material inputs and outputs from the system including transfers from the LDSP. 2.1c: The model should be calibrated so that past periods are accurately reproduced with respect to pond volumes and infringement on the DAS. This should be done for 2021 (the report to be issued spring 2022) and then again once the In-Heap pond volume verification test is completed, should that test result in a material change in the In-Heap pond capacity. 2.1d: Operations should not transfer solution from the LDSP to the Events Pond in the spring or early summer.
Ore Characteristics (2.2)	2.2a: The actual values for initial and residual moisture content should be used in the model. 2.2b: The ore properties (initial moisture, residual moisture, and active leaching moisture) should be verified in the model calibration process. The initial moisture values from the annual report can be used immediately (i.e. for the 2021 annual water balance model update) and in situ residual moisture content values ideally obtained before the next model update (2022 update).
Process Flow Rates (2.3)	2.3: The forecast water balance modeling should consider the higher flow rate (2,070 m^3/hr) either solely or as an alternative alongside the lower rate (1,500 m^3/hr).
In-Heap Pond Capacity (2.4)	2.4a: The In-Heap pond capacity should be limited in the model at the WUL cap of 74,565 m^3 for the 2021 update, and then revised for future updates based on the results of the field verification testing. 2.4b: The In-Heap Pond capacity verification testing should be completed by mid 2022.

Table 4.3: Summary of Recommended Actions for Cyanide Management

Topic & Tech. Memo Section No.	Recommended Actions
ADR Plant Containment (2.1)	2.1a: The ADR plant should be retrofitted to provide adequate containment as described in the CMP and the ADR Plan, or otherwise as intended by the Cyanide Code and best industry practices. This retrofitting should include measures adequate to ensure full containment. The retrofitting envisioned in this recommendation should be relatively minor work. This should be completed in 2022. 2.1b: The CMP and ADR Plan should be updated to reflect current conditions. 2.1c: The next audit of the CMP should include a site visit, thorough reconciliation of as-built conditions with the design, applicable plans, and license requirements.
Process Solution Spills (2.2)	2.2a: All solution piping mechanical connectors located close to the edge of containment should be retrofitted with guards or shields to prevent spray from escaping. In this context, close means close enough that spray could cross the edge of containment. The retrofitting should be completed within 90 days and new connections should include shielding at the time of installation. 2.2b: All areas where granular material crosses over the edge of containment should be sloped so that the flow direction is into the contained area. Such crossings should only be allowed in areas where the underlying geomembrane liner also slopes into the containment area. Existing crossings should be retrofitted within 90 days and new crossings constructed with appropriate protection. 2.2c: Where there is any risk of solution flowing through or over granular layers beyond containment, the areas should be retrofitted in ways which effectively eliminate this risk in all seasons. Retrofitting should be completed within 6 months, and new installations should include appropriate barriers at the time of construction. 2.2d: Inspection protocols should include routine inspection of mechanical connectors to ensure they are safely located or shielded, and frequent inspection of every location where granular material crosses containment (excluding areas where there is no process solution), possibly every shift. This should be implemented within 30 days. 2.2e: Spills of all nature are most common soon after commissioning major revisions or facility expansions. Special inspections and operator training should be implemented in advance of each expansion or significant change to operations. These special inspections should start before the completion of any major revisions or expansions and continue for 12 months after their completion.
Water Balance Management (2.3)	2.3a: Update Sections 5.3 and 5.4 of the CMP, including Figure 5.3-1, to reflect the current water management system, including flows directed from the LDSP to the EP and discharges from the EP. This should occur with the next CMP update. 2.3b: Protocols should be developed for transfers of storm water to the EP to verify that there is no cyanide in the EP so that the intent of Section 5.4.1 is not violated. This should be revised in the next CMP and EMSAMP updates.

TABLE 4.4: Summary of Recommended Actions for the OMS Manual

Topic & Tech. Memo Section No.	Recommended Actions
Heap Leach Facility Overview (3.1)	3.1a: The OMS and related documents (including the water balance model) should be revised to be more closely aligned with each other, including make-up water and surface run-off storage in the Events Pond and compliance with WUL Clauses 48 and 57. 3.1b: The Emergency Pond should be designed, constructed, and commissioned by the fall of 2022. The pond should be lined and at have a minimum capacity of 90,000 m^3. 3.1c: Using an updated and calibrated water balance as a guide, evaluate whether raincoats should be installed during 2022 to reduce the water entering the system in the spring of 2023. Repeat this each year before winter. 3.1d: Include a map or maps of the instrumentation and monitoring locations in the OMS.
Engineering Design (3.2)	3.2a: Verify that the spillways for both the In-heap Pond and Events Pond meet the requirements of the WUL including the peak flows from future pad expansions and designing the spillway for the critical phase of the HLF. If not, implement the needed revisions or retrofits to ensure they do. 3.2b: Include ice management procedures to ensure that ice does not block the spillways of the In-heap Pond or Events Pond.
Ore Stacking Plan (4.1)	4.1: Reconcile the water balance model updates with the stacking rate and period set forth in the OMS and the limitations of QML-0011 Section 9.6. Clarify the relationship between daily ore stacking rate and stacking days per year to be in compliance with the QML-0011 Section 9.6.
In-heap Pond (4.2)	4.2a: The term “trigger” should be more consistently and accurately used and be consistent with MAC guidelines. 4.2b: Add triggers and actions within the OMS to clarify when the CWMP (and any other relevant plans or SOPs) should be implemented. These would include but may not be limited to providing the required available storage and implementing actions when this encroaches upon the DAS. This recommendation can be combined or implemented concurrently with Recommendation 6.1b. These triggers and response actions should also be consistent with the QPOs in CDA (2019), or QPOs should be addressed separately.
Solution Collection and Delivery System (5.1)	5.1a: The actions should further include analyzing the cause of the leak or break and making changes not just to the affected components but any other components which may pose similar risks. A good example of this would be the subject of the VGC spill report dated July 30, 2021 (leak at a blind flange) where the response should apply to any and all mechanical fitting near the edge of containment. 5.1b: The OMS should include specific procedures to ensure that granular material placed near the edge of the leach pad cannot leave containment nor allow cyanide solution to leave containment.
Earthquake Occurrence (5.2)	5.2 Provide specific criteria to trigger the Earthquake Occurrence inspections such as that set forth in Table 5.2-1 of the ERP.
Flood Event (5.3)	5.3: Include updating the operational water balance model and implementing any measures indicated by the water balance model results in a timely manner.

Topic & Tech. Memo Section No.	Recommended Actions (continued)
Maintenance Schedule and Spare Parts (5.4)	5.4: Include in the OMS (or reference a separate SOP) with specific inventory requirements for critical parts and supplies including the materials to implement the WUL requirement for raincoats starting with Phase 2.
Surveillance and Response, General (6.1)	6.1a: Include the MAC 2019 and 2021 recommendations (as applicable) in the OMS, including the recommendations for Trigger Action Response Plans in Appendix 3 of MAC 2019. 6.1b: The triggers and response actions should be coupled with the existing dam break analysis (and updated when that analysis is updated) for things such as issuing warnings and evacuating the downstream areas (on- and off-site, as applicable) in the event of a risk of heap embankment failure. Evacuation routes should be well removed from expected inundation zones.
Heap Leach Facility Surveillance and Response (6.2)	6.2a: Add a network of survey prisms (with routine surveying and analysis of the results) to the crest and downstream slopes of both the In-heap Pond and Events Pond embankments. 6.2b: Specify the frequency of surveillance for instruments such as inclinometers which cannot be automatically reported. 6.2c: Add a discussion about how critical instrumentation (such as piezometer) data will be retrieved during an extended power outage. 6.2d: Where practical and consistent with shift rotations, group types of instruments or monitoring measurements under the responsibility of the same person or group of people/department. 6.2e: Reconcile the language of Table 9.1-1 with the balance of the language of Section 9 and actual practice.
Instrumentation, Monitoring and Response (6.3)	6.3a: Re-evaluate the trigger levels (pond elevations) and recommended or required response actions to ensure that the operators have adequate time to resolve the problem without advancing to the next condition level. 6.3b: Add trigger levels and actions related to encroachment on the DAS, with the first triggers before the DAS is encroached to allow operators to avoid that condition, and then actions when the DAS is encroached to bring it back into compliance within 30 days along with halting any solution transfers into the process system. These should be consistent with the triggers and actions set forth in the CWMP and ERP. 6.3c: Add triggers to implement the CWMP.

Topic & Tech. Memo Section No.	Recommended Actions (continued)
LDRS Levels (6.4)	6.4a: The In-heap Pond RL 3 responses should be more aggressive and include mandatory actions to reduce the leakage flow rates to RL 2 in a timely manner. RL 3 should also include an engineering assessment of the capacity of the LDRS system to ensure (with a high factor of safety) the flow rates are not pressurizing the secondary (bottom) liner. 6.4b: The Events Pond RL flow limits should be significantly lower for all levels (RL 1 through RL 4), and the response actions for RL 3 should mandate repair of the liner during the next dry season after RL 3 was reported, along with reducing pond water levels to reduce leakage rates in the interim. 6.4c: Both ponds should have response actions which trigger implementation of the CWMP when RL 3 is first reached so that the pond levels can be lowered and thus the leakage rates are also lowered. 6.4d: Level-actuated pumps should be used for the LDRS sumps in both the In-heap Pond and the Events Pond and the flow and level date be recorded and reported. 6.4e: The recommendations resulting from annual inspections, performance reviews, and any other reports or studies required by the WUL or QML should be implemented in a timely manner. This includes implementing all the recommendations of Forte (2021a, b, 2022) and BGC (2019).
Movement (6.5)	6.5a: As required by Forte (2022), at least 8 survey monuments should be installed along the embankment crest. These monuments should be anchored in concrete to reduce noise and detect movement more reliably. 6.5b: Install a second inclinometer in the embankment and add this to the monitoring program with monthly or more frequent monitoring and align the language of this section with Table 9.1-1. 6.5c: Alert levels and actions should be added to the monitoring of the survey monuments and inclinometers. The actions should include increasing the frequency of monitoring in the event there is evidence of movement or embankment distress.
Seepage, Underdrain Monitoring (6.6)	6.6: Add trigger levels and actions.
Event-Driven Inspections (6.7)	6.7: Define all events that trigger Event-Driven Inspection, such as the perception of ground motion from an earthquake, the size or intensity of a large precipitation event, or the size or extent of a slide in the heap (since the lifts are stacked at the angle of repose, small, local slides are very common but generally do not require special inspections).
Comprehensive Dam Safety Review (6.8)	6.8: Increase the frequency of Dam Safety Reviews to less than 5 years after commissioning (ideally with the first occurring in 2022), and then again in the year following each leach pad expansion, and in the years following decommissioning unless the dams are breached and can no longer impound water.

Topic & Tech. Memo Section No.	Recommended Actions (continued)
Reporting (6.9)	6.9a: Include routine updates to the GoldSim water balance model using the monthly date to allow better management of the ponds and reduce the frequency and severity of encroachments into the DAS. The modeling results should also be linked to trigger levels and actions. For example, if the March model update forecasts an April or May encroachment into the DAS, there should be actions set forth to avoid this condition 6.9b: Where flowmeter data is required to be reported under the WUL or QML or are otherwise critical to the safe operations of the HLF to avoid extended data gaps, either redundant flowmeters should be installed, or protocols put in place to ensure that quick repair or replacement occurs without regard to the season.
Back-up Power (6.10)	6.10: Provide information on required back-up power and the generator capacity so that operators can verify that there is always sufficient back-up power available.
Pump Redundancy (6.11)	6.11a: Evaluate the pump redundancy in terms of solution accumulation during an extended multi-pump failure and provide either adequate pond capacity or full replacement kits on site. Also evaluate the risk of a motor control center (MCC) failure and the need for a back-up MCC, spare parts, or anther work around. 6.11b: The Events Pond pump should have a spare (either a complete pump and motor ready to install, or a complete repair kit for both the pump and motor).

TABLES 4.5a: Summary of Recommended Actions for the CWMP

Topic & Section No.	Recommended Actions
Contingency Water Management (3.1)	3.1: Implement triggers linked with response actions consistent with WUL Clause 48 and the recommendations of MAC (2019 & 2021). These triggers and actions should be aligned with and, where applicable, linked to those in both the OMS and ERP. Said triggers and actions, where applicable to the In-heap Pond, should also include measures to protect the embankment.
In-heap Dynamic Storage (3.2)	3.2a: The dynamic storage capacity should be expressed relative to the key variables influencing it and provide operators a number of simple ways to conservatively estimate the capacity using available information. 3.2b: Increasing dynamic storage should also address the impacts on the heap draindown under a pumping system failure scenario when the 5th pump has been placed into service.
Snowpack Management (3.3)	3.3a: Develop specific triggers and response actions to implement the intent of WUL 102c. These should include triggers to implement actions such as snow removal from the heap (and methods for appropriate disposal in accordance with WUL Clauses 89 and 90), and other methods to reduce freshet. 3.3b: Apply an appropriate constitutive model using site-specific data to estimate both peak and seasonal snowmelt volumes. Calibrate this model to verify its reliability and verify there is sufficient pond capacity available to safely store the solutions or implement other management methods such as raincoats to reduce freshet volumes to manageable levels.
Total Storage Vol. Available (3.4)	3.4: A range of available volumes along with key variables influencing them should be cited rather than fixed (and potentially optimistic) quantities for dynamic storage.
Water Treatment Plant (3.5)	3.5a: List the minimum daily capacity of the MWTP to treat HLF solutions as required by WUL Clause 103e. 3.5b: List the required inventory of reagents and supplies along with their quantities to operate the MWTP and provide an inspection and reporting schedule to verify the inventories are maintained. Alternatively, maintain said list in the MWTP operating plan and reference that in the CWMP.
General (3.6)	3.6: Provide triggers in the CWMP for implementing the ERP.

TABLES 4.5b: Summary of Recommended Actions for the ERP

Topic & Section No.	Recommended Actions
General (4.1)	4.1: Update the plan to reflect current operating conditions and as built facilities.
MAC and CDA Recommendations (4.2)	4.2: Add additional detail to the ERP to bring it into alignment with MAC 2019, MAC 2021, CDA 2013, and CDA 2019.
Emergency Classification (4.3)	4.3: Add detail and specificity to the table as consistent with current operations, including the ADR plant.
Emergency Scenarios, Causes, Prevention (4.4)	4.4: Add details and clarify as needed. Tie Preventative Measures, Site Response, Potential Effects, and Follow Up to specific causes.
Evacuation (4.5)	4.5a: Clearly identify authority and trigger events to order evacuation and make it clear that rapid evacuation is essential when there is a potential embankment failure. 4.5b: Update Figure 8.1-1 to reflect as built conditions and revise the evacuation routes to provide quicker access to high ground and to keep evacuation routes away from the inundation zone. Different routes may be needed for different locations. 4.5c: Expand Figure 8.1-1 or provide a second figure to show the entire extend of the inundation zone.

5 LIMITATIONS AND CLOSURE

The information presented in this report represents the conclusions from the Piteau review of the documents and limited discussion with EMR and Eagle Gold staff, along with representatives of First Nation Na-Cho Nyäk Dun. Conditions did not permit a site visit or in-person meetings. This can have a limiting effect on the review process. Follow-up in-person meetings and a site visit are recommended during 2022.

The enclosed technical memos presented in Appendices A through E are an integral part of this report. This report must be interpreted and applied in this context. This report has been prepared for the sole use of the Yukon Government. No warranty is expressed or implied, and no representation of any kind is made to other parties with whom Piteau Associates Engineering Ltd. has not entered into a contract.

We trust the above is adequate for your present needs. Please contact us if you have any questions, comments, or concerns.

Respectfully submitted,

PITEAU ASSOCIATES ENGINEERING LTD.

PERMIT TO PRACTICE
PITEAU ASSOCIATES ENGINEERING LTD.
SIGNATURE
Date
PERMIT NUMBER PP457
Association of Professional Engineers of Yukon

PROFESSIONAL ENGINEER
YUKON TERRITORY
MARK E. SMITH

Mark E. Smith, P.Eng. (YT)
Chief Advisor, Geotechnical
31 July 2022

LIST OF APPENICES:

Appendix A	Technical Memo, In-Heap Pond Pump Testing
Appendix B	Technical Memo, Water Balance Modeling
Appendix C	Technical Memo, Cyanide Management
Appendix D	Technical Memo, OMS
Appendix E	Technical Memo, CWMP and ERP

APPENDICES A-E

TECHNICAL MEMOS

PITEAU ASSOCIATES
GEOTECHNICAL AND
HYDROGEOLOGICAL CONSULTANTS

9060 DOUBLE DIAMOND PARKWAY, UNIT B1
RENO, NV 89521
TEL: (775) 324-8880

www.piteau.com

APPENDIX A

MEMORANDUM

To: Monica Nordling

Cc: Erin Dowd

Date: Final 31 July 2022

From: Mark E. Smith

Re: In-Heap Pond Pumping Test Procedure, Forte Rev. 0, 21 Feb. 2020
Victoria Gold Corp (VGC), Eagle Gold Mine, WUL QZ14-041

Monica,

This memo discusses the results of Piteau's review of the in-heap pond pumping test procedure developed by Forte Dynamics (Forte) and presented in their report revision 0, dated 21 February 2020. This test is required by Clauses 67 & 68 of the Water Use License (WUL: QZ14-041) to verify the available storage capacity within the in-heap pond. Said clauses require that the verification test be performed by the time the stacking of Lift 9 on the heap is completed (forecast by VGC to be Q3 or Q4 of 2022), and further specify that the pond level must be at the greater of 933 m elevation or 2 m above the top of the 12 mm crushed ore zone. This memo was first issued as a draft in February 2022. This final version addresses comments from EMR and VGC.

The procedure developed by Forte is sound but could use some improvement. Specifically:

1. The WUL sets a minimum elevation of the pond level to run this test, which is not reflected in the test method.
2. If the test is performed in a zone of dry ore (i.e., not previously wetted by leaching), the measured porosity would be higher than the effective or available porosity.
3. Repeating test runs in a short period of time, as considered in the test protocol, may not produce steady state conditions, since each test (Protocol A + B) requires at least 2.5 hours to complete. Thus, 5 tests will require at least 12.5 hrs, by which time the effects of changing the PLS pumping rate may be affecting the flow into the in-heap pond (depending in part on where on the heap the solution is being applied).

4. The precision of the test may be inadequate to give reliable results, even with a series of 5 tests. That is, the pond level change may be less than 20 mm[1] after the maximum specified test duration of one hour (calculated for a 10% flow rate change at an initial pond elevation of 933 m).
5. The volume calculations ignore the drawdown cone and the gradient from inflowing PLS.
6. The physical properties of the ore likely change with depth, both because of material gradation and because of the relationship between in situ density and depth, though the test as designed will only determine the effective porosity at one depth.
7. There are several potential variables which could affect the reliability of the test results, including those cited above, though the test method includes no procedures to test the statistical validity of the results.

Recommendations:

1. The test methodology should reflect the minimum pond level (elevation) as set forth in WUL Clause 68.
2. The test should be performed in a manner to ensure that the ore within the recovery portion of the test (testing Protocol B) is at or near field capacity before the start of the test.
3. Sufficient recovery time should be allowed between each test (Protocol A + B) to ensure that steady state conditions are reestablished.
4. The test method should be revised to give better precision. This may include some combination of longer test duration and greater flow rate to produce larger changes in pond levels. Alternatively, the effective porosity could be taken as the mean value less 1 or 2 standard deviations.
5. The effect of such drawdown on the tested volume should be estimated, and a tolerance on the final measurement be determined (e.g., +/-x% porosity), or verified mathematically that this effect is negligible.
6. The test should be repeated over a range of pond elevations so that variability in the ore with depth is considered.
7. Test acceptance criteria should be included in the method to confirm the validity of the results. For example, the results of each test could be required to be within an acceptable range from the mean value or with an acceptable standard deviation.

Additionally, given that there was an infringement on the Desired Available Storage (DAS) in 2020, 2021 and 2022, this verification test should be performed as soon as practical, ideally before the 2022 spring freshet, and the water balance model updated as the results indicate

Closing note: VGC completed this test before finalization of this memo, using a revised testing protocol. The test results have not been reviewed by Piteau.

[1] Typical vibrating wire piezometer (VWP) accuracy is 0.1% of full range with a resolution of about 0.025% (i.e. 12.5 mm resolution for VWP full range of 50 m). This also effects the timing to run the 2nd and subsequent tests as the Protocol states that the pond level must be constant for 15 mins between tests but perceived “constant” is based on the VWP resolution.

Please let me know if you have any comments or questions on this.

Sincerely,

PITEAU ASSOCIATES USA LTD.

Mark E. Smith, P.Eng. (YT)
Chief Advisor, Geotechnical

PITEAU ASSOCIATES
GEOTECHNICAL AND
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9060 DOUBLE DIAMOND PARKWAY, UNIT B1
RENO, NV 89521
TEL: (775) 324-8880

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APPENDIX B

MEMORANDUM

To: Monica Nordling

Cc: Erin Dowd

Date: Final 31 July 2022

From: Mark E. Smith

Re: Annual Water Balance Modeling Report, Forte Dynamics, 25 March 2021;
Water Balance Modeling for the Eagle Gold Mine Proposed HLP Facility, Final Design, The Mines Group, 16 Jan. 2018; and supporting documents
Victoria Gold Corp (VGC), Eagle Gold Mine

Monica,

This memo discusses the results of our review of the water balance modeling reports as provided by your office, with focus on the latest report from Forte Dynamics (25 March 2021, for 2020). Forte issued the 2021 report spring of 2022 but that report was only cursorily reviewed. Additionally, older reports were reviewed more cursorily to provide context; especially relevant are the 16 Jan. 2018 report issued by The Mines Group and the 2019 annual update issued by Forte 30 April 2020. This memo was first issued as a draft in March 2022. This final version addresses comments from EMR and VGC.

1. Summary

The approach used by Forte is appropriate. Water balance models early in a new heap leach project are always subject to uncertainty as some of the most important input parameters can only be determined with high confidence from operating experience and a relatively large data set. That said, the input parameters used by Forte generally seem suited to the purpose but should be subject to continued improvement and calibration to actual system behavior.

This review did identify some areas which are discussed in the following section. In general, the model forecasts underestimate the actual storage volumes and both the degree and length of infringements on the Desired Available Storage.

2. **Discussion Points**

2.1. Desired Available Storage (DAS)

The DAS is the intended minimum available storage to allow safe management of extreme event, as set by water use license (WUL) QZ14-041-1.

2.1.1. DAS Used in Modeling

The water balance modeling report states the DAS for each phase, as shown in Figures 20 and 21. The WUL also specified the DAS for each phase, and these values are also cited in the Heap Leach Facility Contingency Water Management Plan (HLF CWMP, Jan. 2020). Table 2.1 summarizes the values used in each document.

Table 2.1: Comparison of DAS (cubic meters) by Document

HLP Phase	Annual Water Modeling Balance Report, Forte (25 March 2021)	QZ14-041-1[1] & HLF CWMP (Jan. 2020)
1	183,259	198,340
2	195,000	210,640
3-5	212,000	227,340

When asked about this discrepancy in a request for information, VGC indicated that the model is not intended to provide commentary on license values. However, the annual water balance report was submitted as an appendix to the Annual Report and is required by QZ14-041-1, Clause 107, which states *"The Licensee must submit to the Board updated surface water balance and water quality models as part of each annual report. The models must include…any updates to the HLF water balance model…"* As such, the Forte report is reasonably read as a commentary on the WUL requirements. The use of lower DAS volumes than set in the WUL can result in misleading conclusions, especially in respect to actual or forecast infringements on the DAS. Further, the WUL specifically defines DAS (Part A – Definitions) and if an alternative definition is used in the annual water balance modeling report, it should be clearly stated.

2.1.2. Infringement on DAS (Actual and Forecast)

The 2021 report found that *"During the summer of 2020 there was a period in which the Total Available Storage Volume infringed upon the DAS as seen in Figure 20."* Fig. 20 shows that the average Total Available Storage briefly dropped below 150,000 cubic meters (m^3) (about 75% of the DAS) and that the total period of infringement ran from late April to mid-July, or about 2.5 months. When the WUL specified DAS volume is used, the infringement duration is increased to over 3 months. The 2021 VGC monthly reports (from WaterLine) show that the DAS was infringed upon from April 21 to July 20, 2021, essentially the same period as in 2020, and again from late April 2022 until at least the date of this report. Though the WUL prohibits the diversion of water into the circuit when the DAS is not available, such diversions continued in each of the above infringements.

The latest Forte deterministic modelling, on the other hand, predicted no infringements on the DAS for the entire period modeled (to 12/31/2029), with the minimum Total Available Storage predicted to remain above 290,000 m^3 for all of 2021, and above 250,000 m^3 for

[1] The DAS for Phase 1 is expressly stated in the WUL. For Phases 2 through 5 a method of determining the DAS is provided in the WUL and the values from the HLF CWMP are consistent with this methodology. The values cited in this column for Phases 2-5 are from the HLF CWMP.

the life of mine. The stochastic modeling estimated the minimum storage during 2021 to be 240,170 m^3 (1st percentile/lower "tail") and thus the report concluded there was *"no probability of an infringement on the DAS during the summer of 2021."* The 2019 annual water balance modeling update (Forte, 30 April 2020) deterministic forecast predicted no infringement on the DAS, and for 2020 and 2021 the Total Available Storage would be maintained above 290,000 m^3 (Fig. 20). The stochastic model predicted a 3.4% chance of infringing on the DAS for one week (Fig. 36). These predictions are consistent with those from the earlier modeling performed by The Mines Group (Water Balance Modeling for the Eagle Gold Mine Proposed Heap Leach Pad Facility, Final Design, 26 Jan 2018) which found *"There is essentially no risk of encroaching on the DAS during Phase 1, Phase 2, or Phase 3."* That report goes on to say, *"On average the month of May maintains the DAS of about 203,000* m^3 *and the most common value is on the order of 210,000* m^3*…there are circumstances that could occur which would encroach on the DAS and those circumstances are expected to occur about 2.7% of the time."* So far, they have occurred 100% of the time.

The predictions missing the infringements for the first three years of operations raises concerns about the reliability of the model forecasts. This could be a matter of lack of calibration and a need to use better estimates of the In-heap Pond capacity, and is probably related in part, to transferring surface runoff from the Lower Dublin South Pond (LDSP) during periods when that water quality does not meet discharge standards (spring and early summer). In the later regard, the monthly reports do not give volumes transferred before July 2020 and thus do not help debug the issue for that year. However, in 2021 they reported monthly transfers of 83000, 93801, 30685 and 20834 m^3 for April, May, June and July, respectively, for a total of 228,320 m^3. The Quartz MLU/Mining/Water Use Inspection Report of 2020-07-16 references a planned discharge from the Events Pond of 180,000 m^3 for a 45-day period commencing the week of July 27, 2020. The Inspection Report of 2020/08/20 confirmed a discharge of approximately 125,000 m^3 from the Events Pond. The Forte water balance model does not appear to consider either the volumes transferred to the Events Pond from the LDSP or the discharge from the Events Pond, and this could explain the discrepancy between forecast and actual infringements on the DAS in 2020 and 2021.

Recommendations:

2.1a: Future water balance modeling reports use the same DAS volumes as set in the WUL and the HLF CWMP.

2.1b: The annual water balance modeling should include all material inputs and outputs from the system including transfers from the LDSP.

2.1c: The model should be calibrated so that past periods are accurately reproduced with respect to pond volumes and infringement on the DAS. This should be done for 2021 (the report issued spring 2022) and then again once the In-heap Pond volume verification test is completed, should that test result in a material change in the In-heap Pond capacity.

2.1d: Operations should not transfer solution from the LDSP to the Events Pond in the spring or early summer.

2.2. Ore Characteristics

A key input into the water balance model is the initial ore moisture content (as ore is stacked on the heap). Section 2.2 of the Forte report cites this as 1.5%. However, the test data reported in the VGC Annual Report, Appendix D, cites initial moisture contents as high as 5.3% with an average of about 3%. This increases the water inflow to the system by about 18,000 m^3 per month during ore stacking months. Thus, using a value for initial moisture content lower than actual will result in an under-estimate of water in the ponds.

An equally or more important parameter is the ore residual (post-leaching) moisture content. Forte estimated this value using an equation, but this should be replaced with in situ values now that there is some operational history. Small variations in this parameter can result in significant changes to the available storage.

Recommendations:

2.2a: The actual values for initial and residual moisture content should be used in the model.

2.2b: The ore properties (initial moisture, residual moisture, and active leaching moisture) should be verified in the model calibration process. The initial moisture values from the annual report can be used immediately (i.e., for the 2021 annual water balance model update) and in situ residual moisture content values ideally obtained before the next model update (2022 update).

2.3. Process Flow Rates

The Forte model uses 1,500 m^3/hr as the maximum flow rate of solution to the plant. However, the WUL allows up to 2,070 m^3/hr and VGC has indicated an intention to increase gold production (see, for example, the VGC webpage) which will require higher process flow rates. The use of a higher flow rate is expressly considered as part of the HLF Contingency Water Management Plan (HLF CWMP) (Sec. 3.3) and in the HLF Operations, Maintenance and Surveillance (OMS) Plan (Table 6.3-1). Thus, there is an important inconsistency between the water balance model and the operating and contingency plans.

Recommendation:

2.3: The forecast water balance modeling should consider the higher flow rate (2,070 m^3/hr) either solely or as an alternative to the lower rate (1,500 m^3/hr).

2.4. In-heap Pond Storage

The water balance model assumes that the In-heap Pond has a total available capacity of 117,141 m^3 (Sec. 2.4). However, the WUL limits the available storage at 74,565 m^3 unless and until a larger capacity is verified by field testing (QZ14-041-1 Clause 62). The WUL requires that the capacity be verified within 3 months of the completion of stacking of lift 9 of the heap and this is to be repeated after Phase 3 is commissioned (Clauses 70 & 71). As of July 2022, the In-heap Pond capacity verification test has been performed, but Piteau has not reviewed the results.

Recommendations:

2.4a: The In-heap Pond capacity should be limited in the model at the WUL limit of 74,565 m^3 for the 2021 update, and then revised for future updates based on the results of the field verification testing.

2.4b: The In-heap Pond capacity verification testing should be completed by mid 2022.

3.0 Summary of Recommendations

Table 3.1: Summary of Recommended Actions

Topic & Section No.	Recommended Actions
DAS (2.1.1)	2.1a: Future water balance modeling reports should use the same DAS volumes as set in the WUL and HLF CWMP.
DAS Forecasting (2.1.2)	2.1b: The annual water balance modeling should include all material inputs and outputs from the system including transfers from the LDSP. 2.1c: The model should be calibrated so that past periods are accurately reproduced with respect to pond volumes and infringement on the DAS. This should be done for 2021 (the report to be issued spring 2022) and then again once the In-heap Pond volume verification test is completed, should that test result in a material change in the In-heap Pond capacity. 2.1d: Operations should not transfer solution from the LDSP to the Events Pond in the spring or early summer.
Ore Characteristics (2.2)	2.2a: The actual values for initial and residual moisture content should be used in the model. 2.2b: The ore properties (initial moisture, residual moisture, and active leaching moisture) should be verified in the model calibration process. The initial moisture values from the annual report can be used immediately (i.e., for the 2021 annual water balance model update) and in situ residual moisture content values ideally obtained before the next model update (2022 update).
Process Flow Rates (2.3)	2.3: The forecast water balance modeling should consider the higher flow rate (2,070 m^3/hr) either solely or as an alternative to the lower rate (1,500 m^3/hr).
In-heap Pond Capacity (2.4)	2.4a: The In-heap Pond capacity should be limited in the model at the WUL cap of 74,565 m^3 for the 2021 update, and then revised for future updates based on the results of the field verification testing. 2.4b: The In-heap Pond capacity verification testing should be completed by mid 2022.

Please let me know if you have any comments or questions on this.

Sincerely,

PITEAU ASSOCIATES USA LTD.

Mark E. Smith, P.Eng. (YT)
Chief Advisor, Geotechnical

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GEOTECHNICAL AND
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9060 DOUBLE DIAMOND PARKWAY, UNIT B1
RENO, NV 89521
TEL: (775) 324-8880

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APPENDIX C

MEMORANDUM

To: Monica Nordling

Cc: Erin Dowd

Date: Final 31 July 2022

From: Mark E. Smith

Re: Cyanide Management Plan, Strata Gold Corp, March 2019;
Summary Audit Report, Review of the Cyanide Management Plan and Implementation, Forte Dynamics, 2 February 2021; Spill Reports; and supporting documents
Victoria Gold Corp (VGC), Eagle Gold Mine

Monica,

This memo discusses the results of Piteau's review of the Cyanide Management Plan prepared by Strata Gold Corp (March 2019), the Summary Audit Report, Review of the Cyanide Management Plan prepared by Forte Dynamics (2 February 2021), and the Independent Limited Assurance Review of Cyanide Management Plan prepared by SmartAccEss (February 2021). The focus of this technical memo is Forte's 2021 Summary Audit Report as it generally captures the other documents. Additionally, the International Cyanide Management Code (Cyanide Code) and the associated mining guide, protocol, and audit report template were referred to during Piteau's review. This memo was first issued as a draft in May 2022. This final version addresses comments from EMR and VGC.

1. Summary

According to the Scope of Work section of the Forte report, this audit is one of a series of *"annual audits of the Eagle Gold Cyanide Management Plan (CMP) and its implementation following the guidelines of the International Cyanide Management Code for the Manufacture, Transport, and Use of Cyanide in the Production of Gold (Cyanide Code, Code)…The scope did not include a Cyanide Code certification audit, nor did it include a dedicated site visit for the purpose of the audit given the challenges due to COVID-19. Rather, Forte relied on prior site visits and communications with the site team, photographs, electronic document review, and personnel interview to conduct the assessments remotely."* This approach seems reasonable; however, it is expected that future audits will include a dedicated site visit to the extent that Covid-19 pandemic restrictions allow.

As the Forte report notes in Section 1, the CMP was developed prior to commissioning of the project and has been in place unchanged since then, even though the permits require annual internal review and updating of the CMP. As such, the CMP is somewhat dated and out of sync with actual operations. As the operation is still new, this is not a significant concern, nor is it unusual. However, it is expected that this will be remedied soon. The Forte Audit Report does not generally make statements about compliance with the Cyanide Code or otherwise as to the adequacy of the CMP. Rather, the report provides some detail as to how the CMP implements each of the Principals of the Cyanide Code. The Independent Limited Assurance Review (SmartAccEss, February 2021) found that the Eagle Gold Mine substantially complies with the Cyanide Code requirements and references the Audit Report's identification of opportunities for improvement. The Piteau review did identify some areas of concern which are discussed in the following sections.

2. Discussion Points

2.1. Containment System within the ADR Plant

There was a process solution release from the ADR plant on 22 June 2021 (Eagle Gold Project Spill Report, July 2, 2021). This was the third reported spill but the first related directly to the ADR plant. The Root Cause analysis presented in that report identified as the primary root cause *"a change in the routing of process solution, which enabled the introduction of warm caustic barren strip to the tail end of the south CIC train.*" This, in turn, contributed to the formation of precipitate which blinded the fine discharge screens and allowed process solution to overflow onto the ADR plant floor and, ultimately, exit the plant through the ADR southeast bay door (see Photo 1, below, which is an excerpt of Photo 2-1 of the referenced spill report). Figure 4-1, also from that spill report (reproduced below), shows the original and re-routed flows.

Photo 1: Southeast ADR bay door showing flow path from containment (enlarged from Photo 2-1 of the spill report)

Since moving pipes and clogged screens are common in ADR plants, this does not seem to address the actual root cause. The area where the spill occurred was within the ADR plant, but the containment was inadequate to hold this spill. This is in contrast with Section 4.1 of the Forte report (page 14) which states *"Any spillage within the ADR plant are contained within the process plant containment."* Since any part of an ADR plant can be exposed to process solution the primary root cause is the lack of adequate containment, which was missed in the audit.

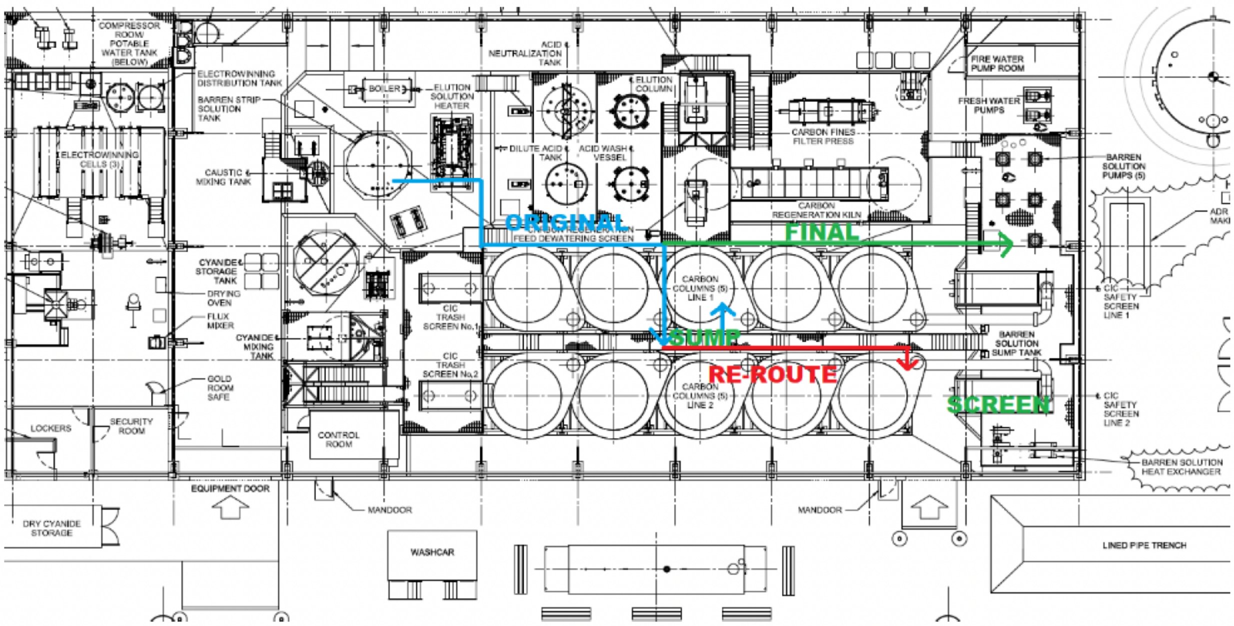


Figure 4-1: ADR Infrastructure Layout

Figure 4.2-1 of the CMP (reproduced below) shows the area of "cyanide containment" as essentially the entire ADR plant (the green outline) including the area of the spill. Section 5.7.5 states *"Process solution pipelines within the ADR area are all installed within concrete secondary containment. All barren solution risers and distribution lines will be placed within the lined footprint of the HLF, thus any potential leakage is captured within the pad, ultimately reporting to the In-Heap Pond. The pregnant and barren solution pipelines to the HLF riser arrangements and associated pumping stations that do not drain directly to the HLF impoundment will be placed in lined trenches, with any leakage, stormwater, or snowmelt accumulation in the liner system reporting to either the HLF impoundment."* Section 2.2 of the ADR Plant Operations Plan (ADR Plan) (StrataGold, March 2019) states *"Beyond concrete containment with the building, The ADR Plant itself rests on pad also designed for cyanide containment. The pad underneath the building is lined and graded such that overflow would be directed into a lined trench that flows back into the Heap Leach Facility (Figure 2.2-2)."* Figure 2.2-2 of the ADR Plan is also reproduced below.

Section 4.2 (Contributing Factors) of the spill report states *"Two main site factors have been identified that contributed to the subsequent release of process solution outside of ADR containment: 1) ADR containment design considers only overflows from defect or damage to the tankage within the ADR (as is common for secondary containment design), 2) pad and road* *grading allowed process solution to escape containment rather than flow to the heap pad."* Item #1 accurately represents the as-built condition of the ADR plant but is inconsistent with the Forte report, the CMP, and the ADR Plan. Importantly, items 1 & 2 are not in compliance with Cyanide Code Standard of Practice 4.1, which states *"Implement management and operating systems designed to protect human health and the environment including contingency planning and inspection and preventative procedures."* That is, since the ADR plant can have process solution anywhere, the plant should include full secondary containment. Further, any potential escape routes from the in-plant containment should be directed towards external containment.

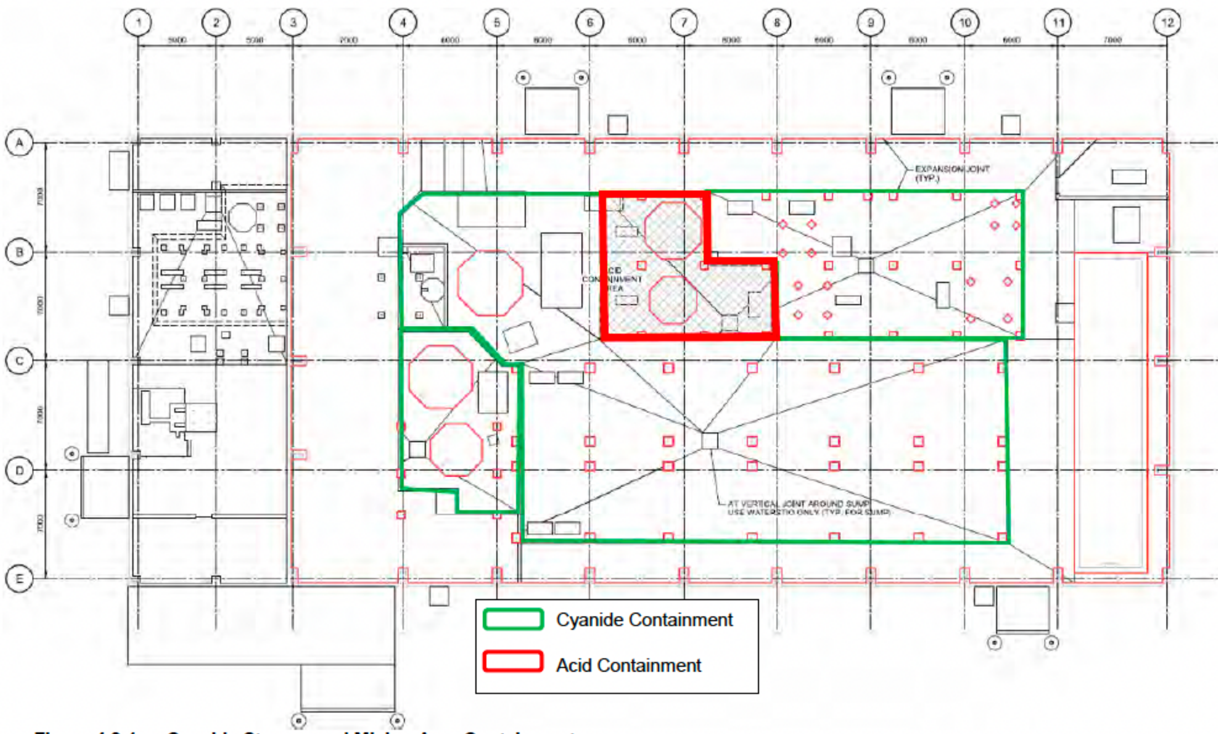


Figure 4.2-1: Cyanide Storage and Mixing Area Containment

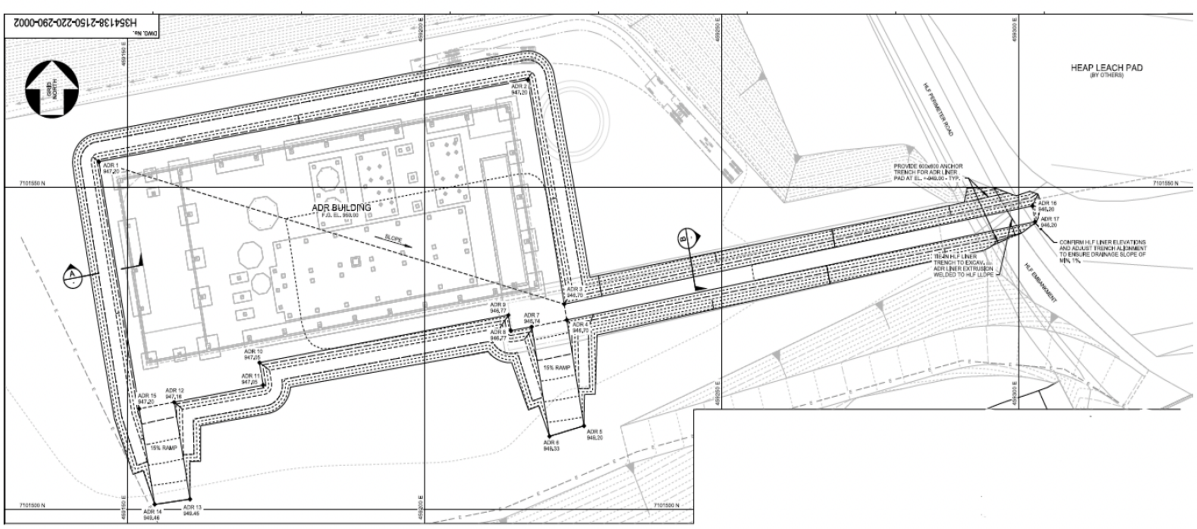


Figure 2.2-2: ADR Plant Secondary Containment

Recommendations:

2.1a: The ADR plant should be retrofitted to provide adequate containment as described in the CMP and the ADR Plan, or otherwise as intended by the Cyanide Code and best industry practices. This retrofitting should include measures adequate to ensure full containment. The retrofitting as envision in this recommendation should be relatively minor work. This should be completed in 2022.

2.1b: The CMP and ADR Plan should be updated to reflect current conditions.

2.1c: The next audit of the CMP should include a site visit, thorough reconciliation of as-built conditions with the design, applicable plans, and license requirements.

2.2. Process Solution Spills

Section 5.7 of the CMP addresses spill prevention and containment measures for process solution tanks and pipelines. In the approximately 12 months ending 30 July 2021 there were 4 reported spills at the site, including the spill at the ADR plant discussed in Section 2.1. Three of these occurred in under 4 months, between mid-March and late July 2021. These spills ranged from minor (70 L estimated volume) to relatively large (30,000 L). The immediate response to each of these was appropriate and effective, and indications are that there were no significant or lasting environmental impacts. The site personnel are to be commended for their quick, professional actions.

However, the frequency of spills and the potential to more effectively integrate lessons learned into operations, must be reflected upon. The frequency is high by industry standards, suggesting some other root cause in terms of management systems and, perhaps, internal inspections. It could be that since heap leaching is new in the Yukon there may not be the institutional knowledge (e.g., in other mining districts, like Nevada, there is an existing experienced work force) and this may simply be a learning curve for the Yukon mining industry. In which case the solution is timing and training. Regarding lessons learned, there have been some changes implemented in response to these spills, but it is not clear if these have been adequate. The ADR plant spill was addressed in detail in the prior section. The other three spills are addressed briefly below.

The spill of 30 July 2021 was caused by a leak in the gasket of a blind flange which sprayed beyond the edge of the HLP containment. Overspray is a very common source of spills in heap leaching. The site response was to add a deflector to stop any future spray from leaving containment, which is a common and appropriate response. Every mechanical connector in a process line poses this same risk. These include mechanical couplers, valves, and meters. Any such connectors located close enough to the edge of containment for spray should be retrofitted with shields or guards, and all new connectors should include them at the time of installation.

The spills of 21 July 2020 and 15 March 2021 have similar root causes. Specifically, process solution was able to flow out of the HLP containment via the granular material on top of the pad. This is perhaps the most common mechanism for spillage from heap leach pads and it is impractical to avoid having granular material connect the contained area with outside. But it is possible to prevent solution following these connections to exit containment. Robust training and internal inspections are required to achieve this, and part of the issue at Eagle Gold Mine may be that the site personnel had not developed an eye for risky scenarios.

Recommendations:

2.2a: All solution piping mechanical connectors located close to the edge of containment should be retrofitted with guards or shields to prevent spray from escaping. In this context, close means close enough that spray could cross the edge of containment. The retrofitting should be completed within 90 days and new connections should include shielding at the time of installation.

2.2b: All areas where granular material crosses over the edge of containment should be sloped so that the flow direction is into the contained area. Such crossings should only be allowed in areas where the underlying geomembrane liner also slopes into the containment area. Existing crossings should be retrofitted within 90 days and new crossings constructed with appropriate protection.

2.2c: Where there is any risk of solution flowing through or over granular layers beyond containment, the areas should be retrofitted in ways which effectively eliminate this risk in all seasons. Retrofitting should be completed within 6 months, and new installations should include appropriate barriers at the time of construction.

2.2d: Internal inspection protocols should include routine inspection of mechanical connectors to ensure they are safely located or shielded, and frequent inspection of every location where granular material crosses containment (excluding areas where there is no process solution), possibly every shift. These protocols should be implemented in 30 days.

2.2e: Spills of all nature are most common soon after commissioning major revisions or facility expansions. Special inspections and operator training should be implemented in advance of each expansion or significant change to operations and continued for about 12 months after commissioning.

2.3. Water Balance Model

The water balance model is the subject of a separate technical memo, but since water balance management is discussed in the CMP (Section 5.3), some specific related issues are pointed out here. This section includes a schematic of the model as Figure 5.3-1, reproduced below. However, there is an important connection missing: water from the Lower Dublin South Pond (LDSP) is periodically pumped to the Events Pond (EP) to avoid discharging non-compliant water from the LDSP. Surplus surface water thus accumulated in the EP is occasionally discharged from the process circuit without treatment (i.e. #14 of Fig. 5.3-1, but not to treatment). Neither of these flows are reflected in the water balance model and that has contributed to extended periods of infringement on the Desired Available Storage (DAS) in the Events Pond during 2020 and 2021. A minor issue is that the diagram identifies the flow from the ADR to the HLF (#19 of Fig. 5.3-1) as "PLS to HLF." This is not usually PLS but rather barren solution.

The transfer of solution from the LDSP to the EP is contrary to the language of CMP Section 5.4.1 Prevention Measures for Open Ponds, which states *"The Events Pond will be maintained empty except to contain and temporarily store exceptional rainfall events or overflows from the in-heap pond."* However, such exclusiveness in terms of use of EP is in the context of protecting wildlife, and so long as the EP has never been used to store process solution the risk to wildlife from these transfers should be minor.

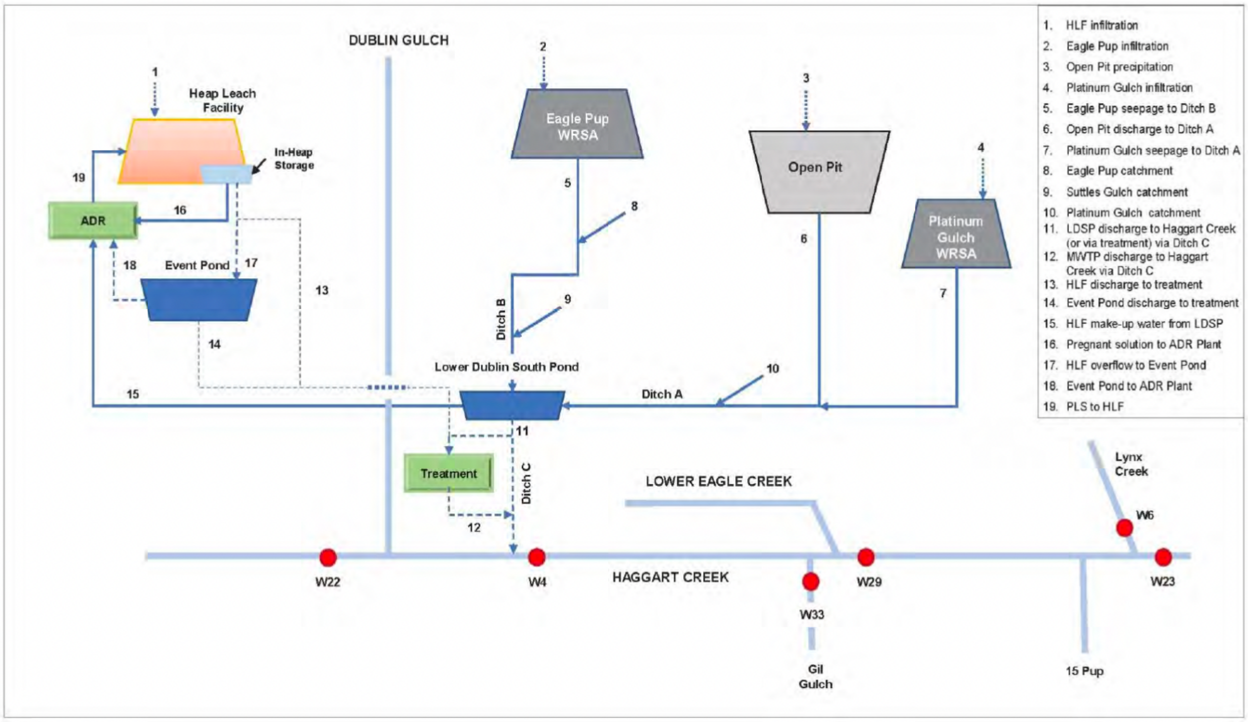


Figure 5.3-1: Site Water Balance Model

Recommendation:

2.3a: Update Sections 5.3 and 5.4 of the CMP, including Figure 5.3-1, to reflect the current water management system, including flows directed from the LDSP to the EP and discharges from the EP. This should occur with the next CMP update.

2.3b: Protocols should be developed for transfers of storm water to the EP to verify that there is no cyanide in the EP so that the intent of Section 5.4.1 is not violated. This should be revised in the next CMP and EMSAMP updates.

3.0 Summary of Recommendations

Table 3.1 presents a summary of the actions recommended herein, along with the suggested timing for their implementation.

Table 3.1: Summary of Recommended Actions

Topic & Section No.	Recommended Actions
ADR Plant Containment (2.1)	2.1a: The ADR plant should be retrofitted to provide adequate containment as described in the CMP and the ADR Plan, or otherwise as intended by the Cyanide Code and best industry practices. This retrofitting should include measyures to ensure full containment. The retrofitting as envision in this recommendation should be relatively minor work. This should be completed in 2022. 2.1b: The CMP and ADR Plan should be updated to reflect current conditions. 2.1c: The next audit of the CMP should include a site visit, thorough reconciliation of as-built conditions with the design, applicable plans, and license requirements.
Process Solution Spills (2.2)	2.2a: All solution piping mechanical connectors located close to the edge of containment should be retrofitted with guards or shields to prevent spray from escaping. In this context, close means close enough that spray could cross the edge of containment. The retrofitting should be completed within 90 days and new connections should include shielding at the time of installation. 2.2b: All areas where granular material crosses over the edge of containment should be sloped so that the flow direction is into the contained area. Such crossings should only be allowed in areas where the underlying geomembrane liner also slopes into the containment area. Existing crossings should be retrofitted within 90 days and new crossings constructed with appropriate protection. 2.2c: Where there is any risk of solution flowing through or over granular layers beyond containment, the areas should be retrofitted in ways which effectively eliminate this risk in all seasons. Retrofitting should be completed within 6 months, and new installations should include appropriate barriers at the time of construction. 2.2d: Inspection protocols should include routine inspection of mechanical connectors to ensure they are safely located or shielded, and frequent inspection of every location where granular material crosses containment (excluding areas where there is no process solution), possibly every shift. This should be implemented within 30 days. 2.2e: Spills of all nature are most common soon after commissioning major revisions or facility expansions. Special inspections and operator training should be implemented in advance of each expansion or significant change to operations. These special inspections should start before the completion of any major revisions or expansions and continue for 12 months after their completion.
Water Balance Management (2.3)	2.3a: Update Sections 5.3 and 5.4 of the CMP, including Figure 5.3-1, to reflect the current water management system, including flows directed from the LDSP to the EP and discharges from the EP. This should occur with the next CMP update. 2.3b: Protocols should be developed for transfers of storm water to the EP to verify that there is no cyanide in the EP so that the intent of Section 5.4.1 is not violated. This should be revised in the next CMP and EMSAMP updates.

Please let me know if you have any comments or questions on this.

Sincerely,

PITEAU ASSOCIATES USA LTD.

Mark E. Smith, P.Eng. (YT)
Chief Advisor, Geotechnical

PITEAU ASSOCIATES
GEOTECHNICAL AND
HYDROGEOLOGICAL CONSULTANTS

9060 DOUBLE DIAMOND PARKWAY, UNIT B1
RENO, NV 89521
TEL: (775) 324-8880

www.piteau.com

APPENDIX D

MEMORANDUM

To: Monica Nordling

Cc: Erin Dowd

Date: Final 30 July 2022

From: Mark E. Smith

Re: Heap Leach Facility Operation, Maintenance and Surveillance Manual (OMS), Jan. 2020 and supporting documents as referenced in the OMS; Victoria Gold Corp (VGC), Eagle Gold Mine

Monica,

This technical memo discusses the results of Piteau's review of the Heap Leach Facility Operation, Maintenance and Surveillance Manual (OMS), the related Water Use and Quartz Mining Licenses (WUL and QML) Clauses and supporting documents. The OMS is closely related to the Heap Leach Facility Contingency Water Management Plan (CWMP) and the Heap Leach and Process Facilities Emergency Response Plan (ERP); however, a separate technical memo addresses the review of those two plans and thus, there are only limited references herein. This memo was first issued as a draft in May 2022. This final version addresses comments from EMR and VGC.

1. Background

According to Clauses 98 and 99 of the Water Use License (WUL, QZ14-041-1), "All plans submitted pursuant to this License form part of the license once submitted" and "subject to any required assessments, authorizations or approvals, the Licensee must implement all plans that form part of this License," respectively. The OMS is required according to WUL Clause 103, and Clause 111 requires that "The Licensee must comply with the monitoring programs and studies in the EMSAMP and in the HLF OMS Manual." The OMS is also required by QML Schedule B.

2. Summary

The OMS is a solid plan with some very good detail. Some portions are light on specifics, and in a few places, it is incomplete, or has gaps between the OMS and both the CWMP and the ERP. The linkage between the OMS and the other two plans is unclear and the OMS lacks specific triggers for implementation of either the CWMP or ERP, even where such triggers are required by the WUL (see for example WUL Clause 48). Clarified or improved linkages between the OMS and other plans are needed.

There are provisions of the OMS which are not being implemented, including (a) generally keeping the Events Pond dry and halting any transfers into the HLF when the DAS volume is not available (Table 6.3-1, Sections 7.9 and 9.2.2), and (b) using manual control of the LDRS pumps rather than level-activated pumps. Critically, there are some issues of non-compliance with the WUL requirements, including regular and extended encroachment into the Desired Available Storage (DAS).

Both the CWMP and ERP are the subjects of a separate technical memo and thus not addressed in detail herein.

3. Discussion Points – General

3.1 Heap Leach Facility (HLF) Overview (Section 4.3)
The end of the 2nd paragraph (page 8) states "The major design components of the HLF include….a downstream Events Pond to contain process make-up water…" The annual water balance model updates prepared by Forte for 2020 and 2021 do not include make-up water storage. The OMS also makes no mention of storing surface runoff from the Lower Dublin South Pond (LDSP) or any other locations. Importantly, WUL Clause 57 (and indirectly 103c) expressly prohibits water transfers to the HLF when the available storage in the HLF is less than or equal to the DAS. During the first three years of operation (including April and May 2022[1]) water was routinely transferred to the Events Ponds from the LDSP during periods when the total available storage was less than the DAS. Clause 48 of the WUL states "Whenever the Available Storage of the HLF is less than the Desired Available Storage, the Licensee must activate the HLF Contingency Water Management Plan and take actions from that plan to, within a period no greater than 30 days, return the Available Storage in the HLF to the Desired Available Storage or greater."

In each of the prior three years the available storage was not returned to the DAS within 30 days, suggesting that the site lacks adequate storage to meet the requirements of the WUL. In July 2022 VGC noted their exception to the above comment, stating: *"This statement does not consider the evolution of the regulatory approvals for the Mine and should be removed. The notion that a specific storage volume trigger must be maintained (and during that time water transfers could not be undertaken) was imposed during the issuance of the amendment to the WUL in August 2019. This represented a fundamental change to how site water management could be undertaken. The construction and commissioning of the MWTP this year will effectively mitigate this concern. Due to long range financial planning for large capital projects, there was limited ability to accelerate the construction of the MWTP to account for the licence [sic] condition."*

The last 2 paragraphs of Sec. 4.3 (middle of page 9) discuss integrity monitoring of the geomembrane liners, underdrains, and embankments and mentions a variety of monitoring stations and instruments (including monitoring vaults, survey monuments, inclinometers, and vibrating wire piezometers (VWP)). The OMS lacks maps showing the locations of these monitoring stations or instruments.

[1] Yukon Compliance Monitoring and Inspections letter to Mark Ayranto, VGC, "Re: Victoria Gold (Yukon) Corp contravention of the Waters Act," May 4, 2022.

Recommendations:

3.1a: The OMS and related documents (including the water balance model) should be revised to be more closely aligned with each other, including make-up water and surface run-off storage in the Events Pond and compliance with WUL Clauses 48 and 57.

3.1b: Design, construct, and commission the Emergency Pond in accordance with WUL Clause 84 by the fall of 2022. The pond should be lined and have a minimum capacity of 90,000 m^3, or as determined by a calibrated water balance model (Recommendation 3.1c) which should also consider the availability and capacity of the MWTP.

3.1c: Using an updated and calibrated water balance model as a guide, evaluate whether raincoats should be installed during 2022 to reduce the water entering the system in the spring of 2023. Repeat this annually before winter.

3.1d: Include a map or maps of the instrumentation and monitoring locations in the OMS.

3.2 Engineering Design Criteria (Section 6.3)

Table 6.3-1 (page 20), states under Events Pond "The purpose of the Events Pond…is to temporarily store excess inflows that cannot be stored in the In-Heap Pond…During initial heap operation…may also be used as temporary storage for make-up water. Otherwise, the Events Pond will be kept dry." This is inconsistent with current operating practices, as discussed in Sec. 3.1, above. The recommendation for this issue is already addressed in Section 3.1a of this memo.

The WUL Clause 12 states that the In-heap Pond and Events Pond spillways "must be sufficient to pass the peak discharge predicted during the passage of the Probable Maximum Flood through the HLF during the most critical phase of the HLF." Table 6.3-1 of the OMS states that both spillways are designed to pass the PMF peak flow with 0.5 m of freeboard. According to Section 5.7 of the report of the Heap Leach Facility Detailed Design prepared by BGC Engineering Inc. (Nov. 16, 2017), "The spillway was sized assuming Phase 1 of the pads are constructed, *and future phases are yet to be developed* [emphasis added]." Table 5-3 reports the calculated peak flows as 12.2 cubic meters per second (cms) from the HLF spillway and 3.8 cms from the Events Pond spillway. The spillway analysis for the In-heap Pond is included as Appendix B, but no analysis of the Events Pond spillway is provided. The design report[2] for the Phase 2 expansion does not address the spillway adequacy for the expanded heap leach pad (HLP) area. In addition, CDA (2013[3]) Section 5.4.6 asks "adequate ice management procedures in cold regions to ensure that the spillways are not blocked by ice when they are needed?" The OMS does not include ice management for either the In-heap Pond or Events Pond spillways.

This raises three important concerns:

- The BGC design report cites the probable maximum flood (PMF) as estimated from the "PMF rainfall event" according to Knight Piesold[4] (cited in BGC Section 5.5). However, according to the Knight Piesold report, this is the probable maximum precipitation, not the PMF. To calculate the PMF the combined flow from rainfall and snowpack must be considered;
- It is not clear that the "most critical phase of the HLF" has been identified, including future phases and the possible use of raincoats as directed by WUL Clause 14; and

[2] Forte Dynamics (2021). Detailed Design Report for Eagle HLF Phase 2," Issued for use 30 Aug.

[3] CDA (2013). "Dam safety guidelines 2007 (2013 Edition)," the Canadian Dam Association.

[4] Knight Piesold Ltd., (2013). Climate Baseline Data Summary, prepared for Vitoria Gold Corp, Eagle Gold Project, August 30. (Note that BGC cites this as Knight Piezold 2012)

- Whether routing of the 12.2 cms discharge from the In-heap Pond through the Events Pond reduces the peak flow from the Events Pond spillway to 3.8 cms under the critical phase Events Pond level. This item may require some investigation into the intent of the term "critical phase," including the initial state of the Events Pond at the beginning of the PMF. For example, in the first three years of operation the available capacity in the Events Ponds was significantly less than the total capacity for several months each spring/early summer, which would directly affect the peak flow from the spillway during a spring PMF.

Recommendations:

3.2a: Verify that the spillways for both the In-heap Pond and Events Pond meet the requirements of the WUL including the peak flows from future pad expansions and designing the spillway for the critical phase of the HLF. If not, implement the needed revisions or retrofits to ensure they do.

3.2b: Include ice management procedures to ensure that ice does not block the spillways of the In-heap Pond or Events Pond.

4. Discussion Points – Operations (Section 7)

4.1. Ore Stacking Plan (OMS Section 7.2)
This section states that ore will be stacked at "39,154 tonnes/day thereafter for 275 loading days, or more, per year." QML-0011 (Section 9.6) sets the maximum 12-month average stacking rate at 29,500 tonnes per day (tpd), which is consistent with the limit set by Clause 9.6 of QML-0011. At an actual stacking rate of 39,154 tpd the loading period is thus capped at 275 days. Further, one of the key inputs into the water balance model is ore stacking, since wetting fresh ore is one of the biggest water consumers. Thus, the water balance model and the OMS should use the same stacking periods and rates.

Recommendations:
4.1: Reconcile the water balance model updates with the stacking rate and period set forth in the OMS and the limitations of QML-0011 Section 9.6. Clarify the relationship between daily ore stacking rate and stacking days per year to be in compliance with QML-0011 Clause 9.6.

4.2. In-heap Pond (Section 7.3.3)
The 4th paragraph (page 23) states "The HLF CWMP includes specific triggers for implementing management strategies to address excess water in the HLF that could result in a potential release to the environment." For example, Table 7.3-1 of the OMS (which is identical to Table 4-1 of the CWMP) is entitled "Definitive Events Pond volume triggers" and is reproduced below. However, this table presents only a summary of the components of the DAS as required by WUL Clauses 103b and d rather than triggers. Importantly, triggers should be tied to specific actions to be taken in the event said trigger is reached. Further, MAC (2019[5] and 2021[6]) recommends that triggers and response actions be set to avoid undesirable events rather than only to respond to them once they have occurred. CDA (2019[7]) includes an example dam safety management system matrix for

[5] MAC (2019). "Developing an operation, maintenance and surveillance Manual for tailings and water management facilities." Mining Association of Canada, 2nd edition.
[6] MAC (2021). "A Guide to the Management of Tailings Facilities," Mining Association of Canada, version 3.2.
[7] CDA (2019). "Technical Bulletin, Application of CDA dam safety guidelines to mining dams," the Canadian Dam Association.

mining dams which includes "quantifiable performance objectives" (QPOs). Other than listing the WUL DAS volumes, this section is lacking QPOs for the In-heap Pond.

Section 3.1 of this memo discusses the history of the total available storage (including the Events Pond) falling short of the WUL-specified Desired Available Storage, and the periods of encroachment exceeding 30 days without definitive action to prevent this as required by WUL Clause 48, allowing the continued diversion of water into the Events Pond during such periods in contravention of Clause 57. One way which may help reduce such events would be to have clear and specific triggers and actions that start before the DAS is encroached upon and require increasingly aggressive measures, including implementing the CWMP, to avoid encroachment and, when encroachment does occur, quickly resolve it.

Table 7.3-1: Definitive Events Pond Volume Triggers

Phase	72-hour Draindown Volume (m^3)[1]	0.5 m Freeboard Volume (m^3)	24-hour 100-year Event Volume (m^3)[2]	Desired Available Storage Volume Required (m^3)	Allowable Percentage Full of Events Pond
1	Not considered as per QZ14-041-1			198,340	34%
2	149,040	19,600	42,000	210,640	30%
3	149,040	19,600	58,700	227,340	24%
4	149,040	19,600	58,700	227,340	24%
5	149,040	19,600	58,700	227,340	24%

Notes:

1 72-hour draindown has been calculated based on a draindown rate equal to the maximum leaching rate or 2,070 m^3/hr as mandated by the Yukon Water Board.

2 Event volume includes runoff from Events Pond Sub-catchment assuming no losses to infiltration (i.e., CN = 100), direct precipitation on the Events Pond, and event volume considered in HLF design for plan area of pad.

Recommendations:

4.2a: The term "trigger" should be more consistently and accurately used and be consistent with MAC guidelines.

4.2b: Add triggers linked to response actions within the OMS to clarify when the CWMP (and any other relevant plans or SOPs) should be implemented. These would include but may not be limited to providing the required available storage and implementing actions when this encroaches upon the DAS. This recommendation can be combined or implemented concurrently with Recommendation 6.1b. These triggers and response actions should also be consistent with the QPOs in CDA (2019), or QPOs should be addressed separately.

4.3. Operational Heap Leach Model (Section 7.9)

The 1st paragraph of this section states "An operational heap leach water balance model will be used to help manage solution storage and operation of the ADR and HLF. The model will be used to evaluate the HLF pad performance by tracking and predicting makeup water demands, and ensuring that an adequate volume of emergency pond storage (i.e., the phase dependent desired available storage) remains available." This criterion does not seem to be fully implemented in practice. That is, the GoldSim model used for the annual water balance updates (Forte Dynamics) does not seem to be integrated with operations or with the OMS, and is not ensuring that the DAS is maintained, or that appropriate actions are taken when the DAS is not maintained. The following paragraph closes with "Water transfers into the HLF…are not permitted when the Desired Available Storage volume is not available in the Events Pond (as per Table 7.3-1)." This prohibition is consistent with the WUL but it is not being implemented, as discussed in the water balance technical memo. The lack of specific triggers and actions either in the OMS or the CWMP may be part of the root cause for this, but it goes beyond that and suggests that management changes are needed to avoid this continuing.

Recommendations:

These issues are addressed in the water balance technical memo as well as in Sections 3.1 and 4.2 of the current memo.

5. Discussion Points – Maintenance (Section 8)

5.1. Solution collection and delivery system pipeline leaks or breaks (Section 8.2.1)
For leaks or breaks which cause, or threaten to cause, process solution to leave containment areas, a leak in one component may provide early warning of future leaks in related components. There have also been two spills related to movement of granular material near or crossing the edge of containment.

Recommendations:

5.1a: The actions should further include analyzing the cause of the leak or break and making changes not just to the affected components but any other components which may pose similar risks. A good example of this would be the subject of the VGC spill report dated July 30, 2021 (leak at a blind flange) where the response should apply to any mechanical fitting near the edge of containment, since all mechanical fittings are vulnerable to the same type of leakage.

5.1b: The OMS should include specific procedures to ensure that granular material placed near the edge of the leach pad cannot leave containment nor allow cyanide solution to leave containment.

5.2. Earthquake Occurrence (Section 8.2.2)
Operators may have limited experience with earthquakes and the ground motion required to trigger special inspections.

Recommendations:

5.2: Provide specific criteria to trigger the Earthquake Occurrence inspections, such as that set forth in Table 5.2-1 of the ERP.

5.3. Flood Event (Section 8.2.3)
The response should also include consulting and, if appropriate, updating the water balance model as the impacts of a significant flood can take days or more to be fully realized, by which time it could be too late to take effective mitigation actions.

Recommendations:

5.3: Include updating the operational water balance model and implementing any measures indicated by the water balance model results in a timely manner.

5.4. Maintenance Schedule and Spare Parts (Section 8.3)
The OMS states, “A spare parts inventory will be maintained as recommended by equipment manufacturers and as required by the Owner.” More specificity would be helpful, either by giving some specific guidance or referencing the Standard Operating Procedures (SOPs) which contain such specifics. Further, any spares essential to the continued safe operations of the HLF, or implementation of contingency plans, should be included in the OMS. Examples include:

- Pregnant and barren solution pump and motor replacements or spare parts;
- Back-up power spare parts;
- Mine water treatment plant (MWTP) spare parts;
- Raincoats once Phase 2 is commissioned (to comply with WUL Clauses 14); and,
- Irrigation system components (to maintain or increase dynamic storage)

Recommendations:
5.4: Include in the OMS (or reference a separate SOP) with specific inventory requirements for critical parts and supplies including the materials to implement the WUL requirement for raincoats starting with Phase 2 (WUL Clause14).

6. Discussion Points – Surveillance and Response (Section 9)

6.1. General
The OMS lists under Section 10 References MAC 2011 & 2019, and MAC 2019 was updated by MAC 2021. Together MAC 2019 and 2021 recommend:

- Using best industry practices and risk-based critical controls crucial to preventing high-consequence failures or mitigating consequences should they occur. An example of a risk-based control would be specifying the frequency of surveying the monuments on the dam with monthly being the default, increasing to weekly when the pond level is above some higher-risk threshold as determined by the dam break analysis; and,
- Implementing QA/QC procedures to verify that maintenance is conducted as specified, such as setting required frequency and method of calibration and maintenance schedules for critical components of the facilities such as instrumentation.

Recommendations:
6.1a: Include the MAC 2019 and 2021 recommendations (as applicable) in the OMS, including the recommendations for Trigger Action Response Plans in Appendix 3 of MAC 2019.

6.1b: The triggers and response actions should be coupled with the existing dam break analysis (and updated when that analysis is updated) for things such as issuing warnings and evacuating the downstream areas (on- and off-site, as applicable) in the event of a risk of heap embankment failure. Evacuation routes should be well removed from expected inundation zones.

6.2. Heap Leach Facility Surveillance and Response (Section 9)
Table 9.1-1 lists the surveillance method, frequency, and responsibility. The listed “Embankment Geotechnical Instrumentation” includes only piezometers and a single inclinometer. Survey prisms are one of the most common and most effective means of monitoring slopes, including embankment dams, and can provide very early warning of problems. The table also sets the frequency of monitoring of these instruments as “Continuous using wireless relays to the office.” However, inclinometers (and generally prisms) require manual surveys and thus the frequency of the surveys should be specified. Further, during an extended power failure (such as the 72-hr failure scenario for the pumping system), the piezometer data cannot be transmitted by wireless relays either, unless there are back-up batteries in place.

There are also some items in Table 9.1-1 which are not clear. Specifically:

- For the solution collection and recovery systems, weekly surveillance is specified. However, for a valley fill heap leach facility the solution collection system is under the heap, reporting to the bottom of the In-heap Pond which is also filled with ore;
- Leak detection and recovery system (LDRS) monitoring ports require daily surveillance. The LDRS monitoring ports for the In-heap Pond are at the bottom of the pond, buried beneath ore, and located between two geomembrane liners. For the Events Pond, it is below the pond (which contains some water much of the time) and between two geomembrane liners. Thus, no visual inspection is possible. Flow to the LDRS is monitored with totalizing flowmeters, and fluid is removed by either level-actuated pumps (according to the OMS) or weekly by manually operating the pumps (according to the Annual Inspection reports);
- Instrumentation is surveilled monthly and per manufacturer's guidelines. Yet some instrumentation (e.g., piezometers) cannot be visually or otherwise inspected and only the data is applicable to verify their functionality, while other instrumentation has surveillance frequencies specified differently than monthly (the inclinometer is monitored quarterly, according to Section 9.2.4); and,
- The responsibilities as listed in Table 9.1-1, have the same type of measurements being taken by the different personnel. For example, piezometer data for the heap embankment and In-heap Pond are the responsibility of the Process General Foreman, while the heap leach pad piezometers are the responsibility of the Environmental Superintendent. The skills required to monitor, calibrate, and analyze such data, to maintain the equipment, and to quickly identify anomalous results, are complicated; there is value in having the same person performing these functions across areas.

Recommendations:

6.2a: Add a network of survey prisms (with routine surveying and analysis of the results) to the crest and downstream slopes of both the In-heap Pond and Events Pond embankments.

6.2b: Specify the frequency of manual surveillance for instruments such as inclinometers and survey prisms which cannot be automatically reported.

6.2c: Add procedures regarding the collection of data from critical instrumentation (such as piezometer) during extended power outages.

6.2d: Where practical and consistent with shift rotations, group types of instruments or monitoring measurements under the responsibility of the same person or group of people/department.

6.2e: Reconcile the language of Table 9.1-1 with the balance of the language of Section 9 and actual practice.

6.3. Instrumentation, Monitoring and Response (Section 9.2)

Tables 9.2-1 In-heap Pond Trigger Level Response and Section 9.2.2.1 Events Pond Water Level Response set forth the "Condition" (green, orange, red) based on the solution level in the pond and the potential response actions. This is a common and successfully used approach in mine site monitoring, but there are some areas for improvement noted in this review.

Table 9.2-1 lists a very broad "Orange" zone, ranging from elevations of 914 to 937 m (a vertical difference of 23 m) for the In-heap Pond, and then just 0.5 m for the "Red" zone. While the last 4 m of Orange includes increasingly significant actions, some of these should be moved to Red and the range of Red increased to provide operators with more time to avoid unintentional use of the spillway. Further, the actions are framed as suggestions (i.e. "Potential Response Actions") but at some point in the Orange range the actions should be pre-determined and tied to outcomes. MAC 2019 Appendix 3 states "Pre-defined management actions are implemented." Table A.1.1 of MAC Appendix 3 presents examples of pre-defined actions.

For Table 9.2-3 Events Pond Trigger Responses for Phase 1 of the HLF, the range of Orange is just 2.5 m of pond level rise, while the Red range is 6.5 m. Note that the levels in Table 9.2-3 do not match the trigger levels presented in bullet form immediately preceding Section 9.2.2.1 (page 42) in that the respective Red thresholds are 888 and 886.5 m.

Table 9.2-3 sets forth "Response" for each level rather than "Potential Response Actions" as set forth in Table 9.2-1. The difference is unclear, but ideally the two would be the same: a system of increasingly specific and mandatory actions as the alert level increases. Neither Table 9.2-1 nor 9.2-3 include triggers for available storage approaching or encroaching on the DAS, though this should also be included (and would be based on the combined available storage of the two ponds); this is an example of where the CDA (2019) QPOs might apply.

Recommendations:

6.3a: Re-evaluate the trigger levels (pond elevations) and recommended or required response actions to ensure that the operators have adequate time to resolve the problem without advancing to the next condition level.

6.3b: Add trigger levels and actions related to encroachment on the DAS, with the first triggers before the DAS is encroached to allow operators to avoid that condition, and then actions when the DAS is encroached to bring it back into compliance within 30 days along with halting any solution transfers into the process system. These should be consistent with the triggers and actions set forth in the CWMP and ERP.

6.3c: Add triggers to implement the CWMP and ERP.

6.4. LDRS Levels (Section 9.2.3)

Two alert levels are defined for each of the two ponds (In-heap Pond and Events Pond), which are combined with four response levels. The two ponds have different operating conditions and as such these are discussed herein separately. The WUL sets the Alert Levels by reference to documents submitted by the Licensee. However, the Response Levels were set by VGC and as such those are the focus of this section.

For the In-heap Pond, a key operating condition is that the pond is buried under crushed stone and thus liner system repair can be impractical. In such cases it is common practice to allow higher leakage rates before taking extreme measures. In this context, Response Levels (RL) 1 and 2 appear appropriate. However, the leakage rates for RL 3 can be very high (up to 1,700,000 L/day for the In-heap Pond), which would suggest a failing liner system. Thus, the "Potential Response Actions" for Level 3 should be more aggressive and should require that the solution levels be held low enough so that the leakage rate returns to RL 2.

Unlike the In-heap Pond, the Events Pond is an open pond and the primary (top) liner can be easily repaired during the construction season. Thus, the response level limits should be lower than for the In-Heap Pond. However, the OMS sets the maximum RL 2 flow only slightly lower than for the In-heap Pond and allows RL 3 flows of up to 1,900,000 L/day, 200,000 L/day higher than the In-heap Pond.

The reports issued by Forte (2021a[8], 2021b[9]) and BGC (2019[10]) state that both the In-heap Pond and Events Pond LDRS pumps are activated manually. Forte (2021a) states "As part of both the 2019 and 2020 EOR Annual Inspections [Ref 5 & 6] it was recommended to VGC that the In-Heap Pond LDRS sump be evacuated, as described in the OMS manual, by a level-actuated pump instead of the scheduled manual evacuation that is currently being performed." The latest Forte Annual Report[11] confirms that the two LDRS pumps are being manually activated and Piteau supports Forte's recommendations. Further, it is concerning that prior recommendations from the EOR went unheeded for at least 3 years. Such inspections and evaluations, especially when mandated by operating licenses, are clearly intended to identify - and timely remedy - deficiencies in the system.

The latest Annual Inspection report (Forte, 2022) also explains that the LDRS system in the Events Pond is not being monitored and that Forte had to infer certain parameters to estimate the flow rates into the LDRS. Specifically, Forte found that the pumped flow volumes and water level readings were not being recorded in accordance with the OMS and recommended that this be changed.

Recommendations:

6.4a: The In-heap Pond RL 3 responses should be more aggressive and include mandatory actions to reduce the leakage flow rates to RL 2 in a timely manner. RL 3 should also include an engineering assessment of the capacity of the LDRS system to ensure (with a high factor of safety) that the flow rates are not pressurizing the secondary (bottom) liner.

6.4b: The Events Pond RL flow limits should be significantly lower for all levels (RL 1 through RL 4), and the response actions for RL 3 should mandate repair of the liner during the next dry season after RL 3 was reported, along with reducing pond water levels to reduce leakage rates in the interim.

6.4c: Both ponds should have response actions which trigger implementation of the CWMP when RL 3 is first reached so that the pond levels can be lowered and thus the leakage rates are also lowered.

6.4d: Level-actuated pumps should be used for the LDRS sumps in both the In-heap Pond and the Events Pond and the flow and level data be recorded and reported.

6.4e: The recommendations resulting from annual inspections, performance reviews, and any other reports or studies required by the WUL or QML should be implemented in a timely manner. This includes implementing all recommendations of Forte (2021a, 2021b, 2022) and BGC (2019).

6.5. Movement (Section 9.2.4)

The embankment design includes 8 survey monuments located every 50 m along the crest and a single inclinometer. These monuments have not been installed. Further, the survey monuments,

[8] Forte (2021a). "Phase 1 performance review," technical memo issued by Forte Dynamics, May 20.
[9] Forte (2021b). "2020 annual inspection of Eagle Gold LF," Forte Dynamics, Inc., March 19.
[10] BGC (2019). "Eagle Gold project heap leach facility annual inspection," BGC Engineering, Inc., Nov. 19.
[11] Forte (2022). "2021 Annual Inspection of Eagle Gold HLF," Forte Dynamics, Inc., March 25.

as designed, are to be simple lengths of rebar embedded into the fill 0.8 m deep which are to be checked visually (per Table 9.2-1). This would provide some useful information but since the rebar pins don't penetrate the frost depth there will be considerable noise due to the daily freeze/thaw cycles in the spring and fall. Traditional survey monuments such as steel pins or caps set in concrete would provide better data and would be able to detect meaningful movement earlier and more reliably than visual inspection of the rebar.

There is one inclinometer in the embankment, which according to Section 9.2.4 is monitored quarterly. Table 9.1-1 states that the inclinometer is monitored continuously "by wireless relays to the office." Continuous monitoring is impractical, but quarterly monitoring is too infrequent. It's more common to have at least 2 inclinometers (on section) to better define any detected movement, and monthly monitoring is common under normal conditions. This may not be sufficiently frequent if there is other evidence of problems such as movement of the survey monuments or high piezometric levels.

Recommendations:

6.5a: As required by Forte (2022), at least 8 survey monuments should be installed along the embankment crest. These monuments should be anchored in concrete to reduce noise and detect movement more reliably.

6.5b: Install a 2nd inclinometer in the embankment and add this to the monitoring program with monthly or more frequent measurements and align the language of this section with Table 9.1-1.

6.5c: Alert levels and actions should be added to the monitoring of the survey monuments and inclinometers. The actions should include increasing the frequency of monitoring in the event there is evidence of movement or embankment distress.

6.6. Seepage and Underdrain Monitoring (Section 9.2.5)

This section describes the monitoring location and frequencies (Table 9.2-1) but does not establish trigger levels or actions. Table 9.2-1 could also be merged with Table 9.1-1 for easier reference.

Recommendation:

6.6: Add trigger levels and actions.

6.7. Event-Driven Inspections (Section 9.5)

There is limited definition of what constitutes an "Event" for the purposes of this section, which can lead to inconsistent implementation and results. Some events are well defined (e.g., power loss longer than 8 hours) but other events lack definition (e.g., large precipitation or slide of the stacked ore).

Recommendations:

6.7: Define all events that trigger Event-Driven Inspection, such as the perception of ground motion from an earthquake, the size or intensity of a large precipitation event, or the size or extent of a slide in the heap (since the lifts are stacked at the angle of repose, small, local slides are very common but generally do not require special inspections).

6.8. Comprehensive Dam Safety Review (Section 9.6)

This section sets a frequency of "no later than 5 years after construction and prior to decommissioning." The period soon after commissioning is a high-risk period for mine site dams, as is the period after each major facility expansion.

Recommendations:

6.8: Increase the frequency (i.e., reduce the time interval) of Dam Safety Reviews to less than 5 years after commissioning (ideally with the first occurring in 2022), and then again in the year following each leach pad expansion, and in the years following decommissioning unless the dams are breached and can no longer impound water.

6.9. Reporting (Section 9.8)

The subsection on Environmental Monitoring and Reporting discusses the reporting of pond volumes, SWE, average and total pumping, and other important hydraulic metrics. However, there is no discussion of incorporating this information into the operational water balance model.

WUL Clause 117 requires that certain data be collected and reported, and these requirements are addressed in this subsection. One of the requirements of Clause 117 is to report pumping rates and total monthly pumped volumes. According to Forte's Performance Review[12] "It should be noted that in October 2020 the totalizer [In-heap Pond LDRS] became non-operational and was replaced after winter in April 2021 *when conditions thawed*" [emphasis added], leaving a gap in the flow data of 5 months. While Clause 117 does not include LDRS pumping, this data gap illustrates the need for back-up measurements or replacements which are not season dependent.

Recommendations:

6.9a: Include routine updates to the GoldSim water balance model using the monthly data to allow better management of the ponds and reduce the frequency and severity of encroachments into the DAS. The modeling results should also be linked to trigger levels and actions. For example, if the March model update forecasts April or May encroachment into the DAS, there should be actions set forth to avoid this condition

6.9b: Where flowmeter data is required to be reported under the WUL or QML, or is otherwise critical to the safe operations of the HLF and to avoid extended data gaps, either redundant flowmeters should be installed or protocols put in place to ensure that quick repair or replacement occurs without regard to the season.

6.10 Back-up Power (Section 9.9.1)

Based on information provided by the site during this review, the back-up electrical generating capacity is greater than the power demand to keep solution circulating during and extended power disruption. CDA (2013) Section 5.4.6 lists backup equipment including alternative power supplies as needing definition in the OMS. However, this OMS does not specify the required power for such a condition nor the power produced by the generators and thus there is no clear guidance for prioritizing maintenance on the generators to ensure this capacity remains available at all times.

Recommendations:

6.10: Provide information on required back-up power and the generator capacity so that operators can verify that there is always sufficient back-up power available.

6.11 Pump Redundancy

The In-heap Pond includes a total of five pumps in what the OMS refers as "N+1+1 redundancy". Specifically, three pumps are normally operational, one pump is installed and in stand-by mode, and another is cycled through maintenance. This is a common approach to pump redundancy. However, the simultaneous failure of multiple pumps or motors can occur due to a power grid surge, lightning strikes, or failure of the voltage regulation system of the back-up generators. Another

[12] Forte (2021a). "Phase 1 performance review," technical memo issued by Forte Dynamics, May 20.

scenario is when additional dynamic storage is being used to manage solution accumulation, which requires the 4th pump to be operational. This leaves only the 5th pump, which may be in for maintenance, thus leaving no back-up or spare pump during the most critical periods for water management. The system should be able to safely operate under such conditions. This is commonly accomplished by either:

- Verifying that the available pond capacity is sufficient to safely store the accumulated solution during a partial pumping system failure (e.g., two pumps down for longer than 72 hrs); or,
- Maintaining full sets of replacement parts for each pump and motor required to operate the system.

According to the 3rd paragraph of this section there is no pumping redundancy for the Events Pond. Reliance on quick re-supply by vendors in case of a pump failure is risky, especially during an extreme storm event in the spring when local runways, roads, and river crossings may be unreliable. Note that the design extreme event lasts just 72 hrs (pumping system failure combined with the 100-yr/24-hr precipitation).

Recommendations:

6.11a: Evaluate the pump redundancy in terms of solution accumulation during an extended multi-pump failure and provide either adequate pond capacity or full replacement kits on site. Also evaluate the risk of a motor control center (MCC) failure and the need for a back-up MCC, spare parts, or another work around.

6.11b: The Events Pond pump should have a spare (either a complete pump and motor ready to install, or a complete repair kit for both the pump and motor).

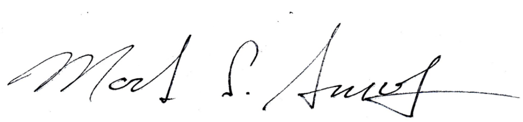
7.0 Summary of Recommendations

The attached Table 7.1 presents a summary of the actions recommended herein, along with the suggested timing for their implementation.

Please let me know if you have any comments or questions on this.

Sincerely,

PITEAU ASSOCIATES USA LTD.



Mark E. Smith, P.Eng. (YT)
Chief Advisor, Geotechnical

ATTACHEMENT 1

TABLE 7.1: SUMMARY OF RECOMMENDED ACTIONS

Topic & Section No.	Recommended Actions
Heap Leach Facility Overview (3.1)	3.1a: The OMS and related documents (including the water balance model) should be revised to be more closely aligned with each other, including make-up water and surface run-off storage in the Events Pond and compliance with WUL Clauses 48 and 57. 3.1b: The Emergency Pond should be designed, constructed, and commissioned by the fall of 2022. The pond should be lined and at have a minimum capacity of 90,000 m^3. 3.1c: Using an updated and calibrated water balance as a guide, evaluate whether raincoats should be installed during 2022 to reduce the water entering the system in the spring of 2023. Repeat this each year before winter. 3.1d: Include a map or maps of the instrumentation and monitoring locations in the OMS.
Engineering Design (3.2)	3.2a: Verify that the spillways for both the In-heap Pond and Events Pond meet the requirements of the WUL including the peak flows from future pad expansions and designing the spillway for the critical phase of the HLF. If not, implement the needed revisions or retrofits to ensure they do. 3.2b: Include ice management procedures to ensure that ice does not block the spillways of the In-heap Pond or Events Pond.
Ore Stacking Plan (4.1)	4.1: Reconcile the water balance model updates with the stacking rate and period set forth in the OMS and the limitations of QML-0011 Section 9.6. Clarify the relationship between daily ore stacking rate and stacking days per year to be in compliance with the QML-0011 Section 9.6.
In-heap Pond (4.2)	4.2a: The term “trigger” should be more consistently and accurately used and be consistent with MAC guidelines. 4.2b: Add triggers and actions within the OMS to clarify when the CWMP (and any other relevant plans or SOPs) should be implemented. These would include but may not be limited to providing the required available storage and implementing actions when this encroaches upon the DAS. This recommendation can be combined or implemented concurrently with Recommendation 6.1b. These triggers and response actions should also be consistent with the QPOs in CDA (2019), or QPOs should be addressed separately.
Solution Collection and Delivery System (5.1)	5.1a: The actions should further include analyzing the cause of the leak or break and making changes not just to the affected components but any other components which may pose similar risks. A good example of this would be the subject of the VGC spill report dated July 30, 2021 (leak at a blind flange) where the response should apply to any and all mechanical fitting near the edge of containment. 5.1b: The OMS should include specific procedures to ensure that granular material placed near the edge of the leach pad cannot leave containment nor allow cyanide solution to leave containment.
Earthquake Occurrence (5.2)	5.2 Provide specific criteria to trigger the Earthquake Occurrence inspections, such as that set forth in Table 5.2-1 of the ERP.
Flood Event (5.3)	5.3: Include updating the operational water balance model and implementing any measures indicated by the water balance model results in a timely manner.
Maintenance Schedule and Spare Parts (5.4)	5.4: Include in the OMS (or reference a separate SOP) with specific inventory requirements for critical parts and supplies including the materials to implement the WUL requirement for raincoats starting with Phase 2.

Topic & Section No.	Recommended Actions
Surveillance and Response, General (6.1)	6.1a: Include the MAC 2019 and 2021 recommendations (as applicable) in the OMS, including the recommendations for Trigger Action Response Plans in Appendix 3 of MAC 2019. 6.1b: The triggers and response actions should be coupled with the existing dam break analysis (and updated when that analysis is updated) for things such as issuing warnings and evacuating the downstream areas (on- and off-site, as applicable) in the event of a risk of heap embankment failure. Evacuation routes should be well removed from expected inundation zones.
Heap Leach Facility Surveillance and Response (6.2)	6.2a: Add a network of survey prisms (with routine surveying and analysis of the results) to the crest and downstream slopes of both the In-heap Pond and Events Pond embankments. 6.2b: Specify the frequency of surveillance for instruments such as inclinometers which cannot be automatically reported. 6.2c: Add a discussion about how critical instrumentation (such as piezometer) data will be retrieved during an extended power outage. 6.2d: Where practical and consistent with shift rotations, group types of instruments or monitoring measurements under the responsibility of the same person where practical. 6.2e: Reconcile the language of Table 9.1-1 with the balance of the language of Section 9 and actual practice.
Instrumentation, Monitoring and Response (6.3)	6.3a: Re-evaluate the trigger levels (pond elevations) and recommended or required response actions to ensure that the operators have adequate time to resolve the problem without advancing to the next condition level. 6.3b: Add trigger levels and actions related to encroachment on the DAS, with the first triggers before the DAS is encroached to allow operators to avoid that condition, and then actions when the DAS is encroached to bring it back into compliance within 30 days along with halting any solution transfers into the process system. These should be consistent with the triggers and actions set forth in the CWMP and ERP. 6.3c: Add triggers to implement the CWMP.
LDRS Levels (6.4)	6.4a: The In-heap Pond RL 3 responses should be more aggressive and include mandatory actions to reduce the leakage flow rates to RL 2 in a timely manner. RL 3 should also include an engineering assessment of the capacity of the LDRS system to ensure (with a high factor of safety) that the flow rates are not pressurizing the secondary (bottom) liner. 6.4b: The Events Pond RL flow limits should be significantly lower for all levels (RL 1 through RL 4), and the response actions for RL 3 should mandate repair of the liner during the next dry season after RL 3 was reported, along with reducing pond water levels to reduce leakage rates in the interim. 6.4c: Both ponds should have response actions which trigger implementation of the CWMP when RL 3 is first reached so that the pond levels can be lowered and thus the leakage rates are also lowered. 6.4d: Level-actuated pumps should be used for the LDRS sumps in both the In-heap Pond and the Events Pond and the flow and level data be recorded and reported.

Topic & Section No.	Recommended Actions
	6.4e: The recommendations resulting from annual inspections, performance reviews, and any other reports or studies required by the WUL or QML should be implemented in a timely manner. This includes implementing all of the recommendations of Forte (2021a, 2021b, 2022) and BGC (2019).
Movement (6.5)	6.5a: As required by Forte (2022), at least 8 survey monuments should be installed along the embankment crest. These monuments should be anchored in concrete to reduce noise and detect movement more reliably. 6.5b: Install a second inclinometer in the embankment and add this to the monitoring program with monthly or more frequent monitoring and align the language of this section with Table 9.1-1. 6.5c: Alert levels and actions should be added to the monitoring of the survey monuments and inclinometers. The actions should include increasing the frequency of monitoring in the event there is evidence of movement or embankment distress.
Seepage and Underdrain Monitoring (6.6)	6.6: Add trigger levels and actions.
Event-Driven Inspections (6.7)	6.7: Define all events that trigger Event-Driven Inspection, such as the perception of ground motion from an earthquake, the size or intensity of a large precipitation event, or the size or extent of a slide in the heap (since the lifts are stacked at the angle of repose, small, local slides are very common but generally do not require special inspections).
Comprehensive Dam Safety Review (6.8)	6.8: Increase the frequency of Dam Safety Reviews to less than 5 years after commissioning (ideally with the first occurring in 2022), and then again in the year following each leach pad expansion, and in the years following decommissioning unless the dams are breached and can no longer impound water.
Reporting (6.9)	6.9a: Include routine updates to the GoldSim water balance model using the monthly data to allow better management of the ponds and reduce the frequency and severity of encroachments into the DAS. The modeling results should also be linked to trigger levels and actions. For example, if the March model update forecasts an April or May encroachment into the DAS, there should be actions set forth to avoid this condition 6.9b: Where flowmeter data is required to be reported under the WUL or QML or are otherwise critical to the safe operations of the HLF and to avoid extended data gaps, either redundant flowmeters should be installed, or protocols put in place to ensure that quick repair or replacement occurs without regard to the season.
Back-up Power (6.10)	6.10: Provide information on required back-up power and the generator capacity so that operators can verify that there is always sufficient back-up power available.
Pump Redundancy (6.11)	6.11a: Evaluate the pump redundancy in terms of solution accumulation during an extended multi-pump failure and provide either adequate pond capacity or full replacement kits on site. Also evaluate the risk of a motor control center (MCC) failure and the need for a back-up MCC, spare parts, or anther work around. 6.11b: The Events Pond pump should have a spare (either a complete pump and motor ready to install, or a complete repair kit for both the pump and motor).

PITEAU ASSOCIATES
GEOTECHNICAL AND
HYDROGEOLOGICAL CONSULTANTS

9060 DOUBLE DIAMOND PARKWAY, UNIT B1
RENO, NV 89521
TEL: (775) 324-8880

www.piteau.com

APPENDIX E

MEMORANDUM

To: Monica Nordling

Cc: Erin Dowd

Date: FINAL 31 July 2022

From: Mark E. Smith

Re: Heap Leach Facility Contingency Water Management Plan, Jan. 2020
Heap Leach and Process Facilities Emergency Response Plan, May 2019, and supporting documents; Victoria Gold Corp (VGC), Eagle Gold Mine

Monica,

This memo discusses the results of the Piteau review of the Heap Leach Facility Contingency Water Management Plan (CWMP), version 2020-01, the Heap Leach and Process Facilities Emergency Response Plan (ERP), version 2019-01, related Water Use and Quartz Mining Licenses (WUL and QML) clauses or conditions and supporting documents. This memo was first issued as draft in May 2022. This final version addresses comments from EMR and VGC.

1. Background

This technical memo should be taken together with the memo on the Heap Leach Facility Operation, Maintenance and Surveillance Manual, version 2020-01 (Appendix D) as there are important interactions between the three documents.

According to Clause 98 of the WUL (QZ14-041-1) "All plans submitted pursuant to this License form part of the license once submitted." Clause 99 further reads "Subject to any required assessments, authorizations or approvals, the Licensee must implement all plans that form part of this License." The CWMP is required according to WUL Clause 102. The ERP is required by QML Schedule B.

2. Summary

There is a close linkage between the Operations, Maintenance and Surveillance (OMS) and both the CWMP and ERP. In some cases, these linkages are explicit, in other cases they are inferred. The memo on the OMS discusses how this linkage could be clarified and strengthened by providing triggers when the CWMP and ERP are to be implemented. The current memo focuses on the CWMP and ERP rather than their linkages or integration with the OMS.

Overall, both plans form good frameworks and are consistent with the level of detail expected for early operations. The CWMP was last updated in January 2020, a few months following the project's commissioning. The ERP was last revised in early 2019, prior to the project's commissioning. Both plans lack some important as built and operational details, and during the first years of operation the site has likely adapted some of the early plans and procedures to accommodate conditions on the ground. In addition, during the 13 months ending July 2021 the site reported four cyanide-related spills and performed investigations into each. Further, the site has been the subject of actions by the Yukon Government related to non-compliance with the WUL requirements for Desirable Available Storage (DAS). Further, in the latest annual Heap Leach Facility (HLF) Inspection Report (Forte, 2022[1]) the Engineer of Record for the HLF listed six required and three recommended updates to the OMS.

This is compelling evidence that it is time to update the plans, addressing those issues as well as the areas discussed herein.

3. Discussion Points – CWMP

3.1. Contingency Water Management Strategies (Section 4)

Table 4-1 Definitive Events Pond Volume Triggers in CWMP summarizes the components used to determine the Desired Available Storage (DAS) by phase, along with an estimate of the percent of the total Events Pond capacity corresponding each DAS. The paragraph before and the title of the table represent these as "definitive triggers." However, these are not consistent with industry standards for triggers. Appendix 3 (MAC 2019[2]) *Trigger Action Response Plans* states "The critical controls and their trigger levels are based on the performance objectives and risk management plan…" A stated objective in the OMS is that "The Events Pond will ordinarily remain dry or occupied temporarily by direct precipitation and/or process makeup water. Any accumulation of water in the pond will be pumped into the process circuit.…For the Process Manager to permit the accumulation of water in the Events Pond, the HLF solution condition must be green and under no circumstances can planned accumulation be above the [DAS]…"

MAC (2021[3]) recommends that operations apply industry best practices to manage risks. Best practices include applying triggers as early-warning tools which require actions designed to avoid the occurrence of undesirable events, and to reduce the consequences of such events should they occur. To accomplish these goals triggers must be set sufficiently before an undesirable event occurs (for example, before any encroachment into the DAS) to allow operators to avoid the event. In this case, such actions would likely include implementing water management strategies - such as increasing dynamic storage, increasing evaporation, and implementing snowpack management plans - to reduce or reverse the rate of rise in the ponds before the DAS is encroached upon. Subsequent triggers might address more significant actions designed, for example, to return the available storage to at least the DAS within 30 days as required by WUL Clause 48.

[1] Forte (2022). "2021 annual inspection report of Eagle Gold HLF," Forte Dynamics, Inc., March 25.
[2] MAC (2019). "Developing an operation, maintenance and surveillance Manual for tailings and water management facilities." Mining Association of Canada, 2nd edition.
[3] MAC (2021). "A Guide to the Management of Tailings Facilities," Mining Association of Canada, version 3.2.

WUL Clause 48 states "Whenever the Available Storage of the HLF is less than the Desired Available Storage, the Licensee must activate the HLF Contingency Water Management Plan and take actions from that plan to, within a period no greater than 30 days, return the Available Storage in the HLF to the Desired Available Storage or greater." Implicit in Clause 48 is the need for the CWMP to include specific triggers and response actions to first prevent encroachment and then to quickly eliminate the potential cause of encroachment.

Recommendations:

3.1: Implement triggers linked with response actions consistent with WUL Clause 48 and the recommendations of MAC (2019 & 2021). These triggers and actions should be aligned with and, where applicable, linked to those in both the OMS and ERP. Said triggers and actions, where applicable to the In-heap Pond, should also include measures to protect the embankment.

3.2. In-heap Dynamic Water Storage (Section 4.1)

Dynamic storage is a well-established method of managing heap leach solutions and reducing surplus accumulation in the ponds. The concept of increasing pumping rates by using back-up pumps is appropriate and consistent with industry practice. Eagle Gold operates with three pumps and a combined capacity of 1,500 m^3/hr under normal conditions, but has a 4th pump installed as a back-up, and a 5th pump on-site to allow one pump to cycle through maintenance (i.e., an N+1+1 system). However, the dynamic storage capacities cited in Table 4-2 for Phases 1, 2 and 3 are hypothetical rather than actual. The storage available for use at any given time will depend on the specific area available on the heap for additional irrigation as well as the actual depth of the ore in said area, the moisture content[4] of that ore relative to the in-leach moisture content, the presence of any snowpack or frozen zones, and perhaps other factors. Thus, while Table 4-2 is a reasonable conceptualization, it may mislead operators implementing the contingency plan and this could lead to non-conservative actions.

The 2nd paragraph after Table 4-2 states "…there is no single unplanned event…that is capable of overwhelming the total available dynamic storage." This is overly optimistic. Two plausible events come to mind: (1) any significant precipitation or freshet event occurring while much of the near-surface area of the heap is frozen (e.g., the area not under normal irrigation) and when the DAS is not fully available (such as has occurred in every spring since and including 2020) could produce surplus solutions in excess of the dynamic storage capacity; and (2) any extended full or partial pumping system failure would disallow use of available dynamic storage until full pumping capacity is resumed.

Regarding the use of the 5th pump to further increase dynamic storage, this is a reasonable contingency. However, if the dynamic storage in the heap is increased due to pumping rates significantly over 2,070 m^3/hr (the flow rate used to establish the DAS), there could be a shortfall in pond capacity if the design storm event occurs (100-yr/24-hr precipitation combined with a 72-hr pumping system failure). Specifically, the 72-hr heap draindown volume could increase to 180,000 m^3 with 5 pumps running at capacity.

[4] The moisture content would be influenced by factors such as how long since the area was last leached, the season (during freshet the ore will have higher moisture contents and thus lower dynamic storage capacity), the properties of the ore, and other factors.

Recommendations:

3.2a: The available dynamic storage capacity should be expressed relative to the key variables influencing it and provide operators a number of simple ways to conservatively estimate the capacity using available information.

3.2b: Increasing dynamic storage should also address the impacts on the heap draindown under a pumping system failure scenario when the 5th pump has been placed into service.

3.3. Snowpack Management (Section 4.2)

WUL Clause 102c requires the "development of a snow management trigger based on the snow water equivalent (SWE) of the snowpack as opposed to a snowpack depth." Implicit in this is the use of the actual SWE in setting trigger levels. Table 4-3 (page 12) provides a predicted SWE from a 24-hr rain-on-snow and 48-hr melt event. The paragraph preceding this table states "Upon the completion of each monthly snow course survey…verify the available volumes in the In-heap Pond and the Events Pond and if the values provided in Table 4-3 are not available within the system, the snowpack management….should be implemented." More specific criteria and triggers linked with actions would better achieve the intent of WUL 102c and be more aligned with the recommendations of MAC 2019 and 2021.

This section also discusses the method used to estimate the maximum snowpack melt rate (MOE, 1991[5]). The analysis was limited to the 48-hr snowmelt following a 24-hr rainfall. However, the system should be able to safely contain the spring freshet, not just a 72-hr event. Further, the MOE method is simplified. A better model is that used in the Eagle Gold annual water balance updates prepared by Forte Dynamics, called SNOW-17[6], or other constitutive models using heat transfer principals and site-specific inputs such as solar radiation and ambient temperatures.

Recommendations:

3.3a: Develop specific triggers and response actions to implement the intent of WUL 102c. These should include triggers to implement actions such as snow removal from the heap (and methods for appropriate disposal in accordance with WUL Clauses 89 and 90), and other methods to reduce freshet.

3.3b: Apply an appropriate constitutive model using site-specific data to estimate both peak and seasonal snowmelt volumes. Calibrate this model to verify its reliability and verify there is sufficient pond capacity available to safely store the solutions or implement other management methods such as raincoats to reduce freshet volumes to manageable levels.

3.4. Total Storage Volume Available to Manage Solution (Section 4.4)

This section cites the available storage volumes for the ponds and dynamic storage as follows:

[5] MOE (1991). "Manual of Operational Hydrology for British Columbia," British Columbia Ministry of Environment, Water Management Division, Hydrology Section, Feb.

[6] Anderson, E. (2006). "River forecast system: Snow accumulation and ablation model – SNOW-17," US National Weather.

Table 3.4-1

Storage Medium	Capacity, cubic meters
In-heap Pond	74,600
Events Pond	299,900
Dynamic Storage (2 additional pumps working)	437,600
Total Pond plus Dynamic Storage	812,100

However, these figures are based on assumptions or forecasts which may not be applicable at the time the storage is needed. Specifically:

- During each spring/early summer period of 2020 and 2021, as well as spring 2022, the Events Pond has routinely had available capacity less than 299,900 m^3. Spring is the critical time of year for maintaining storage capacity;
- The In-heap Pond capacity test has been completed but the results have not yet been reviewed, and the actual available capacity will depend on the solution level rather than the design assumptions; and,
- The dynamic storage available in the heap depends on the availability of the fifth pump to be brought on-line and other factors discussed in Section 3.2, above.

Recommendations:

3.4: A range of available volumes along with the key variables influencing them should be cited rather than fixed (and potentially optimistic) quantities for dynamic storage.

3.5. Water Treatment Plant (Section 4.5)

WUL Clause 103e requires that the CWMP reflects the "requirements for the minimum daily capacity of the MWTP to treat HLF Solutions as identified in this License." Section 4.5 does not cite the plant's capacity or the License requirements. Further, to meet any minimum daily treatment rate the site would need to maintain an inventory of reagents and other supplies (including repair or replacement parts) ensuring that an adequate minimum daily capacity was available. These are absent from the CWMP.

Recommendations:

3.5a: List the minimum daily capacity of the MWTP to treat HLF solutions as required by WUL Clause 103e.

3.5b: List the required inventory of reagents and supplies along with their quantities to operate the MWTP and provide an inspection and reporting schedule to verify that the inventories are maintained. Alternatively, maintain said list in the MWTP operating plan and reference that in the CWMP.

3.6. General

The CWMP lacks triggers to implement the ERP or to otherwise explain how the CWMP links to the ERP. Examples of such triggers might include scenarios when discharge from the Events Pond is imminent[7] or severe distress is noted in heap leach embankment which could be a precursor to a dam failure.

[7] For example, this might include a sliding scale of pond level and its rate of rise to predict the day and time of discharge, which could be coupled with the available capacity in the Events Pond.

Recommendations:

3.6: Provide triggers in the CWMP for implementing the ERP.

4. Discussion Points – ERP

4.1. General

The ERP was prepared by Strata Gold Corporation (SGC) before construction of the Eagle Gold project was completed. As such, there are various outdated citations such as references to SGC (whereas other documents and plans refer to Victoria Gold Corp (VGC)) and discussions of future constructions which are now in service. These warrant a revision to bring such references current.

Recommendations:

4.1 Update the plan to reflect current operating conditions and as built facilities.

4.2. MAC and CDA Recommendations

The Mining Association of Canada (MAC) has two guidance documents relevant to this ERP. Section 4 of MAC 2019 discusses "Linkages with the emergency response plan;" further, Section 5 of MAC 2021 (which updates MAC 2019), discusses emergency response and emergency preparedness plans. This guidance is generally applicable to the heap embankment and, perhaps to a lesser extent, the events pond.

The Canadian Dam Association (CDA) Dam Safety Guidelines[8] includes a detailed section (Section 4) on emergency preparedness, including requirements for the ERP and emergency preparedness plan. As an indication of the level of detail, the CDA Section 4 is 9 pages long, much of which is applicable to the heap embankment. The CDA Guidelines also discuss the importance of developing partnerships between the dam owner, key downstream stakeholders and response agencies (see, for example, Principal 3c in CDA Section 1.3). While Section 5.3 of the ERP addresses communication with stakeholders during an emergency, the intent of the CDA guidelines is for emergency communications to begin well in advance of any emergency. This ERP may be a good place to include the framework for such partnerships.

Recommendations:

4.2: Add additional detail to the ERP to bring it into alignment with MAC 2019, MAC 2021, CDA 2013, and CDA 2019.

4.3. Emergency Classification (Section 5.2)

Table 5.2-1 Emergency Level Determination presents a good framework, but some refinement may be valuable. Examples of such refinements include:

- Ore heap: Shallow slope failures on heaps are commonplace and most often would not rise to emergency status, even Tier 1. Some thresholds for the size or extent of the failure may be valuable.
- Earthquake: Tier 3 should include not just "uncontrolled release of PLS from the HLF" but any conditions suggesting incipient failure of the dam. This might include a sudden change in piezometer levels, misalignment or blockage of an inclinometer, or movement of the survey monuments (visually noted or identified by survey).
- This table excludes any events at the process plant (such as those listed in Section 6).

[8] CDA (2013). "Dam Safety Guidelines 2007 (2013 Edition)," Canadian Dam Association. Section 4 is also referenced by the CDA Application of Dam Safety Guidelines to Mining Dams, 2019.

Recommendations:

4.3: Add detail and specificity to the table as consistent with current operations, including the ADR plant.

4.4. Emergency Scenario Causes, Preventative Measures and Response (Section 6)

Some of the language in this section could be more specific or clarified, and thereby more effective. Examples for the HLF embankment are listed below, but the same concepts apply to the other listed incidents. These are illustrative examples only and the intent of this recommendation can be achieved in a variety of manners. It is important to find proper balance between sufficient detail to materially improve response actions without unnecessarily complicating the plan.

- HLF Embankment Failure
    - Potential Causes
        - Hydraulic.
            - Overtopping of the dam crest during runoff event due to spillway plugging. However, overtopping for any reason (such as flows greater than the spillway's design capacity) would pose the same threat and require similar action.
        - Seepage:
            - Internal erosion/progressive piping of fines is just one of several potential seepage-related failure modes.
    - Preventative Measures
        - Maintain heap water balance operational criteria.
            - This is a potentially critical control but requires significantly more definition to be effective.
        - Preventative maintenance.
            - Without reference to a schedule of maintenance or the components which require preventative maintenance this may be ineffective.
    - Site Response
        - These are not tied to the potential causes, which could lead operations personnel to implement inappropriate responses. For example, if the In-heap Pond spillway is blocked the best and immediate response would be to clear the spillway, if possible, not pump solution to the Events Pond.
    - Potential Effects
        - These also include significant downstream damage and risk to human lives.
    - Follow Up
        - Cease pad loading and new solution application
            - Pad loading may not affect the embankment depending on the failure mode.
            - Ceasing new solution applicable could exacerbate the problem if this leads to more solution accumulation by releasing dynamic storage.

Recommendations:

4.4: Add details and clarify as needed, and tie Preventative Measures, Site Response, Potential Effects, and Follow Up to specific causes.

4.5. Evacuation (Section 8)

The first paragraph states "A full evacuation can only be authorized by the Mine Manager." Section 4.1 states "…only the IC [incident commander] has the authority to order the evacuation of personnel from the Project site…" The ERP does not specify who has the authority to authorize lesser evacuations, such as directing workers from the dam inundation zone (ERP Figure 8.1-1) to other areas of the site. Further, in the event of incipient failure of the heap embankment there may not be time to go through required channels and obtain the needed approvals, since once initiated dam failures can progress extremely rapidly.

Figure 8.1-1 shows the predicted inundation zone from a failure of the heap embankment and a single evacuation route, which generally parallels the inundation zone. The inundation zone continues off the right-hand edge of this map and shows the evacuation route crossing the inundation zone. Further, evacuating parallel to and near the inundation route is dangerous, especially considering that there are quicker and more reliable routes to high ground, and the optimum route which may be dependent on where workers are located.

Recommendations:

4.5a: Clearly identify authority and trigger events to order evacuation and make it clear that rapid evacuation is essential when there is a potential embankment failure.

4.5b: Update Figure 8.1-1 to reflect as built conditions and revise the evacuation routes to provide quicker access to high ground and to keep evacuation routes away from the inundation zone. Different routes may be needed for different locations.

4.5c: Expand Figure 8.1-1 or provide a second figure to show the entire extent of the inundation zone.

5.0 Summary of Recommendations

Tables 5.1a and 5.1b present a summary of the actions recommended herein, along with the suggested timing for their implementation.

Table 5.1a: Summary of Recommended Actions, CWMP

Topic & Section No.	Recommended Actions
Contingency Water Management (3.1)	3.1: Implement triggers linked with response actions consistent with WUL Clause 48 and the recommendations of MAC (2019 & 2021). These triggers and actions should be aligned with and, where applicable, linked to those in both the OMS and ERP. Said triggers and actions, where applicable to the In-heap Pond, should also include measures to protect the embankment.
In-heap Dynamic Storage (3.2)	3.2a: The dynamic storage capacity should be expressed relative to the key variables influencing it and provide operators a number of simple ways to conservatively estimate the capacity using available information. 3.2b: Increasing dynamic storage should also address the impacts on the heap draindown under a pumping system failure scenario when the 5th pump has been placed into service.
Snowpack Management (3.3)	3.3a: Develop specific triggers and response actions to implement the intent of WUL 102c. These should include triggers to implement actions such as snow removal from the heap (and methods for appropriate disposal in accordance with WUL Clauses 89 and 90), and other methods to reduce freshet. 3.3b: Apply an appropriate constitutive model using site-specific data to estimate both peak and seasonal snowmelt volumes. Calibrate this model to verify its reliability and verify there is sufficient pond capacity available to safely store the solutions or implement other management methods such as raincoats to reduce freshet volumes to manageable levels.
Total Storage Vol. Available (3.4)	3.4: A range of available volumes along with key variables influencing them should be cited rather than fixed (and potentially optimistic) quantities for dynamic storage.
Water Treatment Plant (3.5)	3.5a: List the minimum daily capacity of the MWTP to treat HLF solutions as required by WUL Clause 103e. 3.5b: List the required inventory of reagents and supplies along with their quantities to operate the MWTP and provide an inspection and reporting schedule to verify the inventories are maintained. Alternatively, maintain said list in the MWTP operating plan and reference that in the CWMP.
General (3.6)	3.6: Provide triggers for implementing the ERP in the CWMP.

Table 5.1b: Summary of Recommended Actions, ERP

Topic & Section No.	Recommended Actions
General (4.1)	4.1: Update the plan to reflect current operating conditions and as built facilities.
MAC and CDA Recommendations (4.2)	4.2: Add additional detail to the ERP to bring it into alignment with MAC 2019, MAC 2021, CDA 2013, and CDA 2019.
Emergency Classification (4.3)	4.3: Add detail and specificity to the table as consistent with current operations, including the ADR plant.
Emergency Scenarios, Causes, Prevention (4.4)	4.4: Add details and clarify as needed. Tie Preventative Measures, Site Response, Potential Effects, and Follow Up to specific causes.
Evacuation (4.5)	4.5a: Clearly identify authority and trigger events to order evacuation and make it clear that rapid evacuation is essential when there is a potential embankment failure. 4.5b: Update Figure 8.1-1 to reflect as built conditions and revise the evacuation routes to provide quicker access to high ground and to keep evacuation routes away from the inundation zone. Different routes may be needed for different locations. 4.5c: Expand Figure 8.1-1 or provide a second figure to show the entire extend of the inundation zone.

Please let me know if you have any comments or questions on this.

Sincerely,

PITEAU ASSOCIATES USA LTD.

Mark E. Smith, P.Eng. (YT)
Chief Advisor, Geotechnical