



**FORT KNOX GOLD MINE**

**PLAN OF OPERATIONS&WASTE MANAGEMENT PERMIT  
RENEWALS**

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Updated April 2026

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## **APPENDICES**

Appendix A	Walter Creek Valley Heap Leach Pad Operations & Maintenance Manual Rev. 19
Appendix B	Barnes Creek Heap Leach Pad Operations & Maintenance Manual Rev 4
Appendix C	Tailings Storage Facility Operations and Maintenance Manual Rev 12

## ACRONYMS

AAC	Alaska Administrative Code
ACOE	US Army Corps of Engineers
ADL	Alaska Division of Lands
amsl	above mean sea level
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish & Game
ADNR	Alaska Department of Natural Resources
APDES	Alaska Pollutant Discharge Elimination System
BCHLF	Barnes Creek Heap Leach Facility
Barnes Creek WRD	Barnes Creek Waste Rock Dump
CIC	carbon-in-columns
CIP	carbon in pulp
Code	International Cyanide Management Code for the Manufacture, Transport, and Use of Cyanide in the Production of Gold
Fish Creek WRD	Fish Creek Waste Rock Dump
ft	feet
FGMI	Fairbanks Gold Mining, Inc.
Fort Knox	Fort Knox Mine
MC	Manh Choh
NAG	non-acid generation
POO	Plan of Operations
RO	reverse osmosis
ROM	Run of Mine
SAG	semi-autogenous grinding
TPD	tons per day (milling or
TSF	tailings storage facility
VCWRD	Victoria Creek Waste Rock Dump
WCHLF	Walter Creek Heap Leach Facility
WMP	Waste Management Plan
WRD	waste rock dump
Yellow Pup WRD	Yellow Pup Waste Rock Dump

## INTRODUCTION

Fairbanks Gold Mining, Inc. (FGMI) is requesting the renewal of the Plan of Operations (POO) and the Waste Management Permit (WMP) for the Fort Knox Mine (Fort Knox). The current POO F20209852POOA.3 was issued on October 2, 2025, which included the Roman Hill Waste Rock Dump (WRD), in accordance with Alaska Department of Natural Resources, Division of Mining, Land and Water, Mining Section (ADNR) March 18, 2020, Fort Knox Mine POO and Fort Knox Mine Reclamation Plan extension letter to FGMI.

The current WMP (DB20140002 Modification 2) expired March 27, 2025. WMP DB20140002 Modification 2 remains in force pursuant to the provisions of 15 AAC 15.110(a). The WMP renewal application was submitted on December 24, 2024.

It was agreed upon by the Alaska Department of Natural Resources Division of Mining, Land, and Water (ADNR), Alaska Department of Environmental Conservation (ADEC), and FGMI that updated documents in support of the permit renewals will be provided to the two agencies by December 24, 2024. The following documents are included with this application:

- Fort Knox Mine Reclamation and Closure Plan including costs;
- Fort Knox Mine Pit Lake Evaluation;
- Fort Knox Mine Solid Waste Management Plan;
- Fort Knox Mine Monitoring Plan; and
- Plan of Operations, including:
  - Facility Description;
  - Walter Creek Heap Leach Pad Operations & Maintenance Manual;
  - Barnes Creek Heap Leach Pad Operations and Maintenance Manual; and
  - Tailings Storage Facility Operations & Maintenance Manual.

As of this renewal, Gil Satellite Mine is under temporary closure. No proposed mining operations are being conducted at the site. A POO modification request will be submitted to ADNR to amend the current authorization once the site returns to active status and mining operations resume.

### 1.1. Facility Description

Fort Knox is owned and operated by FGMI, a wholly owned subsidiary of Kinross Gold USA, Inc. Fort Knox is located in the Fairbanks North Star Borough, approximately 26-road miles northeast of Fairbanks, Alaska (Figure 1-1). FGMI maintains the mine access roads from the Steese Highway to Fort Knox. The road surface is graded to ensure a smooth-running surface and proper drainage. During the winter months, the Fort Knox

Road is kept free of snow and is sanded as necessary to maintain safe operating conditions.

The Fort Knox Mine and facilities encompass approximately 12,400 acres, of which there are no federal lands. The project area includes the Amended and Restated Millsite Lease (ADL 422542). FGMI Security patrols the mine site and access roads to ensure the safety of our employees, contractors, guests, and the public. Access is limited based on need and function.

Fort Knox is located along a belt of lode and placer deposits that comprise one of the highest gold-producing areas in Alaska. The deposit at Fort Knox is mined by conventional open-pit methods. The milling and mining operations at Fort Knox operate 24 hours a day, 365 days per year. Fort Knox processes ore onsite at a carbon in-pulp mill with a daily capacity of up to 45,000 tons. In recent years, Fort Knox has produced between approximately 250,000 and 400,000 ounces of gold annually. Major site facilities include the active open pit mine, mill, tailings storage facility (TSF) and Pit Lake, waste rock dumps, water storage reservoir, Walter Creek Valley Heap Leach Facility (WCHLF), Barnes Creek Heap Leach Facility (BCHLF), and water treatment plants (Figure 1-3).

During the initial Millsite Lease application process a series of public meetings were held to identify trail systems that would potentially be affected by mining activities. In 2011, Fort Knox initiated meetings with ADNR Trails and Easement Section to start the process of rerouting trails for future use. Meetings with ADNR continued in 2013. A formal application was submitted to the Trails and Easement Section with an alternate route in 2013. As part of this process, a public notice and comment period occurred in 2014. In 2015, ADNR executed the entry authorization for the approved Administrative Reroute of RST 644 Cleary Summit to Gilmore Dome Trail. In 2018, FGMI submitted an Application to Relocate Portions of RST644 and RST1931 trails to ADNR, Land. ADNR approved the application and construction was completed (Figure 1-4).

Fort Knox is a signatory company of the International Cyanide Management Code for the Manufacture, Transport, and Use of Cyanide in the Production of Gold (Code). The Code's development occurred in the early 2000s and implemented in 2005 for safe and responsible management of cyanide by an international multi-stakeholder committee under the auspices of the United Nations Environment Program and is administered by the International Cyanide Management Institute. As a signatory company, Fort Knox is required to meet the Code's Principles and Standards of Practice criteria, which is verified by strict independent third-party auditing. Fort Knox achieved Code certification in February 2008, received recertification in September 2011, February 2015, August 2018. Fort Knox was recertified in 2024. Fort Knox certification summary audit reports may be found at <http://www.cyanidecode.org>.

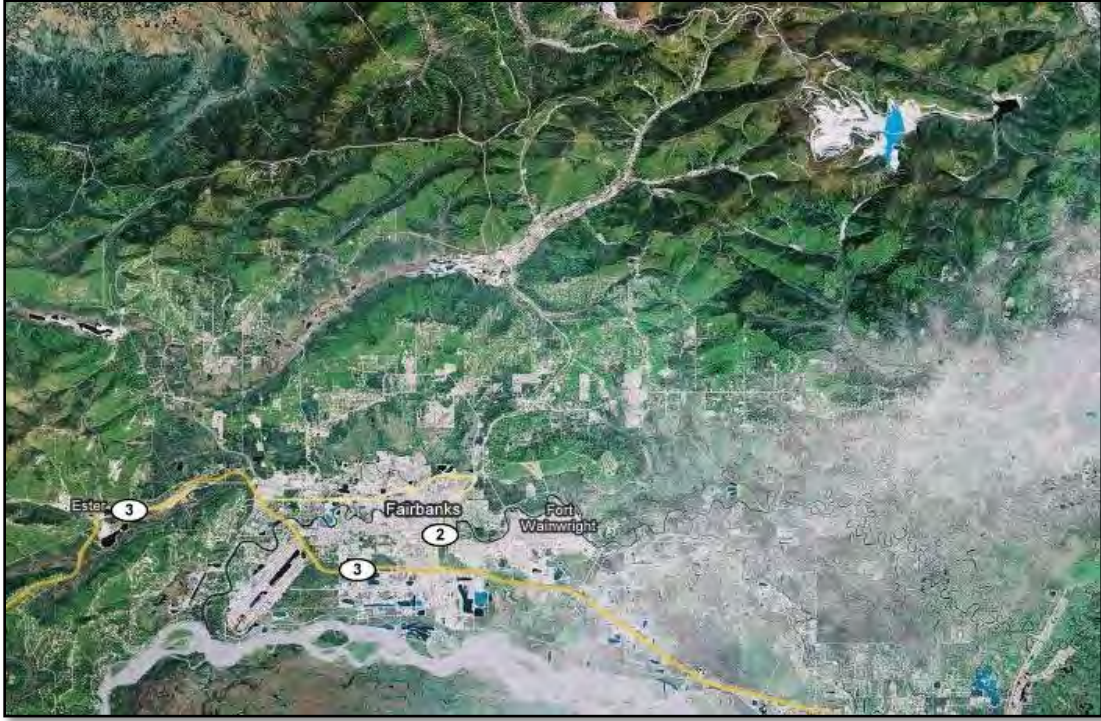


Figure 1-1: Site Location and Vicinity

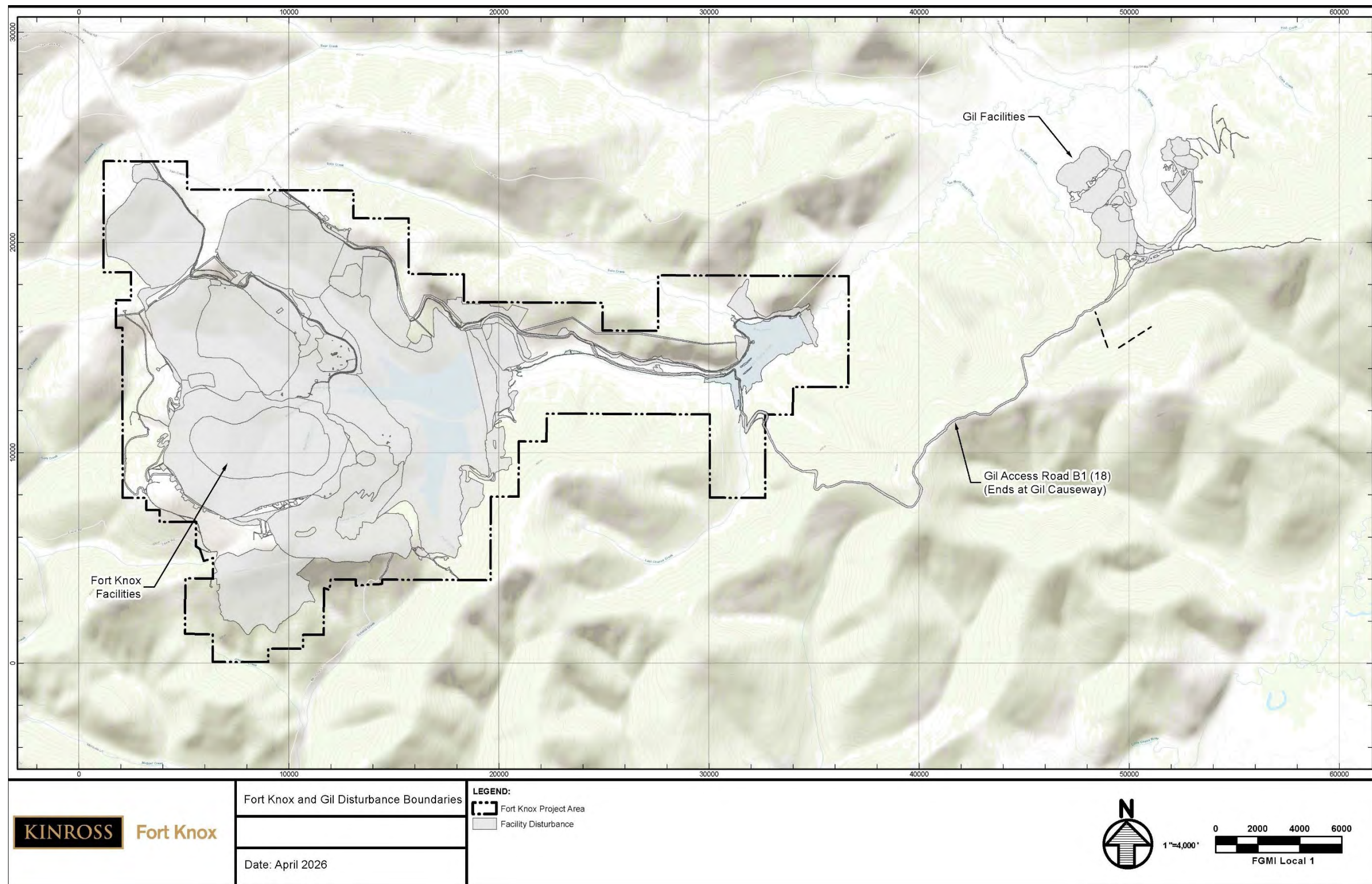


Figure 1-2: Site Disturbance Area

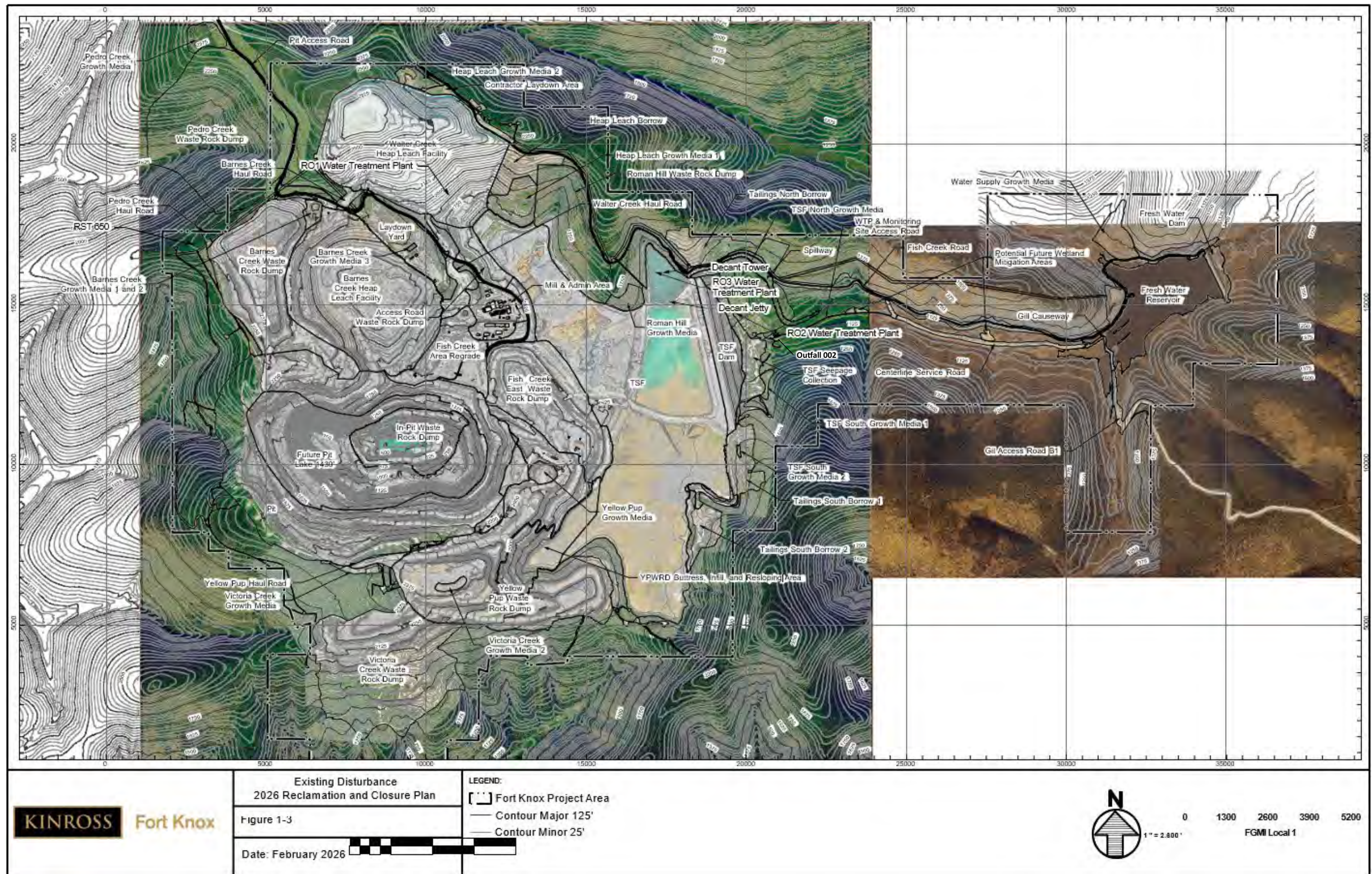


Figure 1-3: Fort Knox Boundary and Facilities



Figure 1-4: RST 644, 650, and 1931 Partial Relocations

### 1.1.1. **OPEN PIT MINE**

The Main Pit is shown in Figure 1-3. Mining operations continue 24-hours per day, 365 days per year at Fort Knox. Ore and waste are mined using standard drilling and blasting techniques with shovel and haul truck fleets to move the material. Blast holes are sampled and assayed for production grade control purposes. Material is hauled to the rock dumps, primary crusher, heap leach, or low-grade stockpiles depending on grade.

Fort Knox directly employs 746 people. Additionally, there are generally between 50 and 150 contractor personnel working at Fort Knox. The average onsite staffing is between 300 and 375 people.

The mining equipment fleet at the Fort Knox Mine includes:

- 3 Hitachi EX5600 loading shovels;
- 2 Caterpillar 994 wheel loaders;
- 1 Caterpillar 992 Wheel loader;

- 28 Caterpillar 793 Haul Trucks;
- 2 Caterpillar 789 haul trucks;
- 8 Rotary Blasthole Drills;
- 9 Caterpillar tracked bulldozers (D10/D11 class);
- 3 rubber tired dozers;
- 6 Caterpillar Motor Graders (16/18 class); and
- 8 blast trucks.

In addition to mining fleet, Fort Knox maintains a fleet support equipment that includes small loaders (966 class and below); cranes; telehandlers; skid steers, and pickups.

In 2025, mining within the Fort Knox open pit occurred in Phase 9 and Phase 10. Phase 9 mining commenced in the 3<sup>rd</sup> quarter of 2019. Stripping for phase 9 continued through the 2<sup>nd</sup> quarter of 2020 before sustained ore was achieved. Phase 9 mining ended in the 2<sup>nd</sup> quarter of 2025.

Phase 10 stripping commenced in 2022 and is expected to continue through the 2<sup>nd</sup> quarter of 2025, when sustaining ore will be achieved. Phase 10 mining is anticipated to end in 2028.

### **1.1.2. MILL**

Mill feed is first crushed to minus 6 inches in the primary gyratory crusher located near the Fort Knox pit and then conveyed to a coarse-ore stockpile located near the mill. The crushed material is conveyed to a semi-autogenous grinding (SAG) mill. Some hard ore of a critical size is rejected from the SAG mill discharge to increase throughput. This material is crushed and stockpiled for use on the BCHLF.

The remainder of the material from the SAG mill operates in an open circuit and feeds a ball mill. The ball mill operates in a closed circuit through a cyclone pack. The cyclone packs regulate the size of material that is allowed to move beyond the grinding circuit. A gravity gold recovery circuit operates in conjunction with the grinding circuit. It consists of three Knelson concentrators.

Correctly sized material flows into a high-rate thickener and then into leach tanks where cyanide is used to dissolve the gold. Activated carbon is used in the carbon-in-pulp circuit to absorb the gold from the cyanide solution. Carbon particles loaded with gold are removed from the slurry by carbon screens and are transferred to the gold recovery circuit. In this circuit, the gold is stripped from the carbon using a strong alkaline cyanide solution by electro-winning, where it is plated onto a cathode. The gold is removed from the cathode mechanically and melted into doré bars for shipment to an offsite refinery for final processing. Mill tailings are discharged into the TSF below the mill.

Fort Knox Process has been modified to include the transportation of Run of Mine (ROM) ore from the Manh Choh (MC) mine site to the Fort Knox processing facility.

Starting in 2024, MC ore is campaigned through the Fort Knox concentrator at a rate of 12,000 Tons per Day (TPD) for 21-30 days approximately four times a year. The MC ore is processed using the existing milling flow sheet except for some modifications. Instead of the SAG mill screen oversize being sent to reject, it is recirculated to the ball mill after being crushed. Other existing Fort Knox equipment and facilities with the capacity for processing Manh Choh ore are utilized (e.g., gold smelting facilities, leaching, and carbon in pulp (CIP) circuits) with minor modifications. Leach Tanks 1 through 4 are utilized as Pre-Aeration tanks with cyanide being added in Leach 5. Before MC tailings are discharged, they go through a detox circuit. Following detox, the final tailings are discharged into the Pit Lake. Additionally, no MC material is sent to the Heap Leach Facilities.

### **1.1.3. TAILINGS STORAGE FACILITIES**

The main TSF area is inclusive of the Fish Creek TSF Dam, The Pearl Creek Causeway (PCC), the mill tailings and decant ponds behind the dam, and the seepage interception and monitoring systems present at the base of the dam. The tailings depositional area is within the Fish Creek drainage and includes portions of the Walter Creek, Pearl Creek, and Yellow Pup drainages.

In addition to mine tailings, the TSF Dam is also used to store the water which will be used in the milling and heap leach processing circuits. Water storage is upstream of the TSF dam and is divided into two primary basins, the Barge pond, and the North pond. The barge pond is approximately 18 acres and the north pond ranges between 300 to 400 acres depending on water level. As of January 30, 2026, estimated total water storage in the TSF was approximately 1,550 acre-feet of water between both ponds.

Starting in 2024, Fort Knox commissioned a second TSF area within the existing open pit, referred to as the Pit Lake. Placement of mill tailing and storage of water started in May 2024 and has continued. As of January 30, 2026, approximately 5.1 million tons of tailings and 7,180 acre-feet of water have been deposited in the Pit Lake. In total between the TSF Dam and Pit Lake, the site was estimated to have 9,700 ac-ft of water stored at the end of January 2026.

The TSF dam is approximately 4,600 feet long and has a crest height of 395 feet. A TSF dam raise was completed in October 2025 raising the crest to an elevation of 1565 amsl. Construction of the dam is a modified centerline design. It impounds all of the tailings generated by the mill (Figure 1-3). The TSF and the mill form a closed system for process water. Water used in the mill is pumped from the decant pond, and this process water is returned to the decant pond in the tailings slurry after the slurry has been processed to comply with cyanide threshold levels in accordance with the mine's Waste Management Permit.

#### **1.1.4. WASTE ROCK DUMPS**

Waste rock from development of the pit is placed in one of the following waste rock dumps (WRD): Yellow Pup WRD, Barnes Creek WRD, Fish Creek WRD, Fish Creek WRD Expansion, Access Road WRD, Roman Hill WRD, Victoria Creek WRD, or Pedro Creek WRD (Figure 1-6). The Barnes Creek WRD is currently at capacity and can only accept a very limited amount of additional waste rock. Construction of all WRDs are similar consisting of end dumping in shallow benches in a bottom up. The benches are developed to allow for regrading at closure and provide a consistently sloped surface from top to bottom of the dump face.

##### **1.1.4.1. Yellow Pup WRD**

The Yellow Pup WRD is located between the pit and TSF facility, near the southern boundary of the Mill Lease Site permit boundary. Construction of the Yellow Pup WRD began shortly after commencement of mining waste rock placement continued through mid-year 2024. The Yellow Pup WRD will reach an ultimate elevation of 2,400 feet (ft) above mean sea level (amsl). The Yellow Pup WRD contains non-acid generating (NAG) waste rock. The reclamation footprint is approximately 438 acres.

##### **1.1.4.2. Barnes Creek WRD**

The Barnes Creek WRD is located on the north side of the pit between the western boundary of the Mill Lease Site permit boundary and the BCHLF. Construction began in 2011 and continued through mid-year 2022. The Barnes Creek WRD has reached its maximum elevation of 2,450 ft amsl. The Barnes Creek WRD contains NAG waste rock. The reclamation footprint is approximately 245 acres.

##### **1.1.4.3. Fish Creek WRD**

The Fish Creek WRD was constructed as part of the initial development of the Main Pit. Waste rock placement began during initial stripping of the pit and consisted of waste rock and, at the time, uneconomical low-grade ore. The low-grade ore has since been relocated to the WCHLF for recovery through leaching. A small portion of the original dump remains and was incorporated into the Fish Creek WRD Expansion. The Fish Creek WRD will reach an ultimate elevation of approximately 1,900 ft amsl. The Fish Creek WRD contains NAG waste rock. The reclamation footprint is approximately 213 acres.

##### **1.1.4.4. Fish Creek WRD Expansion**

The Fish Creek WRD Expansion incorporated the original Fish Creek WRD into an expansion that encroaches on the eastern limit of the TSF. The Fish Creek WRD Expansion will reach an ultimate elevation of approximately 1,900 ft amsl. The Fish

Creek WRD Expansion contains NAG waste rock. The reclamation footprint is included in the Fish Creek WRD footprint.

#### **1.1.4.5. Access Road WRD**

The Access Road WRD is located adjacent to the central pond of the TSF, southeast of WCHLF, directly north of the Mill and Admin Area. The dump is constructed on a site previously used for mill reject stone storage. Waste rock will be placed to a maximum height of approximately 175 feet, reaching a final elevation of about 1,750 ft-amsl. The dump covers an area of approximately 39 acres.

#### **1.1.4.6. Roman Hill WRD**

The Roman Hill WRD was permitted in 2024 as a two-phase project. Initial stripping and site preparation of the first phase (northern 2/3 of the final footprint) began in January 2026. The Roman Hill WRD is located along the northeastern margin of the Walter Creek drainage between the WCHLF and the TSF. The Roman Hill WRD will contain NAG waste rock. The reclamation footprint is approximately 141 acres.

#### **1.1.4.7. Victoria Creek WRD**

The Victoria Creek WRD is located south of the YPWRD and primarily consists of two distinct construction locations. The northern location is constructed over a portion of the existing YPWRD footprint and onto adjacent undeveloped land. The southern location is located south of the YPWRD on a south facing slope of the upper reaches of the Victoria Creek watershed. The dump will reach an ultimate elevation of approximately 2,300 ft-amsl and will have a footprint of approximately 323 acres.

#### **1.1.4.8. Pedro Creek WRD**

The Pedro Creek WRD is a proposed WRD facility. Planned waste rock placement in the Pedro Creek WRD will be in mid-June 2026. The Pedro Creek WRD is located north of the Main Pit at the top of the Pedro Creek drainage west of the Twin Creek Access Road in Sections 05, 06, 07, and 08, Township 2 North, Range 002 East, Fairbanks Meridian. The Pedro Creek WRD will contain NAG waste rock. The reclamation footprint is approximately 375 acres.

Access to the Pedro Creek WRD will be provided by a new haul road that will parallel the western and northern toe of the Barnes Creek WRD adjacent to Revised Statute Trail 650. To maintain continued pedestrian access along the trail corridor, a tunnel structure will be constructed over the trail alignment.

#### **1.1.4.9. In-Pit Waste Storage**

Over the course of mining, approximately 20 million tons of tailings and 84 million tons of waste rock will be placed within the lower elevations of the eastern pit bottom.

#### **1.1.5. WATER STORAGE RESERVOIR**

The downstream water storage reservoir (Freshwater Reservoir) including the dam, causeway, and spillway complex, encompasses approximately 173 acres and is located on Fish Creek approximately three miles below the TSF. Overall, the structures associated with the water reservoir are in good working order.

The Freshwater Reservoir dam is a zoned fill embankment that contains a relatively impervious seal zone constructed of highly weathered schist. Sand filter zones are located upstream and downstream of the seal zone followed by upstream and downstream transition zones constructed of weathered schist. Upstream and downstream random rockfill zones complete the embankment cross section. The upstream face has a riprap layer of wave erosion protection. The embankment includes a grout curtain installed in the bedrock below the seal zone cut off trench and a gravel drain incorporated into the downstream toe of the embankment. The toe drain is directed to a sump to collect seepage passing through the embankment for recycling back to the reservoir if required.

There is a concrete open channel spillway with a low flow channel adjacent to the Freshwater Reservoir dam. The low flow channel provides protection by reducing the build-up of ice in the spillway chute during winter months.

A low-level outlet system consisting of a primary valve on the upstream end of a 30-inch outlet pipe located in a valve house situated on the Freshwater Reservoir dam crest adjacent to the spillway. The valve is manually operated and is provided for drainage of the reservoir for maintenance and repairs and can provide additional drainage in emergency situations.

Solo Creek Causeway is an embankment crossing Solo Creek to accommodate access road to the Freshwater Reservoir dam. A single galvanized corrugated steel pipe was installed to carry flow from Solo Creek to the Freshwater Reservoir.

The Fresh Water Pump House houses the infrastructure that pumps make-up water from the reservoir to the Barge Pond and mill. There are two lines, one for each destination. The make-up water is used for the beneficiation process of the gold ore. The two lines run parallel to the Fish Creek Road on the surface. Vegetation that grows around the pipeline is removed for inspection as needed.

### **1.1.6. WALTER CREEK HEAP LEACH FACILITY**

The WCHLF is in the upper end of the Walter Creek drainage upstream from the TSF (Figure 1-3). Excluding the haul road and access roads, the WCHLF encompasses approximately 435 acres and contains approximately 307 million tons of ore. WCHLF was constructed in ten stages as a valley-fill type of facility. Ore for the WCHLF consists of run-of-mine rock from the Main Pit and various stockpiles.

Barren solution is applied on the heap leach using drip emitters. The solution flows through the run-of-mine ore dissolving gold in solution. The pregnant solution then flows to the in-heap storage reservoir, with a maximum capacity of 113,800,000 gallons. The pregnant solution collected in the in-heap storage reservoir is pumped to the two Carbon-In-Columns (CIC) plants using pumps located in the in-heap storage reservoir. Barren solution and pregnant solution are pumped in separate pipes between the heap leach pad and CIC 1 and CIC 2 plants through a lined corridor. Loaded carbon is processed in the Fort Knox mill facilities.

The WCHLF was brought into production in 2009. On October 13, 2009, ADNR issued a Certificate of Approval to operate the heap leach dam. On October 14, 2009, FGMI began filling the in-heap storage pond. In November 2009, FGMI had the first gold pour from heap leach production.

In 2011, construction of Stage 3 of the heap leach pad began and its construction completed in 2013. The Stage 4 construction of the heap leach pad began in 2012 and was completed in 2014. The Stage 5 construction began in 2012 with clearing and grubbing, and construction was completed in 2015. The Booster Pump Station was constructed in 2015. Stage 6 clearing and grubbing occurred in 2015, and construction continued and was completed in 2017. Stage 7 construction began and was completed in 2017. Construction of Stages 8, 9, and 10 were completed in 2018. New ore is not currently being added to the WCHLF.

### **1.1.7. BARNES CREEK HEAP LEACH FACILITY**

The BCHLF is located south of the WCHLF, upstream and west of the tailings impoundment. The BCHLF received approval for construction in 2017 (Figure 1-3). The BCHLF will be constructed in six phases. Phase One construction started in 2018 and consisted of foundation preparation for the secondary liner deployed in 2019. Loading of the BCHLF started in 2020. The final phases will be constructed in 2026 and reach elevation 2,340 ft amsl equating to a height of 810 ft from toe to crest.

Low-grade ore from the Phase 9 and Phase 10 pit expansion will be hauled to and leached on the BCHLF. The Phase 9 and 10 pit expansion will produce 155 million tons of low-grade ore for leaching at the BCHLF. Phase 9 ore brought the BCHLF elevation to 1,840 ft amsl.

The Phase 10 pit expansion will produce an additional 117 million tons of ore leached on the BCHLF. The BCHLF will be completed to an elevation of 2,340 ft amsl. The total reclamation footprint will encompass approximately 297 acres. Currently, there are 172.2 million tons that have been placed on the BCHLF, with a total of 222.18 million tons by life of mine.

### **1.1.8. WATER TREATMENT PLANTS**

Since the TSF design did not have capacity to contain all water until the end of mine life, an Alaska Pollutant Discharge Elimination System (APDES) permit application was submitted to the DEC, Division of Water in early 2012. DEC granted FGMI an APDES permit in August 2012 and effective October 2012 to discharge non-process and non-contact groundwater extracted from pit dewatering wells into the Old Fish Creek Channel (Outfall 001) from which it flows to the freshwater reservoir. Since receiving the APDES permit and until March 3, 2015, there was no discharge of dewatering well water. Discharge of dewatering well groundwater that did not require treatment began on March 4, 2015. The APDES permit was reissued by the DEC on April 30, 2018, became effective June 1, 2018, and expires on May 31, 2023. Under DEC regulation 18 AAC 83.155(c)(1), the existing permit will remain effective and enforceable until a new permit is issued. The reissued permit authorizes discharge to two outfalls (Outfall 001 and Outfall 002) at an annual rate of 4.8 billion gallons. With the reissuance of the APDES permit, treatment systems may treat and discharge waters from mine drainage and facility processes, waste streams, and operations.

FGMI operates three reverse osmosis treatment systems and is authorized by the APDES permit to discharge to Outfall 001 and Outfall 002. Location of the treatment systems and outfall are identified in Figure 1-3.

#### **1.1.8.1. Reverse Osmosis Water Treatment Plant One**

The reverse osmosis water treatment system (RO1) for the dewatering well groundwater that required treatment before sending treated water (permeate) to RO2, became operational in 2016.

#### **1.1.8.2. Reverse Osmosis Water Treatment Plant Two**

The second reverse osmosis water treatment system (RO2) for the TSF seepage and intercept water was approved for construction by DEC in 2017. RO2 was constructed and underwent commissioning activities and became operational on January 15, 2019, and began discharging to Outfall 002.

### **1.1.8.3. Reverse Osmosis Water Treatment Plant Three**

A temporary reverse osmosis treatment system (RO3) for the TSF water was approved for construction by DEC in 2019. RO3 was constructed and underwent commissioning activities in 2019 and became operational June 22, 2019, and began sending treated water (permeate) to the RO2 treatment system.

## **2. SUPPORTING DOCUMENTS**

FGMI operates under the following major operating permits and plans.

### **2.1. Plan of Operations**

Plan of Operations No. F20209852POOA.2, which was issued October 2, 2025, includes the new Roman Hill WRD located next to the WCHLF. FGMI submitted a renewal application letter to ADNR on February 22, 2019, and a letter to extend the Plan of Operations to March 27, 2020, was issued to FGMI by ADNR on March 18, 2019. The Fort Knox Mine Plan of Operations has included amendments and approvals by ADNR from March 1994 to August 2019.

### **2.2. Reclamation and Closure Plan**

The Fort Knox Mine Reclamation and Closure Plan (Plan) No. F20209852RPA was approved by ADNR on March 25, 2020. Since 2020, there have been three additional amendments with the current amendment, No. F20209852RPA.3, issued on October 2, 2025 which includes the new Roman Hill WRD. The Plan includes the estimated costs associated with reclamation and closure of the Fort Knox Mine. The Plan describes the procedures and processes to return land disturbed by mining and ore processing operations to a stabilized condition that will provide long-term protection of land and water resources. Additional goals include reducing the effects of disturbance during mining, implementation of concurrent reclamation where appropriate, reducing or eliminating long-term management requirements, management of the dams for the protection of life and property, and meeting state and federal regulatory requirements. The Plan describes the schedule for reclamation, general reclamation procedures, and the methods for achieving the final closure requirements and objectives. In addition, the Plan serves as a basis for calculating reclamation costs and the amount of the financial assurance. The October 2025 plan update is submitted under separate cover.

### **2.3. Waste Management Permit**

Waste Management Permit No. 2020DB0002 was issued by DEC on March 25, 2024. FGMI submitted a renewal application letter to DEC on December 24, 2024. in accordance with condition 37 of the permit. Until renewal of the WMP is issued, the

current WMP remains effective as specified by 15 AAC 15.110(a). The following documents are associated with the permit.

- Fort Knox Mine Solid Waste Management Plan, Update July 2023. The July 2023 update is provided with this POO and WMP renewal document.
- Fort Knox Mine Monitoring Plan, Update August 2024. The August 2024 update is provided with this POO and WMP renewal document.
- Fort Knox Mine Pit Lake Evaluation. The February 21, 2024, Pit Lake Evaluation was previously submitted to DEC and ADNR on March 5, 2024.
- The third-party facility audit was conducted in 2024 in accordance with condition 2.8 of the WMP and the Environmental Audit condition of the POO. The revised final report (*Environmental compliance and Management Systems Audit, Fort Knox gold Mine, Revised December 19, 2024*) was provided to Mr. William Groom (Large Mines Project Manager) on December 24, 2024.

## **2.4. Title 1 Air Quality Control Minor Permit**

Air Quality Control Minor Permit No. AQ0053MSS05 was issued by the ADEC Division of Air Quality on July 11, 2025, replacing Minor Permit No. AQ0053MSS04, which remained in effect until July 11, 2025. The Air Quality Control Minor Permit does not have an expiration date.

The minor permit authorizes owner requested limits to reduce allowable emissions of all regulated pollutants to below 100 tons per year to avoid the need for an operating permit. The permit contains requirements for Fort Knox stationary sources including onsite generators, boilers, and pumps operating on fuel oil and used oil.

## **2.5. Title V Air Quality Operating Permit**

Air Quality Operating Permit No. AQ0053TVP04 was issued by the ADEC Division of Air Quality on August 14, 2023, and expires on August 14, 2028. First revision of this operating permit was issued on July 10, 2025.

The operating permit authorizes operation of the Fort Knox stationary sources that include induction furnaces, carbon regeneration kilns, five electrowinning cells, pregnant solution tanks, and two activated carbon emission control beds.

## **2.6. Water Use**

FGMI has received water use appropriations from ADNR Water Resources Program for operating the Fort Knox Mine. These appropriations include:

- LAS 13986 - Water Right Certificate of Appropriation for 5,350 acre-feet per year: Fish Creek for Freshwater Reservoir impoundment for Mining and Milling

and 456.57 acre-feet per year: Fish Creek for Mining and Milling, December 11, 1992, priority date

- LAS 13987 - Water Right Certificate of Appropriation for 724 acre-feet per year: Interceptor Wells for Mining and Milling, December 11, 1992, priority date
- LAS 13988 - Certificate of Appropriation for 5,245 acre-feet per year: Fish Creek for Mining, Milling, Heap Leach, December 11, 1992, priority date
- LAS 21760 - Water Right Certificate of Appropriation for 1,600 acre-feet per year: Dewatering Well Field, February 3, 1998, priority date
- LAS 28158 - Permit to Appropriate Water for 4,043 acre-feet per year: Dewatering wells for Mining and Milling, July 20, 2010, priority date
- LAS 28160 - Permit to Appropriate Water for 3,000 acre-feet per year: Drilled wells for Mining and Milling, July 20, 2010, priority date
- LAS 28161 - Permit to Appropriate Water for 13,255 acre-feet per year: TSF & Heap Leach for Mining, Milling, and Heap Leach, July 20, 2010, priority date
- LAS 33002 - Permit to Appropriate Water for 20,000 acre-feet per year: TSF for Mining and Milling, July 24, 2019, priority date
- LAS TWUA F2025-066 - Temporary Water Use Authorization for 17,280,000 gallons per day: Withdrawal from the Pit Lake for pit dewatering, July 16, 2025, priority date.

## **2.7. Jurisdictional Dams**

FGMI has received approvals from ADNR Dam Safety Program to construct, modify, and operate the following Fort Knox Mine dams.

- AK00211 - Fort Knox Water Dam;
- AK00212 - Fort Knox Tailings Dam;
- AK00310 - Walter Creek Heap Leach Pad Dam;
- AK00315 - Barnes Creek Heap Leach Pad Dam; and
- AK00311 - Pearl Creek Causeway Dam

## 2.8. Fish Habitat

FGMI has received fish habitat permits from the Alaska Department of Fish and Game (ADF&G) for the Fort Knox Mine operations. Fish habitat permits that have been issued are listed below:

<u>Permit Number</u>	<u>Issuance Date</u>	<u>Expiration Date</u>	<u>Permit Scope</u>
FG93-III-0201	2/15/1994	Life of Structure	WSR Dam
FG93-III-0202-A1	11/20/2014	Life of Structure	Solo Creek Culvert
FH15-III-0218-A2	7/22/2021	Life of Structure	Fish Creek Pond F
FH17-III-0181	10/4/2017	Life of Structure	Fish Creek Beaver Dam Removal
FH18-III-0039-A1	4/22/2021	Life of Structure	RO Channel Culverts
FH18-III-0118-A1	8/25/2022	8/31/2027	Twin, Pedro, Deadwood Creeks
FH21-III-0076-A1	7/30/2021	Life of Structure	Gil Causeway Culvert
FH21-III-0111-A1	5/24/2022	12/31/2026	WSR/Last Chance Creek Water Withdrawal
FH25-III-189	10/10/2025	12/31/2030	Gil Pond/Last Chance Creek Water Withdrawal
FH25-III-0251	12/1/2025	12/31/2030	WSR/RO Channel Water Withdrawal

## 2.9. Wetlands

FGMI has received US Army Corps of Engineers (ACOE) permits authorizing the discharge of fill material into waters (including wetlands) of the United States in conjunction with hard rock mining activities in the Fish Creek drainage. The permits include the original Permit No. POA-1992-574 (4-920574) and its modifications since 1994.

### **3. FINANCIAL ASSURANCE**

As required by ADNR, DEC and ACOE, the financial assurance amount was revised and updated to reflect current 2024 plans for Fort Knox. The annual adjustment of financial assurance amount approved by the agencies is \$102,235,000.00 for Fort Knox. The financial assurance letter of credit (Irrevocable Standby Letter of Credit No. S18572/260177, Amendment No. 14) was issued by the Bank of Nova Scotia on July 17, 2023, and provided to ADNR.

A revised financial assurance amount and adjustment to the financial assurance letter of credit will be provided to ADNR once the updated Fort Knox Reclamation and Closure Plan and costs are approved at the proposed amount of \$218,337,824.

**APPENDIX A**

**WALTER CREEK VALLEY HEAP LEACH PAD OPERATIONS & MAINTENANCE  
MANUAL  
REV. 19**

**KINROSS**

**Fort Knox**

**WALTER CREEK VALLEY FILL  
HEAP LEACH PAD  
OPERATIONS & MAINTENANCE MANUAL  
REVISION 18**

**Fairbanks Gold Mining, Inc.  
A Subsidiary of Kinross Gold Corporation  
P.O. Box 73726  
Fairbanks, Alaska 99707-3726**

**December 2023**

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# Walter Creek Valley Fill

## Heap Leach Pad

### Operations & Maintenance Manual

#### Preface

---

This document is the Operations & Maintenance Manual (O&M Manual) for the Fairbanks Gold Mining, Inc. (FGMI) Walter Creek Valley Fill Heap Leach Pad (WCHL) located near Fairbanks, Alaska in the North Star Borough. This O&M Manual has been prepared to facilitate both effective and efficient practices for the operation, maintenance, surveillance, and documentation of the facility. This document contains information and instructions that will assist FGMI operations and maintenance personnel in the performance of their duties; as well as contribute to their training in recommended procedures. Also included in this manual is an organizational chart showing key personnel, and a remedial action contingency plan that covers general emergency response and communication procedures.

Proper O&M is crucial for the WCHL to operate safely and efficiently, of which this manual is an essential component of the O&M program. Owing to the lengthy and cold winters experienced at the site, the WCHL was constructed to contain an internal process solution storage pond, which resides behind an embankment dam at the toe of the heap. This manual presents the procedures for operation of the pond under normal or extreme conditions and provides technical guidance and procedures for monitoring, inspection, and long-term maintenance programs. Also contained are descriptions of unusual conditions that might occur at the dam and the operating procedures and inspections that should be followed under those conditions.

As with any structure of this complexity, the operations manual may not foresee every potential problem. However, with a well-conducted training program, careful observation, and regular inspection, unusual circumstances will be identified and brought to management's attention to be appropriately addressed.

It should be noted that for the majority of the time over the life of the WCHL, the inspection and monitoring program will be routine and encounter no surprises. However, close attention and continued diligence on the part of the operation is required so that potential problems will be identified early and remediated prior to becoming significant. This can only be achieved with the ongoing commitment and support of operating personnel and management at all levels of the operation

Monitoring equipment, procedures, and instrumentation are required to accomplish the following:

- Confirm that the structure is performing in accordance with the design
- Determine if a problem exists that may require remediation
- Provide timely notice of an adverse change in the state of the dam or in-heap storage pond

The facility descriptions presented in this manual are summary descriptions designed to serve as a basis for presenting the O&M and monitoring procedures. The reader should refer to the more detailed descriptions presented in the design and record of construction reports as situations warrant.

In this manual figures are provided to aid in the understanding of the operation and maintenance of the WCHL facility and have been copied from drawings in:

- "Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Facility Design Report", Revision 2, March 27, 2007 prepared by Knight Piésold and Co. of Denver, Colorado
- "Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Expansion Report on Final Design Issued in Final Revision 0", June 7, 2017 prepared by Knight Piésold and Co. of Denver, Colorado
- Construction related Addendums
- The latest edition of the Construction Completion Report.

## Section 1.0 - Introduction

---

### 1.1 Purpose and Objective

This O&M Manual exists to provide a descriptions of the Walter Creek Heap Leach (WCHL) facility and related methods and procedures that will help to ensure that each component of the facility is performing as designed and constructed. In addition, it will help to provide for early detection of component damage, degeneration and/or performance outside the limits of the design intent so that appropriate remedial measures and actions can be implemented.

### 1.2 Scope

This O&M Manual describes the roles of responsible parties and the procedures that will be used for the operation, maintenance, inspection, and monitoring of the WCHL. It specifically addresses components of the facility including: the in-heap storage embankment, the composite liner system, the foundation underdrain, the process component monitoring system (PCMS), the leachate collection and recovery system (LCRS), monitoring systems, surface water controls and related facilities. Also included within the manual is an emergency response plan that outlines responses for various emergency scenarios.

### 1.3 Overview of the Heap Leach Pad

The WCHL is a gold heap leach pad located in the upper end of the Walter Creek drainage immediately upstream from the Fort Knox tailing impoundment facility. Run-of-mine ore from the Fort Knox pit and existing ore stockpiles is stacked in the lined containment area located behind and above the in-heap storage embankment, which is constructed in the upper reaches of the Walter Creek drainage. The design capacity of the WCHL is approximately 307 million tons. Ore is loaded on the pad in incremental lifts which are 50' tall. A general arrangement of the WCHL facility can be viewed in the next section in Figure 2-1. A Project Data Sheet presenting key statistics for the WCHL is available in Appendix A.

As part of a robust design, extensive monitoring systems and flow controls were included in the construction of the WCHL facility. The systems described below allow for ongoing assessment and assurance that the facility is performing as expected.

- 1) A visual inspection and reporting program has been implemented. Participants in the program perform inspections and file reports at various routine and non-routine frequencies and include FGMI, the Engineer of Record, State of Alaska Dam Safety Engineer, Alaska Department of Natural Resources (ADNR) and the Alaska Department of Environmental Conservation (ADEC). Only the FGMI inspection points and report details are covered in this document.
- 2) A number of vibrating wire piezometers are installed throughout the facility. Piezometers are used to measure fluid levels and feet of pressure present on a given area. There are piezometers located in the LCRS and corresponding sump, as well as in the overliner of the in-heap pond and liner expansions above.
- 3) Ground movement and settlement survey monuments have been installed on the in-heap embankment crest, pipeline bench road, base platform bench crest, and on the tops of the solution collection wells.
- 4) A process component monitoring system (PCMS) has been installed in each of the three western drainages where concentrated solution flows are anticipated. The PCMS monitors for leaks through the liner beneath the solution collections headers, which sit above the elevation of the in-heap storage pond.
- 5) The LCRS includes a pump back system that will collect and return any solution passing through the primary liner of the double lined pond back into the in-heap storage pond.
- 6) To prevent existing ground water below the liner from negatively impacting the facility, an underdrain system has been installed beneath the lined base of the WCHL in the valley bottom. This facilitates the capture and transport of flow from seeps and springs under the pad.

On WCHL, the gold recovery process follows the general steps outlined below:

- 1) A non-gold enriched (barren) solution consisting of a dilute alkaline cyanide is applied across the surface of the pad through a network of drip tube emitters.
- 2) The barren solution slowly percolates through the run of mine ore down to the in-heap pond and collects. Along its journey downward, barren solution accumulates gold in solution.
- 3) Gold enriched (pregnant) solution is recovered from the in-heap storage pond through operation of five vertical solution collection wells. These wells are located at the lowest portion of the in-heap pond, and are just up gradient of the upstream toe of the WCHL embankment.
- 4) Pregnant solution is pumped directly to the Carbon-in-Column (CIC) plants for gold recovery.
- 5) The now barren solution from the CIC plants is pumped back to the WCHL where it goes through an intermediate booster station and arrives back at the top of the active pad to start the process over again.

Solution transfer to and from the WCHL is through pipes sitting inside of a lined solution collection corridor.

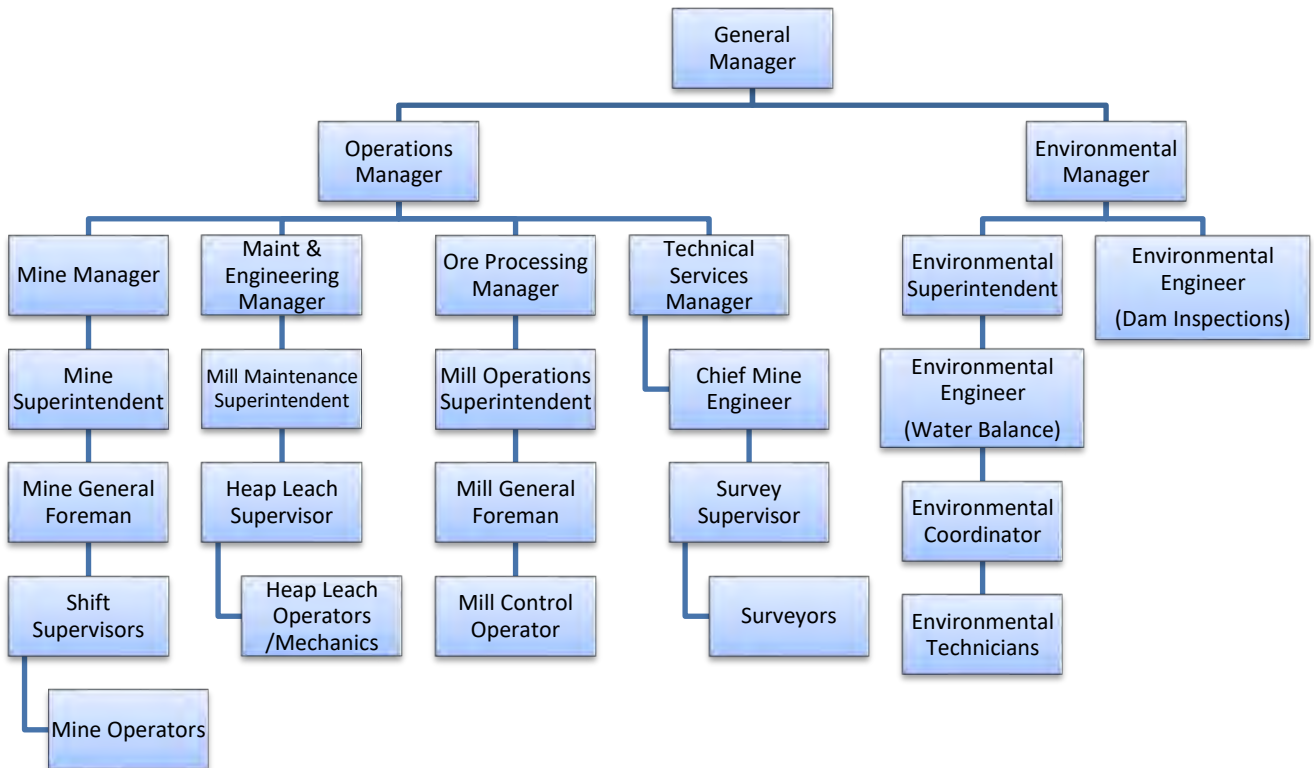
#### 1.4 Operator Training Program

An ongoing operator-training program and refresher is held annually at a minimum. The program intent is to provide the employees who are responsible for the implementation of the O&M procedures with the expertise required for them to perform their respective duties. New employees are trained prior to them starting any duties.

#### 1.5 Assignment of Responsibilities and Procedures

A partial organization chart outlining relationships between personnel who are involved with operation of the WCHL is shown below in Figure 1-1. General responsibilities for positions can be seen on the following page in Table 1-1.

**Figure 1-1 – FGMI Organizational Chart**



**Table 1-1 – WCHL O&M Responsibilities**

TITLE	RESPONSIBILITY
General Manager	Overall Responsibility for Project
Environmental Manager	Environmental Compliance and Permitting
Engineers & Technicians	Read/Record Monitoring Data & Inspection
Operations Manager	WCHL Management
Maint & Engineering Manager	WCHL Operation & Maintenance
Operators/Mechanics	Routine Maintenance & Inspection
Mine Manager	Ore Placement
Mine Supervisors/Operators	Active Dumping Operations
Technical Services Manager	Stacking Plan Design
Engineers & Surveyors	Ore Placement Planning & Monitoring
FGMI and Consultants as Needed	Data Reduction/Interpretation & Inspections

Heap Leach Operators/Mechanics are responsible for conducting daily inspections and general monitoring of the operation of WCHL.

Mine Supervisors/Operators are responsible for conducting daily inspections and monitoring of the ore placement on the facility.

The Environmental Department Engineers will review the Heap Leach operator's daily inspection logs on a weekly basis and conduct a monthly inspection using the inspection form that is located in Appendix B. Additionally, the environmental department will ensure that collected data and operator logs are electronically filed and maintained. Agency requests for data will be met and provided for in the fashion requested.

The Environmental Department Technicians are responsible for collection of water quality samples from the PCMS and LCRS system when flows are present.

Emergency situations and responses are described in Section 4.0.

Any variances from the design basis such as higher than design water levels, signs of instability, improper ore placement, or other items with the potential to adversely affect facility performance shall be reported daily to the Ore Processing Manager, Operations Manager, and Environmental Manager so corrective actions can be taken. The Ore Processing Manager, Operations Manager, and/or Environmental Manager shall advise the General Manager of any deviations and corrective actions.

Any event that has the potential to affect overall pad safety, integrity, could lead to the release of solutions, or present a threat to the health and/or safety of workers and/or persons offsite shall be reported to either: the General Manager and/or Environmental Manager or acting site manager. The informed manger shall initiate notifications and corrective actions. Additionally the informed manager will initiate the emergency response plan, as appropriate.

## Section 2.0 - Description

### 2.1 General

Major components of the WCHL consist of the ore heap, the composite geomembrane liner and solution collection system, the in-heap storage embankment, the internal in-heap storage pond, the leachate collection and removal system (LCRS), the process component monitoring system (PCMS), the underdrain collection system, the process solution handling system including the vertical solution collection wells, and the surface water controls. The following sections provide descriptions of these components to help understand the necessary operation and maintenance requirements.

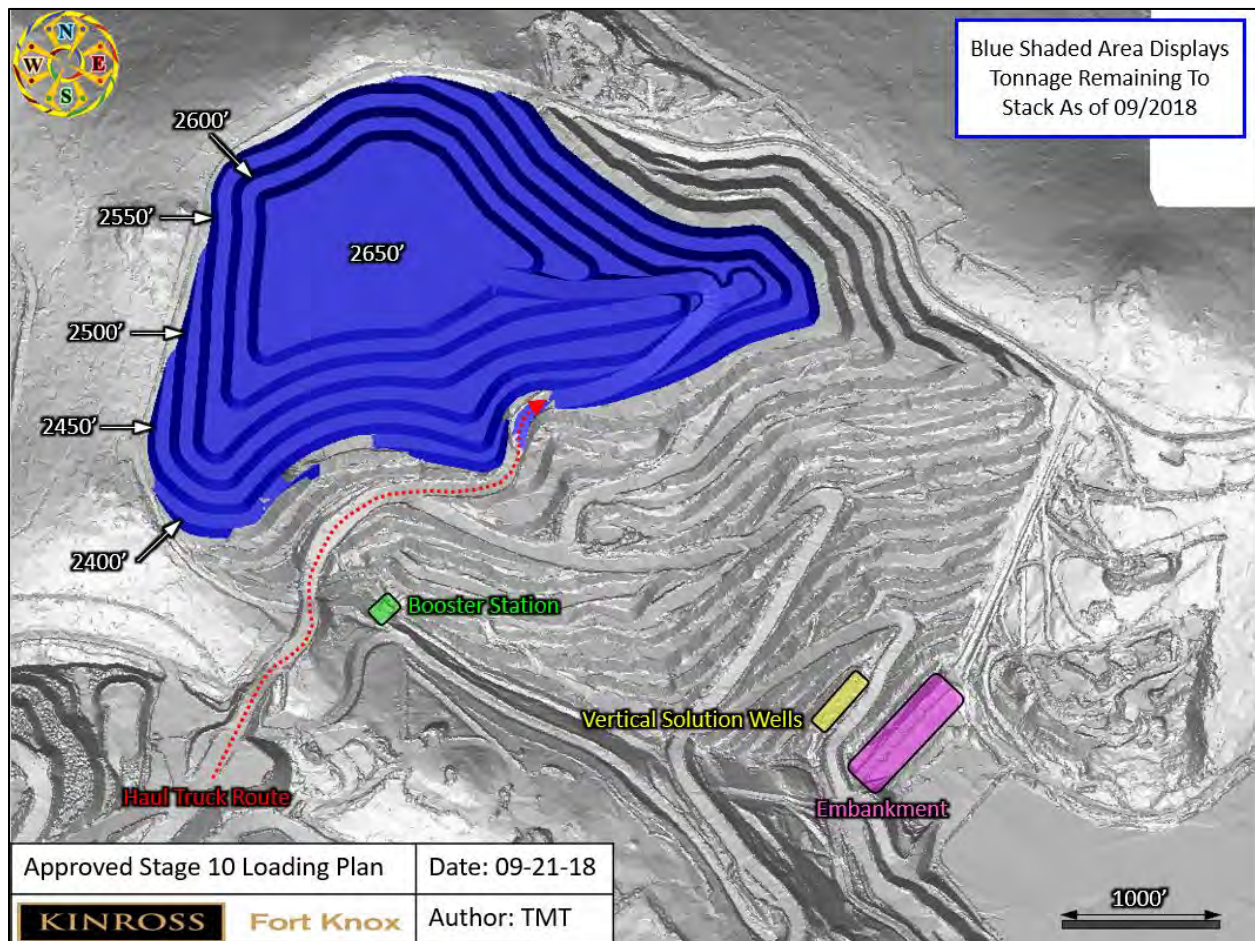
### 2.2 Ore Heap

Run-of-mine ore from the Fort Knox pit is placed on WCHL generally year-round and is stacked in lifts that are 50' tall. Material dumped out generally settles to an angle of repose slope of about 37.5° (1.3' Horizontal to 1' Vertical). Catchbenches are included between each successive lift of ore such that the overall exterior slope is at a ratio of 3H:1V (18.4°), some local variations exist and are described in the Design Report.

As the active dump face advances, the area behind the active face is ripped in three different directions with a dozer to breakup and eliminate the surface compaction created by the haul truck traffic. After the ripping is complete, feedline pipes and drip tube emitters are installed and active leaching commences.

As of the 08/31/2018, the WCHL facility had 228.7 Mtons placed with an additional 68.5 Mtons still planned for placement over the period through 2022. The currently approved ore heap configuration through Stage 10 is illustrated below.

**Figure 2-1 –Stage 10 Heap Loading Configuration**



### 2.3 In-heap Storage Pond Embankment

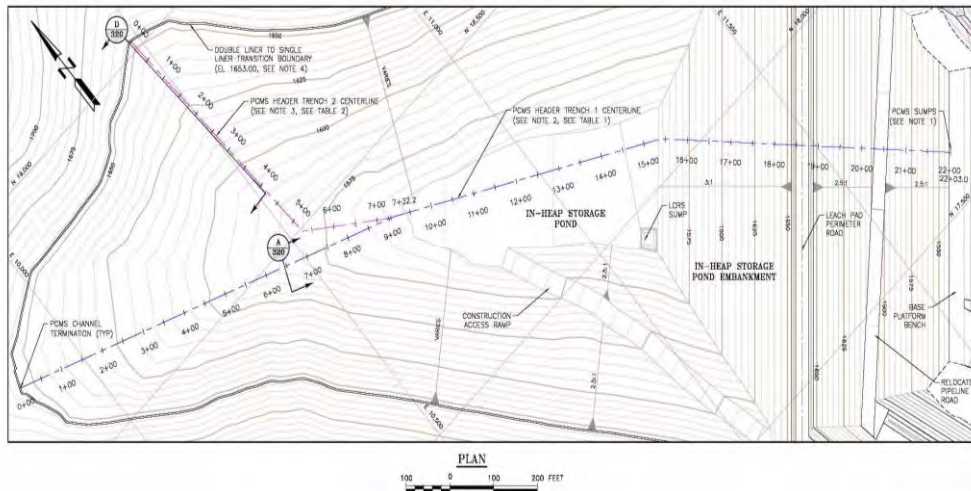
The in-heap storage pond embankment has been designed to provide containment of process solution and any precipitation amounts up to a 100-year/24-hour design storm event.

The embankment has a crest width of 50 feet and sits at elevation 1653 feet. The downstream toe sits at approximately elevation 1540 feet. Thus, the overall height of the embankment is 113 feet when measured from downstream toe to crest. When measured along the upstream side, the embankment from toe to crest measures 100 feet tall. Along the exterior downstream slope of the embankment, the slope was constructed using a minimum ratio of 2.5:1. Along the interior upstream slope of the embankment, a ratio of 3:1 was used. A plan view of the in-heap storage embankment is shown below.

Construction of the embankment first began in 2008 with the removal of unsuitable soils, weathered rock, alluvium, and organic material from the foundation footprint and corresponding abutments. FGMI geologists compiled a geologic map containing bedrock types, fractures, faults, and other pertinent information in the exposed embankment footprint. Afterwards mine waste rock meeting the random fill specification was placed in 4-foot-thick compacted lifts in the base platform, underdrains, and in-heap pond embankment areas. Waste rock was compacted by loaded haul truck traffic being routed across the designated areas. In order to transfer flow from springs, seeps, and other flows beneath the WCHL, random fill drains consisting of a backfill material with no fines was incorporated into the base platform.

When inspecting the embankment, it should be noted that some settlement and movement of the embankment is anticipated, and normal, given its size and type. Commonly settlement-cracking parallel to the dam crest can occur. However, any cracking, regardless of orientation to the embankment crest is to be recorded in the daily logs, making sure to note the amount of movement, and photographed. Any movement is to be discussed and reviewed by the Engineer of Record to verify that it is within normal and anticipated limits.

**Figure 2-2 – In-Heap Storage Embankment**



#### 2.3.1 Embankment Spillway

A spillway has been constructed through the Northern side of the embankment and is photographed in Figure 2-3. In the event of an emergency, the spillway protects the main embankment from being overtopped by a rising solution pond. The spillway invert sits at the 1650.5 elevation, which is 2.5 feet below the embankment's design crest. Where it crosses through the embankment, the South side slopes down at a 10:1 gradient to a flat channel bottom that is 35' wide and constructed of concrete. From the channel bottom, the North side slopes back up at a ratio of 2:1. The spillway has been designed to maintain 0.5 foot of freeboard on the dam while passing the peak flow from a 100-year/24-hour storm event. This freeboard is deemed acceptable within the weir section because:

1. The conditions leading to potential flow through the spillway (100-yr/24-hr January rain-on-snow event with the entire surface of the heap frozen resulting in 100-percent surface runoff to the swale) represent highly conservative assumptions. See
2. With the design configuration, the 0.5-ft freeboard represents a 30-percent increase in potential flow area above the 2-ft flow depth. The weir flow capacity rating to the embankment crest elevation, 1653 ft, is estimated to be 460.8 cfs or an approximate 40-percent increase in flow capacity.
3. The containment level along the spillway weir section can be temporarily raised using sandbags or other methods if needed.

The spillway will direct any overflow to the downstream TSF via the riprap-lined and grout supported spillway channel, seen in Figure 2-4. The outlet channel matches the channel width of 35-ft initially and then transitions down to 15' in some areas. Channel width varies and is determined by the depth, cross-sectional area, and steepness of the channel section. The end results in to provide a continuous channelized flow from the concrete spillway to the outlet channel discharge point, immediately upstream of the TSF.

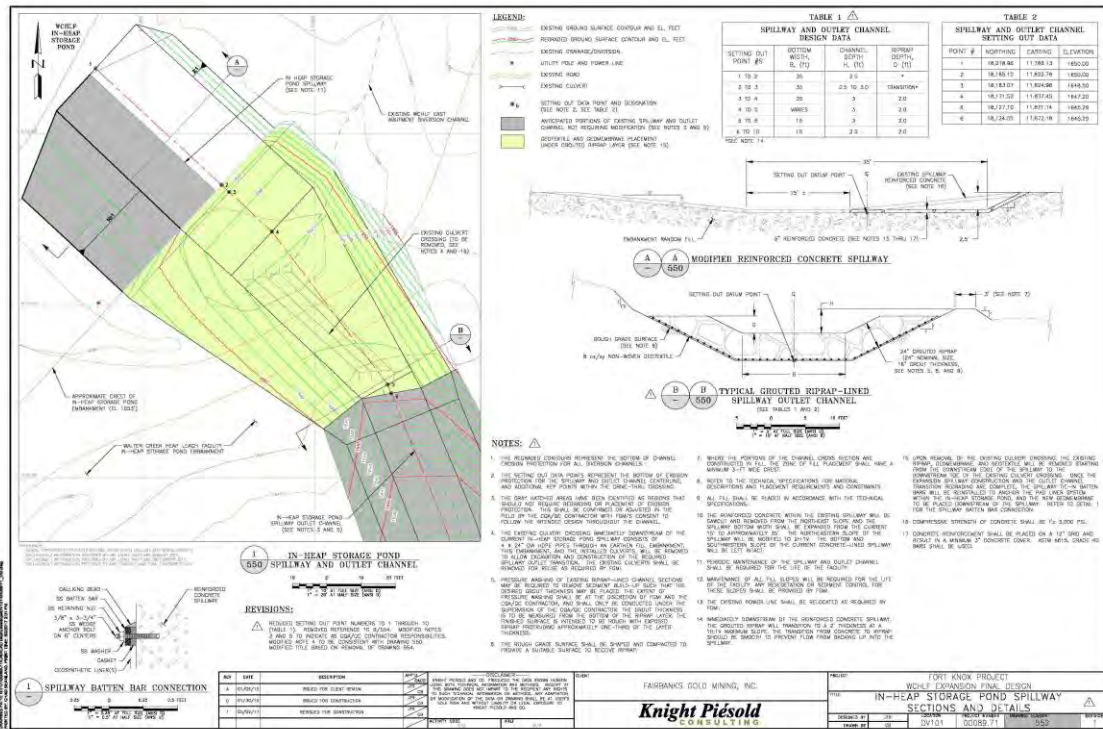
**Figure 2-3 – Concrete Spillway**



Figure 2-4 – Riprap Lined Spillway Channel



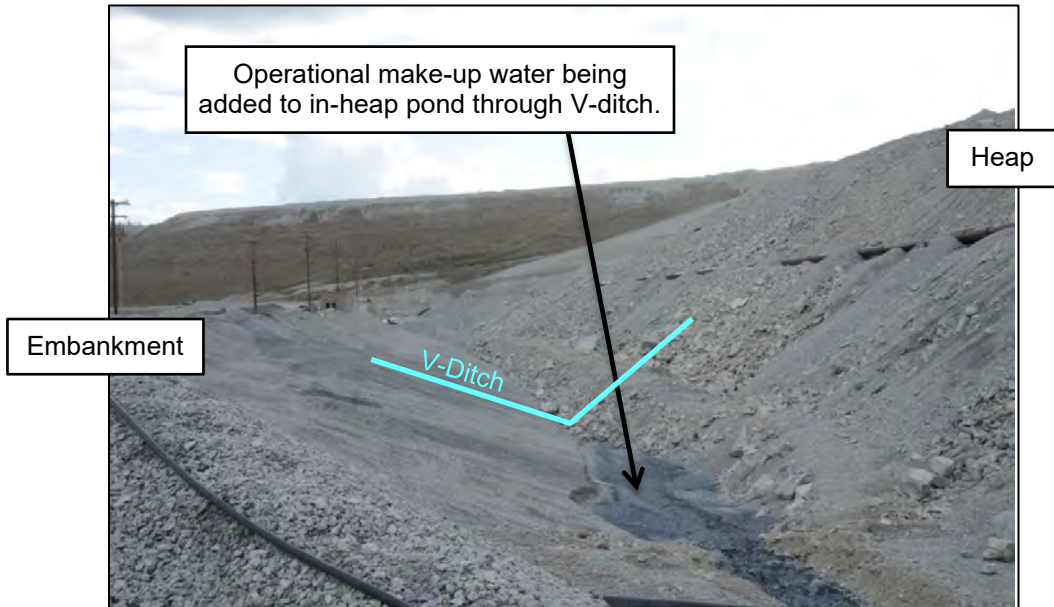
Figure 2-5 – Spillway Outlet Channel



### 2.3.2 Swale & V-Ditch

In the time prior to the spillway becoming active, solution levels will rise in the pond and begin to pool in the area between the upstream face of the embankment and run of mine ore. Seen in Figure 2-6 and Figure 2-7, this area is known as the “V” swale or “V” Ditch. During normal operations, this area is available to temporarily store storm water runoff that flows to it from around the heap toe. Flow or accumulation in this area will enter the pervious ore at the base of the heap and drain into the pond below. The estimated as-built storage volume of the swale is approximately 6.2 million gallons. In the unlikely event that the surface of the swale is completely frozen, the calculated runoff volume of 38 million gallons from the 100-year/24-hour design storm event could be conveyed through the emergency spillway.

**Figure 2-6 – V Ditch Looking South**



**Figure 2-7 – V Ditch Looking North**



## 2.4 Internal In-Heap Storage Pond

The in-heap embankment creates an internal in-heap storage pond for collection of pregnant solution. At the design stage for WCHL, an in-heap pond was selected to avoid freezing of the pond during winter months. A plan view of the in-heap storage pond is shown in Figure 2-8.

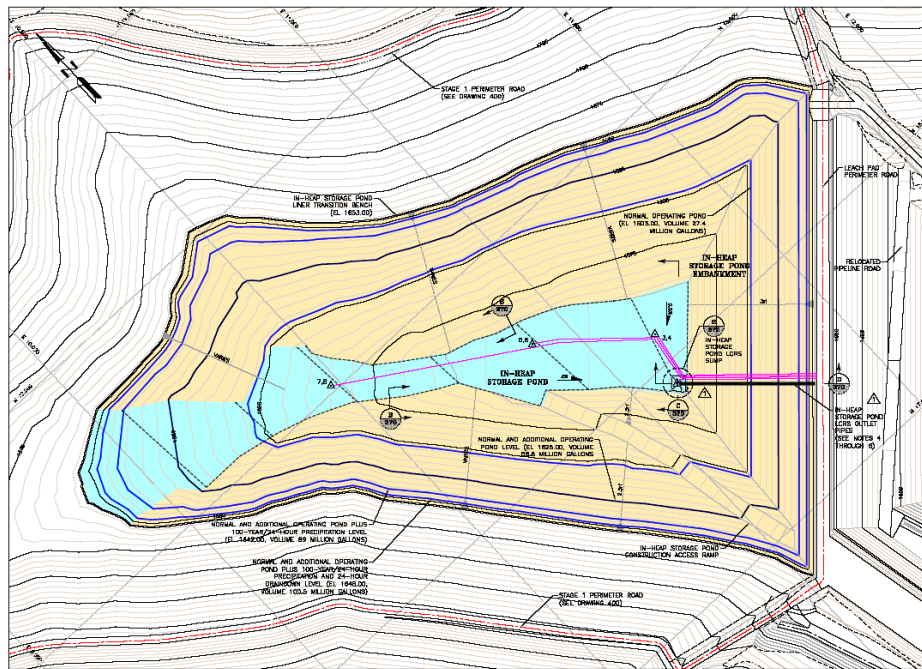
Heap leach operations using drip emitters was initiated in early 2010 at the rate of 8,000 gpm. Following the completed installation of two new vertical extraction wells in 2012, the application rate was doubled to 16,000 gpm. In 2018, FGMI secured a new permit, which allowed for an increased solution application rate of up to 20,000 gpm. With each modification to the WCHL facility, there have been corresponding updates to the allowable volume contained within the in-heap pond.

When discussing volume of the in-heap pond, it is with the understanding that solution storage is located within the interstitial pore spaces between ore particles. Estimates of available solution storage consider settlement and consolidation that has occurred as of result of subsequent lifts being placed over the facility.

During full scale leaching operations, the design volume of the in-heap storage pond considers:

- Maximum normal operating level
- 24-hour draindown volume
- The 100-year/24-hour storm event potential contribution
- Freeboard on the embankment

**Figure 2-8 – In-Heap Storage Pond**



### 2.4.1 24-hr Emergency Draindown due to Loss of Power or Pumps

An emergency draindown condition could begin to occur on the WCHL facility if the power supply is interrupted or if one or more of the active solution extraction pumps are temporarily rendered inoperable. Either of these cases would result in reduced pumping capacity from the in-heap pond. The in-heap pond capacity allocated for this occurrence only accounts for the first 24 hours of draindown on the basis that normal operations will be resumed within 24 hours. A conservative draindown requirement can be estimated by multiplying the draindown duration by the solution flowrate supplied to the heap (i.e. 24 hours at the supply flowrate). In the event of an actual draindown occurrence, a transient flow condition would exist and the observed flow rate to the pond would gradually reduce over time as the draindown occurs.

In consideration of a potential emergency situation, FGMI has equipped WCHL with sufficient back-up power and redundant pumps such that 8,000 gpm can be recirculated from the pond back to the top of the pad if required. FGMI has operated the in-heap pond below the maximum normal operating level with the ability to recirculate 8,000 gpm. To understand the full potential scope of a draindown event, a calculation without any recirculation has also been considered.

- 16,000 GPM – With 8,000 Recirculated: 11.5 Mgallons
- 16,000 GPM – No Recirculation: 23.0 Mgallons
- 20,000 GPM – With 8,000 Recirculated: 17.3 Mgallons
- 20,000 GPM – No Recirculation: 28.8 Mgallons

The 24-hr draindown component corresponds to the flow rate supplied to the pad and will change the maximum normal operating pond volume, level, and operational flexibility

#### 2.4.2 100-yr/24-hr Design Storm Event

With respect to expansion of the liner footprint, as each progressive construction stage is built, an increased amount of precipitation becomes available for capture by the facility. This results in the need to reduce the maximum normal operating level of the pond to accommodate the increased volume of a potential 100-year/24-hour design storm event.

The storm event storage components associated with the completed Stage 4 pad area through the ultimate Stage 10 configuration were estimated to vary between 26.2 and 45.7 M gallons, respectively.

#### 2.4.3 Freeboard Allowance

A freeboard allowance is the vertical distance typically included as a contingency against overtopping of a dam. A 5-ft freeboard depth from 1648 to 1653 fmsl, has been retained for WCHL. Important freeboard elevations for operators to know are detailed in Section 3.4.1 - Operation and Maintenance – Internal In-heap Storage Pond (Page 3-5).

- The volume within the 5-ft freeboard allowance was estimated to be approximately 15.7 M gallons.
- The volume up to the spillway invert was estimated to be approximately 7.6 M gallons.

#### 2.4.4 Past Operational Events

Over July 2016, there was a total of 7.1 inches of rain for the month. On July 19<sup>th</sup> there was a loss of power to the mine site and there was a pump that went down. The combination of these factors resulted in an increase to the pond operating level. On July 18<sup>th</sup> the operating level of the pond was at elevation 1609. Based on the aforementioned factors, the pond elevation peaked at elevation 1631'. On August 20<sup>th</sup> the operating level of the pond was at elevation 1623', within the normal operating levels for Stage 7. During the 30-day duration, the average pond elevation was 1625.6'.

#### 2.5 Liner & Solution Collection Systems, Including the LCRS

Two distinct containment zones exist within WCHL. The first zone consists of the in-heap storage pond directly behind the embankment. The second zone comprises the elevations above the in-heap storage pond. Each zone was constructed following a specific construction plan consisting of different elements that are layered on top of each other; a cross-sectional view is available in Figure 2-9.

Zone 1: Double Lined & In-Heap Pond, starting from the valley floor and advancing up

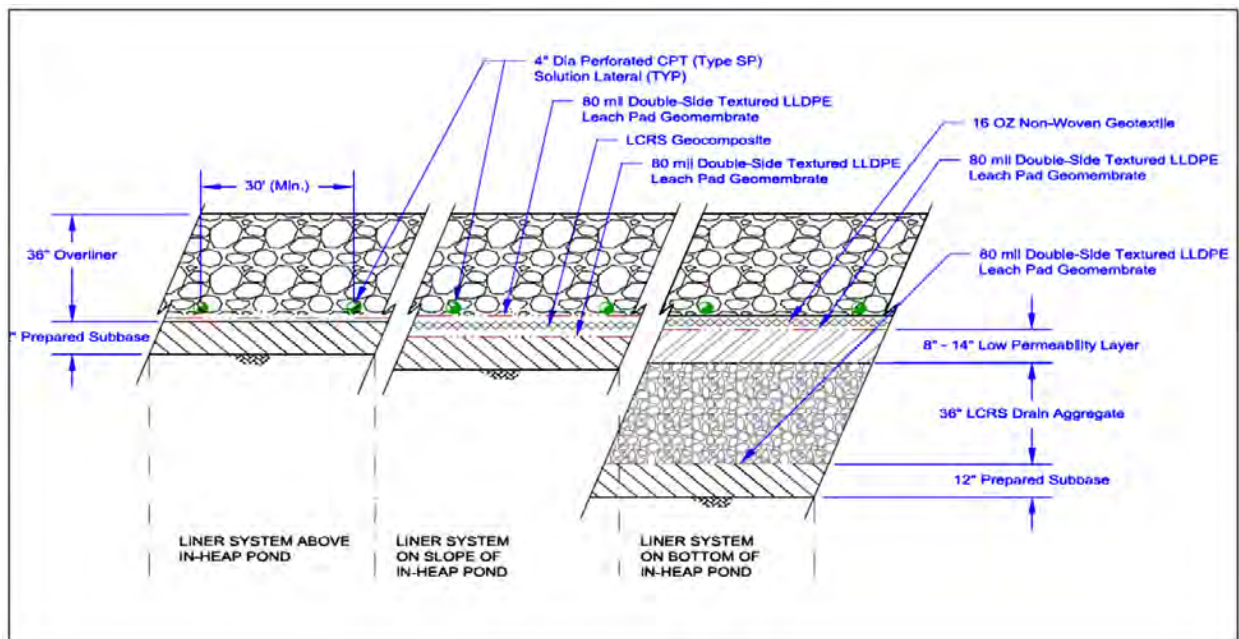
- 1) 12-inch-thick low permeability prepared sub base
- 2) 80-mil double-side textured Linear Low Density Polyethylene (LLDPE) geomembrane liner, this is a secondary containment layer
- 3) A leachate collection recovery system (LCRS) which is composed of either:
  - a. geocomposite drain, used along valley slopes

- b. 3-foot thick layer of drain aggregate overlain by 8 to 14 inches of low permeability material, used along flatter valley bottoms with a grade of 10% or less
- 4) 80-mil double-side textured LLDPE geomembrane, this is the primary containment layer
  - a. In the valley bottoms only, an additional 16-Ounce Non-woven geotextile is placed over the primary containment layer above the footprint of the LCRS drain aggregate.
- 5) 3-foot-thick overliner layer with solution collection pipe works buried within, the collection pipes are designed to promote solution flow to the solution collection wells located just upstream of the in-heap embankment

Zone 2: Stages Above The Double Lined Zone (1653' And Higher), starting from the bottom up

- 1) 12-inch-thick low permeability prepared sub base
- 2) 80-mil double-side textured LLDPE geomembrane liner
- 3) 3-foot-thick overliner cover with solution collection pipes buried within. These pipes are a direct extension of the pipes placed in zone 1. Along with promoting drainage, the overliner and solution collection pipework will significantly reduce head pressure on the zone 2 liner. Feet of head on liner in zone 2 is designed to be less than 1 foot on average.

**Figure 2-9 – Composite Liner Cross Section**



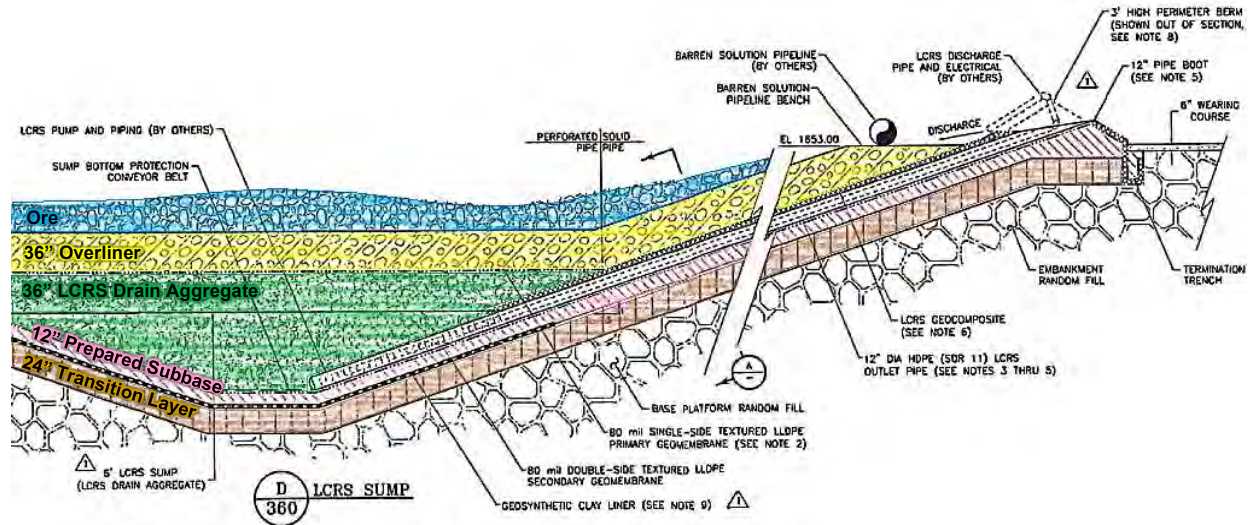
### 2.5.1 Leachate Collection and Recovery System (LCRS) Detail

The LCRS is part of the double lined pond zone. The LCRS serves as a monitoring and collection system for any process solution passing through the primary liner; it also provides a hydraulic break between the primary and secondary containment liners. This break means that although the head acting on the primary liner is the full depth of process solution during operations, the head acting on the secondary liner is designed to be less than one foot.

Flows passing through the primary liner into the LCRS are rapidly conveyed via the geocomposite drain and/or the drain aggregate and are captured by solution collection pipes. These pipes then convey flow into the LCRS sump located at the south end of the embankment's upstream toe. The LCRS sump consists of an approximately 40 square-foot by 6-foot-deep sump filled with LCRS drain aggregate. Monitoring and return of any collected solutions within the sump is accomplished using two submersible pumps; each located in one of the two 18-inch diameter carbon steel pipes between the primary and secondary geomembranes. The pipes are inclined up the interior face of the in-heap storage embankment, extending

from the bottom of the LCRS sump to the embankment crest. The portions of the pipes within the sump are slotted with openings sized appropriately with to avoid migration of the LCRS drain aggregate into the pipes. The bottom of the LCRS sump has been protected from damage by the outlet pipes with the placement of conveyor belting. A layer of geosynthetic clay liner was installed below the LCRS sump, between the 12-inch-thick prepared sub base and the secondary liner, to further limit the potential for leakage. Reference Figure 2-10 for LCRS details

**Figure 2-10 – LCRS Details**



A monitoring station and access to the LCRS sump is located on the in-heap embankment crest. The LCRS was initially monitored daily for flow establishing a baseline. Currently the LCRS is visually inspected daily and pumped on a weekly basis. During Q2 of 2014, Piezometers 1 and 2, which are located at approximately elevation 1541, at the bottom of the LCRS sump, began registering a small head of approximately 4.0 feet. These readings suggest that a small depth of water has accumulated in the sump, but this level remains below the top of the sump and is pumped down periodically

### 2.5.2 Solution Collection System Pipeworks and Overliner

A key part of the WCHL design is the solution collection system, which is constructed as part of the overliner layer of the pad. The overliner layer consists of a 3-foot-thick drainage aggregate with a series of periodically spaced small diameter slotted solution collection pipes. The overliner layer serves three primary functions:

- 1) To reduce head pressure on liner
- 2) Protection of the liner from damage during ore placement
- 3) Facilitate flow and recovery of the process solution

The solution collection pipework in the overliner consists of 4-inch diameter Corrugated Polyethylene Tubing (CPT) slotted pipe with a smooth interior. These feed pipes are placed laterally in a herringbone pattern along the slope and are oriented to drain into larger diameter collection headers. Spacing between the feed pipes is dictated by the slope grade and ranges between 30'-90'. Collection headers are situated in the low areas & valleys of the contoured pad basin.

The original solution collection system and pipes were designed to a 8,000 gpm flow rate and would maintain less than one foot of head on the primary liner above the limits of the in-heap pond. Each pipe's capacity was based on the potential for reduced flow area between 0 to 50 percent due to deflection created by ore loading.

A second analysis on the performance of the solution collection system under a 16,000 gpm flow rate was done as part of the work supporting CIC#2 installation in 2012. This assessment determined that small localized lengths of the existing solution collection headers would potentially be unable to convey the increased flow. To account and offset this potential, additional dispersion pipework was designed and installed during Stage 3 construction.

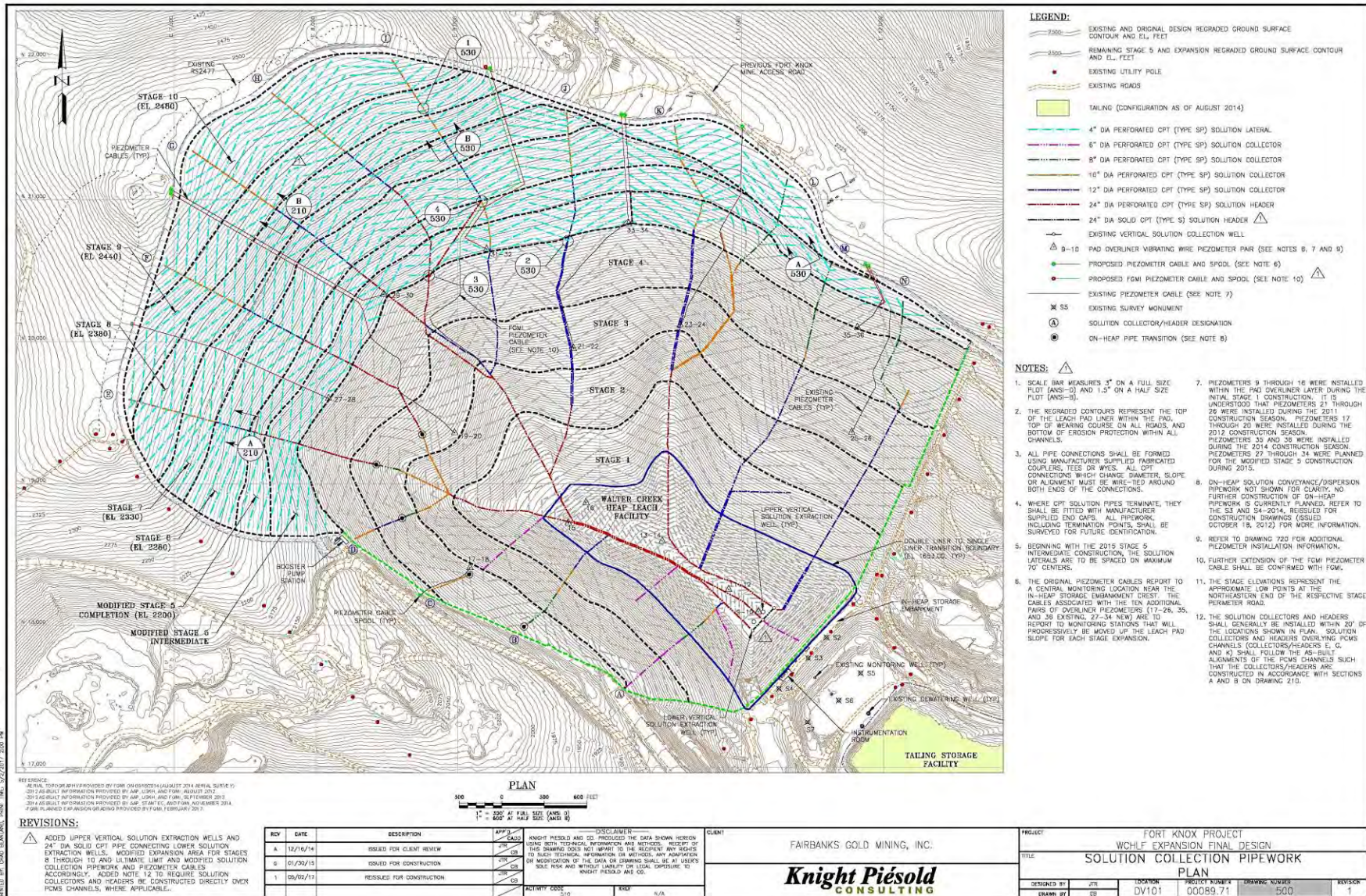
In 2017, another assessment was performed on a potential solution application rate of 20,000 gpm. The methodology followed the same logic seen in the WCHL Expansion final design report and considered the points below:

- Reduced size(s) of the header pipe(s) due to loading of the heap.
- Slopes/gradient of the pipe(s).
- Tributary area to the pipe(s) due to lift-by-lift development of the heap.

Evaluation of eighty-three (83) flow-analysis points throughout the WCHLF basin determined that there were 6 points in which calculated flows would exceed the estimated pipe capacities above the limits of the in-heap storage pond. In these areas excess flow will be conveyed through the overliner rock drainage layer. In addition to the six flow transfer conditions, three areas were identified where localized hydraulic heads could exceed the 1-ft maximum adopted in the design criteria. Conclusions of the study were that the calculated head applied to the pad liner system under the increased flow regime of 20,000 gpm will remain low, at less than 1.0', for the area under leach. Some small areas are predicted to have localized heads higher than 1.0'. The consultant KP concluded that even with these small areas of exceedance, the high-quality liner and solution monitoring systems installed in the WCHLF in tandem with the hydraulic containment provided by the downstream TSF provides for a very high level of environmental protection.

See the following Figure 2-11 for the general layout of the solution collection system through Stage 10

Figure 2-11 – Solution Collection System



### 2.5.3 Solution Collection Wells

The purpose of the solution collection wells is to remove leachate from the in-heap storage pond.

Initial solution collection was achieved on WCHL through the construction and use of two inclined solution wells. These were located along the upstream face of the embankment and were used to remove pregnant solution in 2009/2010 at a rate of 2,500 gpm. These wells are still accessible. However, they do not have pumps installed nor are they connected to a pipeline.

As of today, recovery of pregnant solution is achieved through the operation of five vertical solution collection wells. The original WCHL design had three wells located near the lowest point along the upstream toe of the in-heap storage pond embankment. As part of the design to maximize solution flow, these wells were directly connected to the solution collection header pipes. These three wells were constructed to allow for 8,000 gpm of flow through active operation of two wells while the third was retained as a backup/standby. As part of the plan increase the flow to 16,000 gpm, an additional two wells were constructed during the summer of 2012. These new wells are offset a few feet upstream from the original wells and are within the footprint of the in-heap storage pond. Their completed depth is approximately ten feet above the overliner drain layer and they are not directly connected to the solution collection header pipes like the three in initial design.

All the wells are constructed of 30-inch diameter steel pipe and have intermittent screened lengths in the lower portions to allow the inflow of solution. Each well is fitted with a 4,000 gpm turbine pump.

Initial design expectations were that substantial drawdown would occur around the extraction wells; however, FGMI's operating experience indicates that very little drawdown occurs around either of the three original or two supplemental wells. This better-than-expected performance in all extraction wells is attributed to a hydraulic conductivity of the ore that is much greater than the values used in the model. Because the extraction wells and pumping strategies have been implemented by FGMI with negligible resulting drawdown, further assessment of potential drawdown is not deemed necessary to support the WCHL Expansion Final Design. FGMI currently utilizes 4,000-gpm-capacity pumps within each of the WCHL's five solution extraction wells. To achieve a total flow rate of 20,000 gpm, all five wells will be in operation at any one time. Future increases in solution extraction capacity through larger pumps could be possible if FGMI chooses to pursue the issue.

The structural integrity of the solution collection wells was verified in 2018. The casings are structurally sound to operate at any solution level in the in-heap pond.

### 2.5.4 Solution Level Monitoring

In accordance with the original design, three pairs of vibrating wire piezometers are used to monitor solution levels within the in-heap pond. Piezometers have also been installed above the pond elevation, which are used to monitor the depth of solution on liner. The design calls for less than one foot of head on liner in these areas. See Figure 3-8 in the following section for details on piezometer locations.

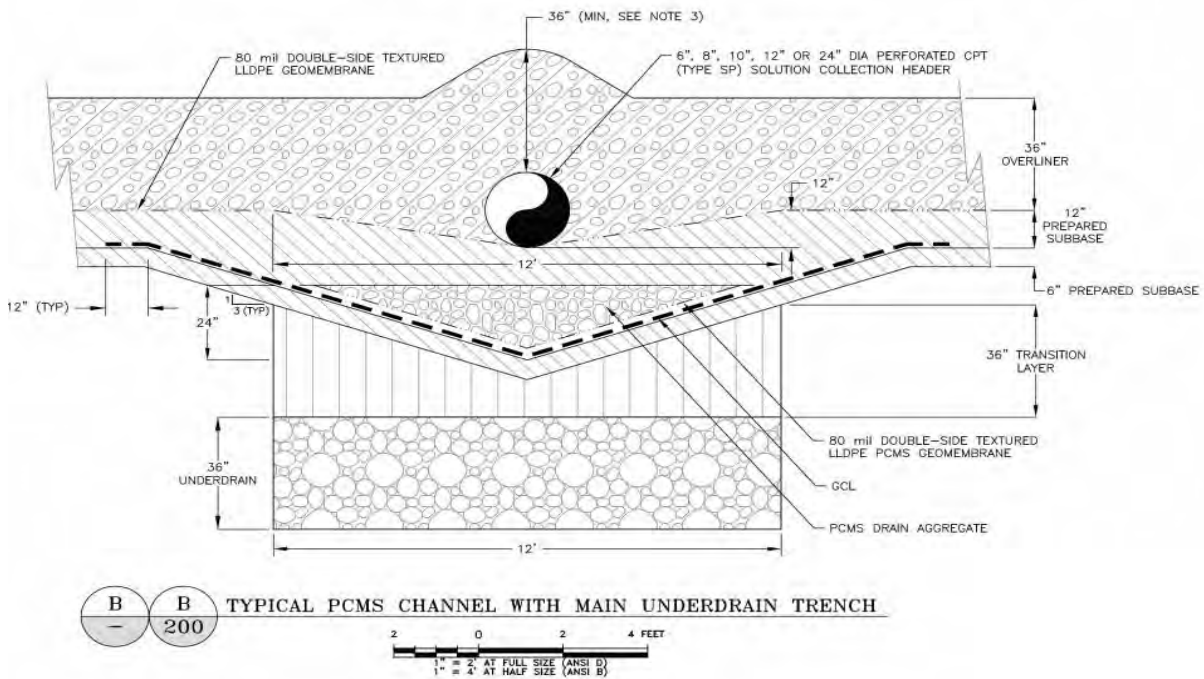
2.6 Process Component Monitoring System (PCMS)

The PCMS serves to monitor the performance of the liner system beneath the solution collection headers. These headers have been placed in the three drainages where concentrated flow is anticipated, the valleys are designated Valleys 1, 2 and 3, of the heap leach pad. The PCMS monitors for leaks through the liner beneath the solution collection headers where they are outside the limits of the in-heap storage pond.

If leakage occurs through the liner beneath the solution collection headers, it will be collected in the PCMS channel and conveyed by header pipes to the monitoring and discharge points.

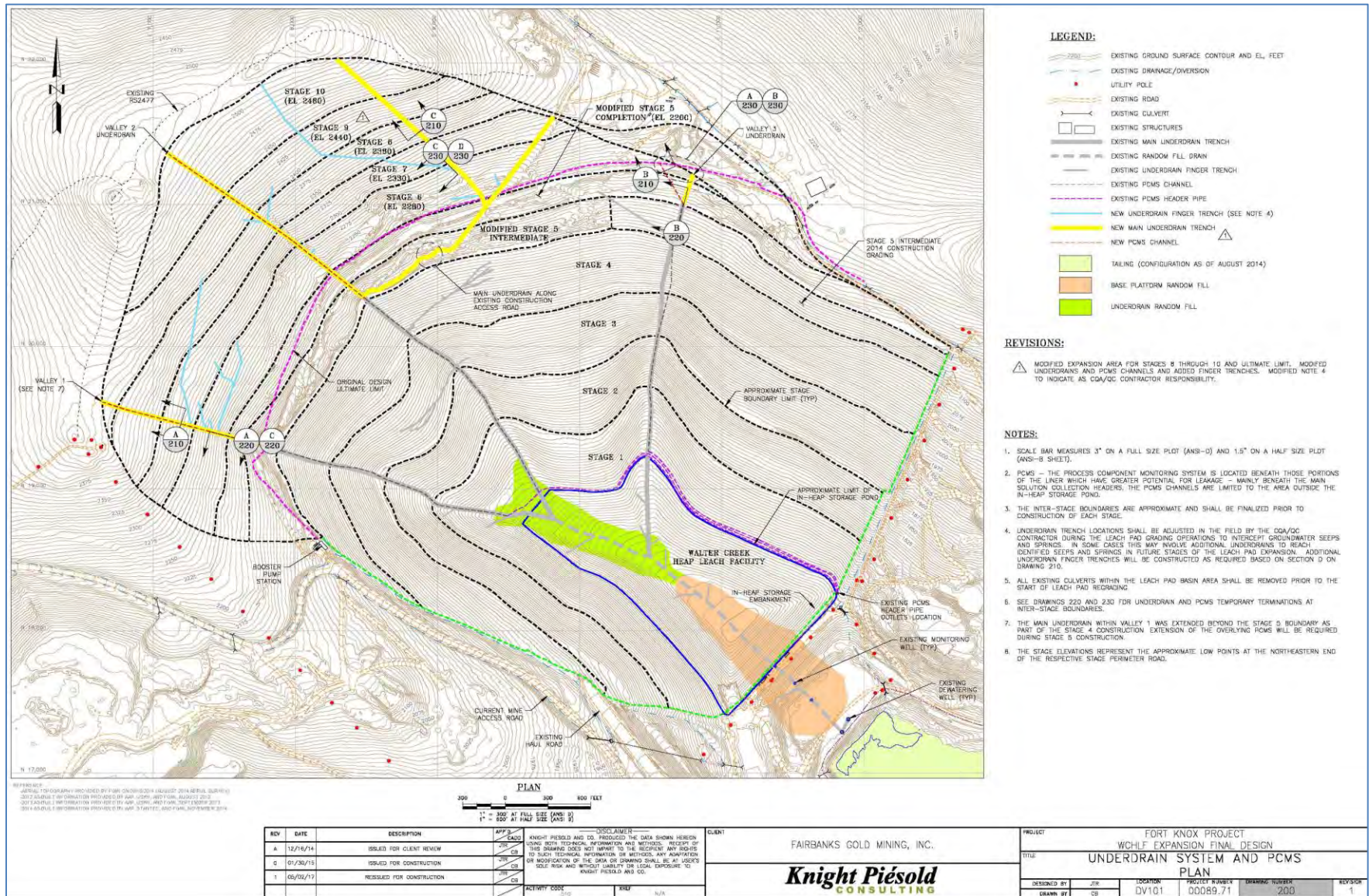
In the three drainages, the PCMS consists of a lined “V” channel filled with pervious PCMS drain aggregate. The design width of the top of the PCMS channel is 12 feet, and the depth is 2 feet. The composite liner for the channel includes a geosynthetic clay liner (GCL) overlain by an 80-mil double-side textured LLDPE geomembrane. The GCL was used in lieu of the prepared sub base to simplify construction and extends about a foot outside the edges of the PCMS trench. Figure 2-12 illustrates the design.

Figure 2-12 – PCMS Channel Detail



The 4-inch-diameter PCMS header pipes are routed along an alignment just above the north side of the in-heap pond. The pipes follow a 1% slope down gradient to the outlet monitoring points and operate through gravity flow. The outlet monitoring point is in the northeast corner of the in-heap storage pond at a location downstream of the ore pile but upstream of the in-heap storage pond embankment. The outlet monitoring points are exposed and easily accessible to field monitoring personnel and will discharge any flows directly onto the double lined pond area. The pipes penetrate the single geosynthetic liner in a reinforced concrete block and the geomembrane is connected to the concrete block by embedment strips. This penetration is just above the transition boundary from the double lined in heap pond (below) to the single liner (above). The last 50 feet of the pipes are heat traced to prevent icing of the outlets in winter. The PCMS plan is shown on Figure 2-13.

Figure 2-13 – PCMS and Underdrain System



## 2.7 Underdrain Collection System, Monitoring and Dewatering Wells

A number of groundwater springs and seeps, including the original Walter Creek, flow down and through the valley bottom. An extensive underdrain system incorporating trenches and coarse rock fill has been included in every stage of liner construction including the region below the in-heap pond. The system is designed to collect flows below the lined areas and route them to a sump downstream of the embankment. Ground water sources and surface water outside, or above, the active leach pad are transported around the pad in diversion channels. This both serves to reduce the flow required to pass beneath the leach pad and limit recharge to seeps/springs.

The underdrains on the valley side slopes consist of trench drains excavated with a backhoe. The trenches are 3 feet deep by 12 feet wide and are backfilled with pervious underdrain trench drain aggregate. These connect directly to the random fill drains initially constructed as part of the embankment and in-heap pond construction.

As part of the initial WCHL design, several monitoring wells were envisioned to be placed in the underdrain flows to detect for any cyanide leaks. Three monitoring wells were installed, one at the base platform below the embankment, one at the pipe bench of the in-heap storage pond in the embankment, and one at the crest of the in-heap storage pond embankment. The wells extend to just below, or at, the bottom of the base platform random fill and were constructed with some slotted casing to facilitate water sampling. Initial design was for the wells to be used for water quality sampling and to measure water levels. However, as tailings deposition has continued downstream of WCHL, the water chemistry in these wells registers decant constituents and is no longer useful for informing any leakage from WCHL.

Monitoring well, HL-1 is an 18-inch diameter pipe; it could be converted to a solution interception well if required.

Two underdrain dewatering wells are installed at the TSF/HPL interface fill through the heap leach underdrain, see Figure 2-15 and Figure 2-16 below. These wells were constructed in place as the random fill was placed. They are on the same plane 100 feet apart. Their designed intent is to capture any backflows from the tailings pond prior to such flow entering and restricting the underdrain flow into the TSF.

With concurrence from the state, FGMI has discontinued pumping the dewatering wells.

Figure 2-14 – Dewatering Wells At TSF/HLP Interface

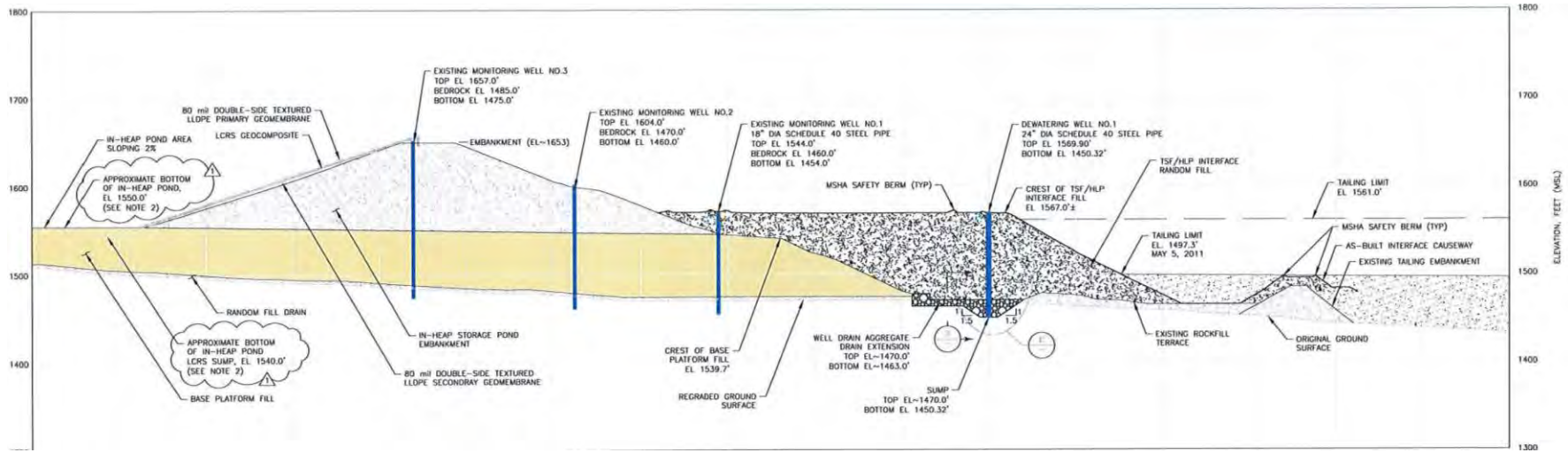
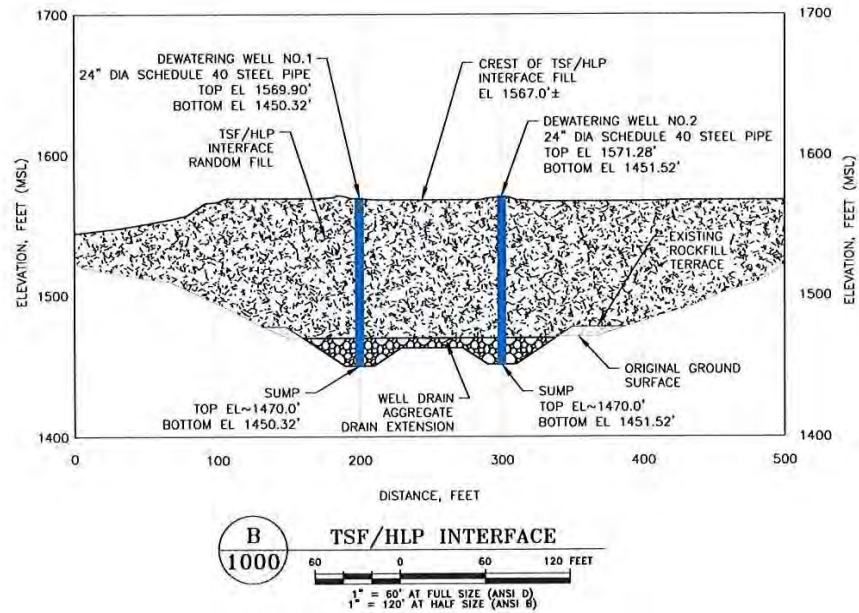


Figure 2-15 – TSF/HLP Interface Dewatering Well General Description



## 2.8 Pregnant and Barren Pipeline Corridor

### 2.8.1 Carbon in Column One

Solution transportation between WCHL and the CIC#1 plant is conducted through the use of a 2781-foot long pipeline network which includes both the pregnant and barren pipelines.

Starting at CIC#1, the pipelines leave the plant and run through a 125' long support pipe rack. After this point, which coincides with the beginning of the mill parking lot area, the pipelines enter a geomembrane-lined trench and run down gradient at 0.6% to 0.9% slope to the WCHL facility. The pipeline then exits the trench and connects with the valve enclosure on the heap leach pad. Design of the trench and pipeline corridor was completed to consider any dynamic loading on the pipelines from vehicle traffic where it runs below the mill parking lot and site access road.

The trench is filled with overliner drain aggregate, which protects and covers the pipes. Additionally, the permeable overliner aggregate will pass small flows from pipe leaks to the heap leach pad. The overliner drain aggregate will allow an estimated capacity of 25 GPM flow to the leach pad, which is sufficient for a minor leak. Any flows through the trench will be detected and alert operators of the need for a pipeline repair. To facilitate the location of a leak, a series of 4-inch PVC and steel pipes with an atrium grating at the bottom were placed inside the trench at designated locations along the corridor. Inside of the trench, the pipe was placed on the side adjacent to the access road for easy access and monitoring.

### 2.8.2 Carbon in Column Two

The pipeline corridor conveying the pregnant and barren lines from the two 2012 solution collection wells to the CIC#2 plant was designed using the same standards and criteria as the corridor to CIC#1. There was minimal disturbance of the CIC 1 pipeline corridor to maintain its integrity. The second pipeline corridor is approximately 2,500 feet in length. Starting from the trestle bridge, the pregnant and barren lines enter a corridor trench located next to the mill parking lot. Where the corridor crosses below the access road, the pipes were placed on 80 mill LLDPE liner that was backfilled with mill reject material and folded over itself, see Figure 2-16 on the following page. This portion of the corridor does not interact with CIC#1 corridor.

After the mine access road crossing, the CIC#1 corridor trench was carefully excavated to expose the trench liner, which was then connected to the CIC#2 corridor liner as seen in on the following page in Figure 2-17. To increase the flow capacity of the combined trench, a perforated, corrugated polyethylene drain pipe was installed. Inspection ports with similar spacing were installed between the CIC#1 corridor ports. This construction method exists between the mine access road and valve house enclosure except for a small section that is constructed using the design detail in Figure 2-18. The remaining run was installed following the design detail shown in Figure 2-19 on the next page.

Figure 2-16 – CIC #2 Pipeline Corridor Detail 1

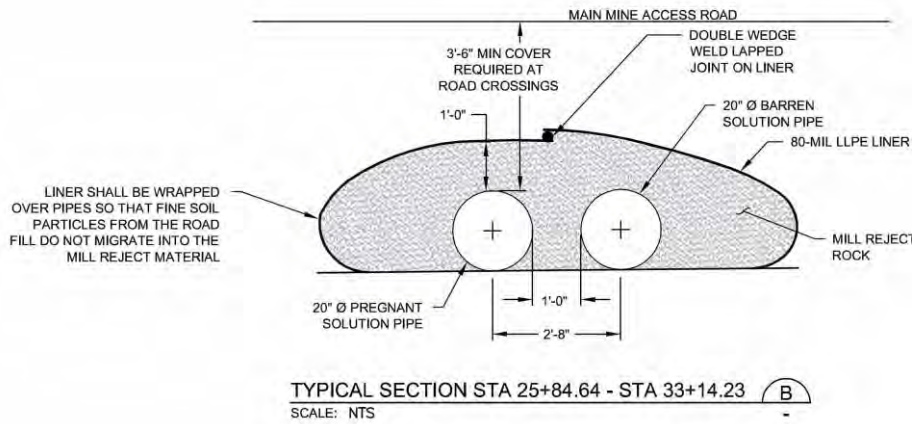


Figure 2-18 – Pipeline Corridor Detail 3

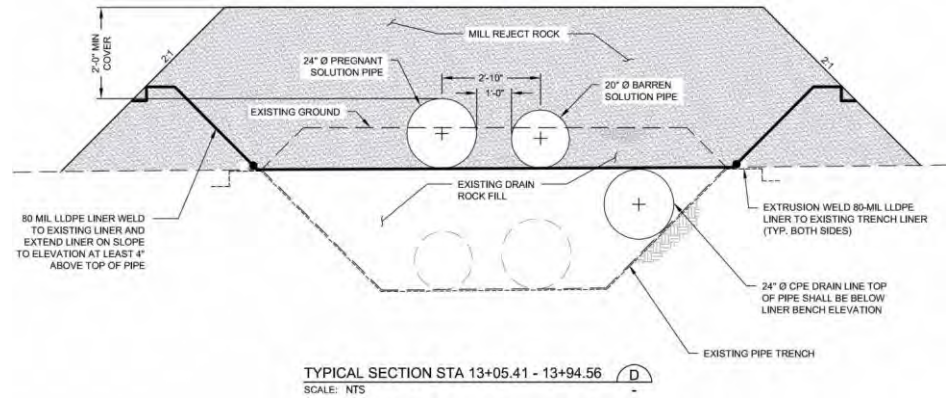


Figure 2-17 – Pipeline Corridor Detail 2

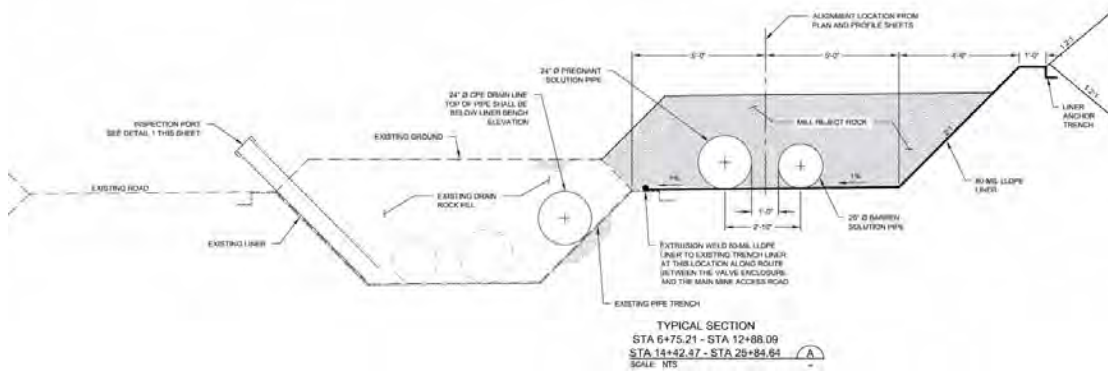
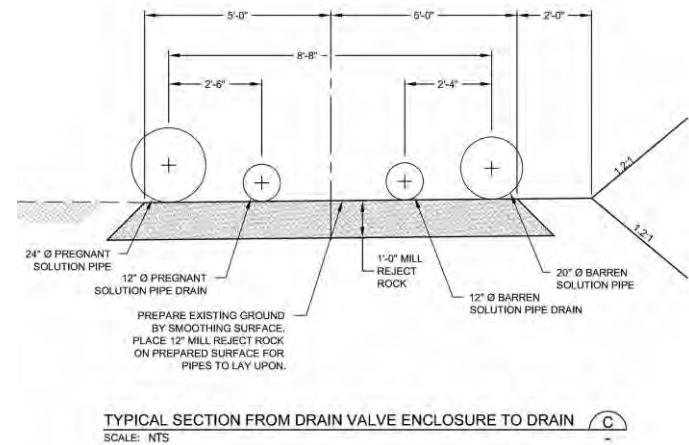


Figure 2-19 – Pipeline Corridor Detail 4



### 2.9 The In-line Booster Station & On-Pad Barren Header Lines

Due to the height of the pad, an in-line booster station is required to pump barren solution from the CIC buildings to the top of WCHL. The booster station is located on the southwest side of the facility and contains five 900 HP booster pumps, each capable of a 4,000gpm pumping rate. The booster station operates off a two-step interlock system to ensure safe operation of the system. Prior to a booster pump starting operation, two or more CIC barren pumps, from either plant, need to be running. Additionally, the inlet pressure must be higher than the low-pressure lockout of the suction side, which will prevent pump or surge tank damage. All other interlocks are standard to most pumps and are displayed on the interlock popup for each pump.

Barren solution leaving the booster station is distributed through two steel pipeline headers. Each header services opposite sides of the pad, one North/East, one South/West.

### 2.10 Perimeter Roads and Surface Water Diversions

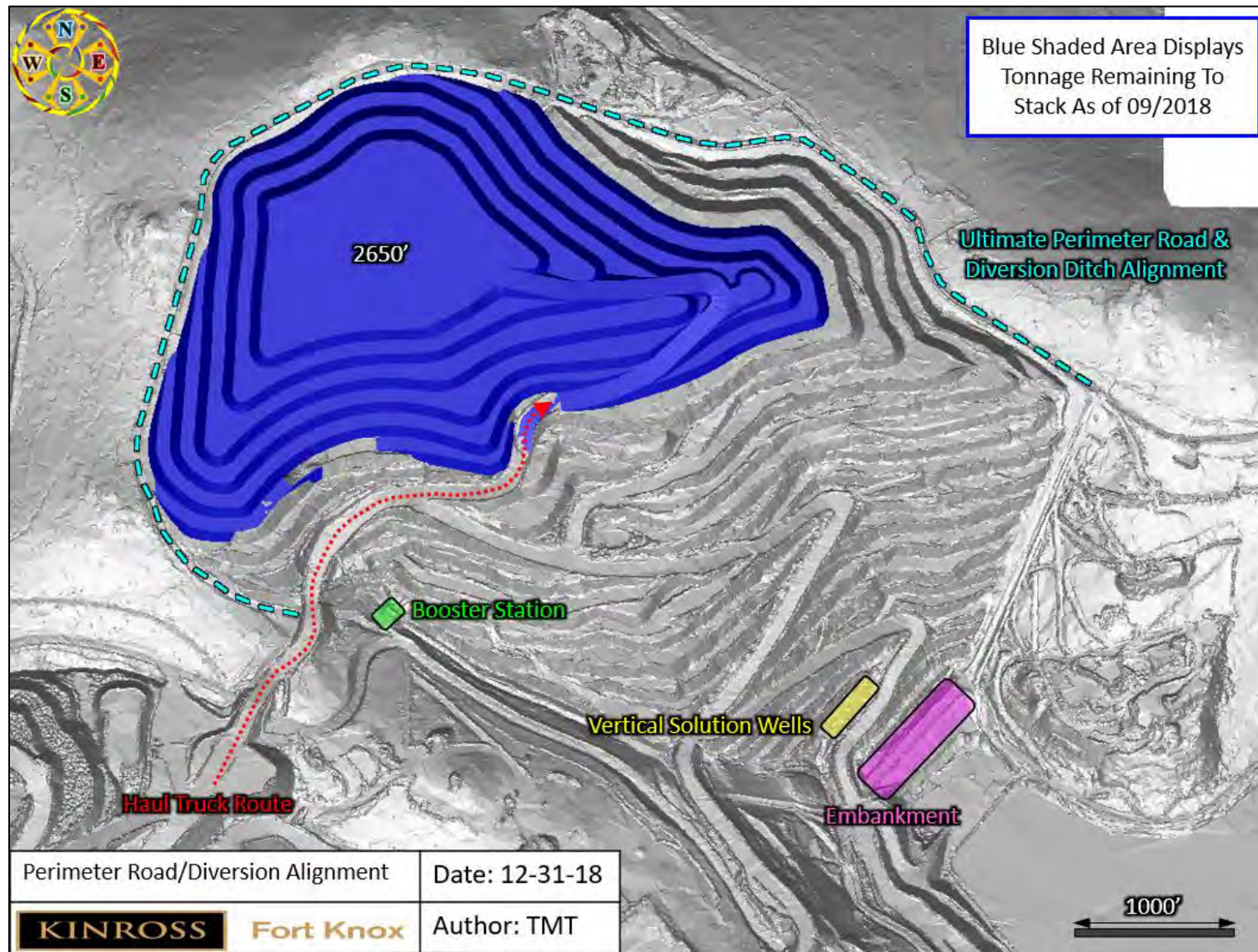
The WCHL perimeter road run along exterior perimeter of the ultimate WCHL footprint. The ultimate perimeter road starts above the booster pump station on the southwestern side of the pad and runs up and around the entire exterior perimeter of the ultimate (Stage 10) pad area and then crosses back down along the northeastern perimeter of the ultimate pad configuration. At the northeastern corner of the Stage 5 pad area, the ultimate perimeter road ends and becomes the Fish Creek utility road.

The ultimate perimeter road is designed with a 16-ft running width to provide construction and maintenance access. A diversion channel runs adjacent to the ultimate perimeter road to convey runoff around the facility from the upstream catchments. Because the ultimate perimeter road and diversion channel are located near the ridgelines of the Walter Creek valley, the long-term contributing watershed areas will be limited.

The diversion channel adjacent to the ultimate perimeter road is riprap-lined and has been sized to pass the peak flow associated with the 100-yr/24-hr design storm event. The design peak flows for the northeast and southwest ultimate perimeter diversions were estimated to be approximately 83 and 28 cfs, respectively.

At the easternmost corner of WCHL, the ultimate pad perimeter road proceeds away from the facility as the Fish Creek utility road. To pass the design peak flows from upstream catchment areas, beyond the current organics and unsuitable waste stockpiles, improvements have been incorporated in the WCHL Expansion final design for the Fish Creek road and diversion channel. The improved diversion channel adjacent to the Fish Creek utility road is only envisioned to be required during the WCHLF operational period. See the following page for a general alignment.

Figure 2-20 – Ultimate Perimeter Road Alignment



## Section 3.0 - Operation and Maintenance Procedures

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### 3.1 General

The O&M program includes a description of the parameters by which the WCHL is to be operated. As part of the WCHL operation, FGMI also conducts a monitoring program to ensure all elements of the facility are performing in accordance with their designs. The monitoring program includes both routine formal and informal inspections by FGMI personnel, the engineer of record, and state agencies.

### 3.2 Ore Heap

#### 3.2.1 Operation and Maintenance – Ore Heap

Operation of the heap leach pad involves ore placement on lifts that are up to 50 feet tall. The exterior slope of the lift, including the active dump face will settle, or be dozed down, to maintain an angle of repose between 36°-38°. The overall pad has been designed to maintain a 3:1 slope and limits ore thickness to a maximum of approximately 500' above the liner surface. To ensure these design criteria are maintained, the FGMI Mine Operations and Technical Services delegates will implement controls to ensure reasonable compliance to the design limits. The current controls are listed below:

- Technical Services delegate will ensure that:
  - A row of lathing is installed in the field that delineates the approved overliner limit
  - A lath line is installed delineating the run of mine ore fill boundary, AKA "Toe Stakes".
  - A row of lathing delineating a "no-rip" zone is installed 18 vertical feet from the as-built geomembrane liner surface. This should ensure that ripping only occurs over areas that have at least 18 feet of material above the lined surface.
- Mine operators will use the CAES system to provide real-time information on their elevation and location on the WCHL.
- A Technical Services delegate, designated by the Chief Mine Engineer, will be responsible for providing and updating CAES projects to delineate the dump limits and other critical information.

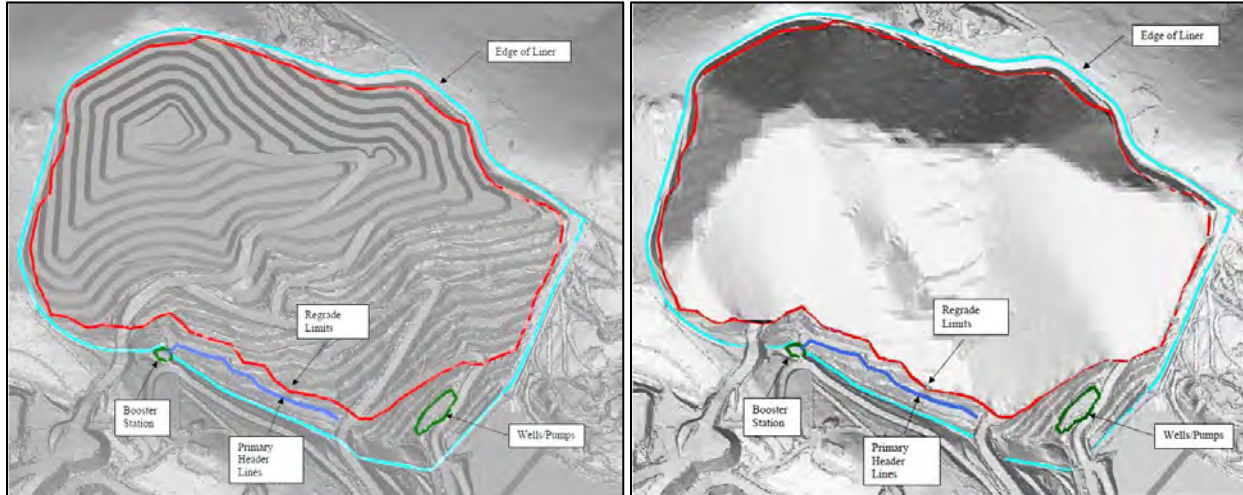
After ore placement has been completed for a given lift, the mine may decide to reduce the final slopes of the dump down to the reclamation slope angle of 3:1. In the interest of operational efficiency, FGMI may defer this work until multiple lifts are available for re-contouring or until the reclamation & closure period. In order to minimize risks to critical infrastructure while the pad is in operation, FGMI will only re-contour final slopes to within one lift above liner or above sensitive areas. Examples of sensitive areas are the booster station, primary header pipelines or the vertical solution wells.

To ensure safe and proper operations during re-sloping activity, the controls listed below will be used:

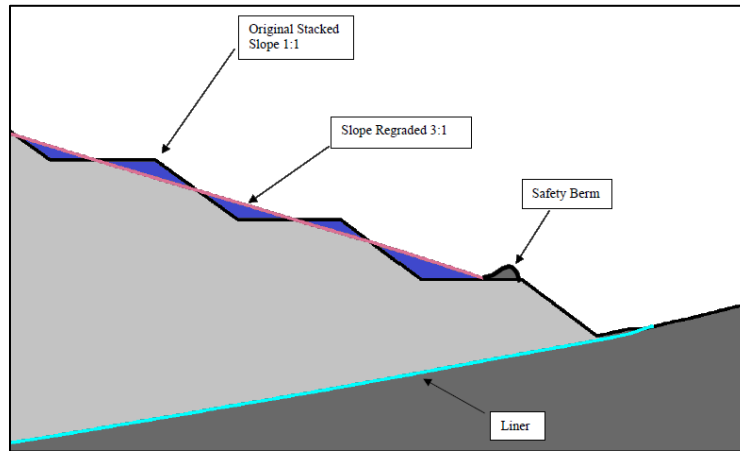
- Prior to starting or continuing work on active re-contouring of an area
  - A Technical Services delegate will ensure that the desired project area is delineated and displayed on a plan view map. The map will clearly show the assigned CAES project name and indicate the location of major pipelines, electrical infrastructure, stability monuments and liner relative to the project area. The map will be distributed electronically to the Mine Operations, Heap Leach Operations and Environmental group at least 1 week prior to work starting.
  - A CAES project will be created that delineates the project area and the desired final slope configuration.
  - Equipment operators will conduct an in-field risk analysis with their supervisor and will be provided a copy of the plan view map referenced above.
  - Equipment operators will be trained on proper slope construction and sloping techniques
- While active re-contouring of an area is occurring
  - A visual inspection of the work area and work progress will be made by a representative from the Technical Services department on a daily basis.
  - Equipment operators will utilize the designated CAES project for the area. At no time will equipment work on a re-sloping project without an operational CAES and GPS unit.
- After re-contouring of an area is complete
  - A safety berm will be placed at the toe of the re-contoured slope. The berm must be of sufficient size to stop rolling and/or falling rocks from continued travel down the slope.

- The area will be surveyed and an as-built file created. This information will be compiled and incorporated into mine as-built topography files as appropriate.
- At the mines discretion, drip tube emitters may be placed or ripped into regraded slopes to allow for active leaching of the area.

**Figure 3-1 – Conceptual Pad Pre and Post Regrade & Project Limits**



**Figure 3-2 – Regraded Slope Section**

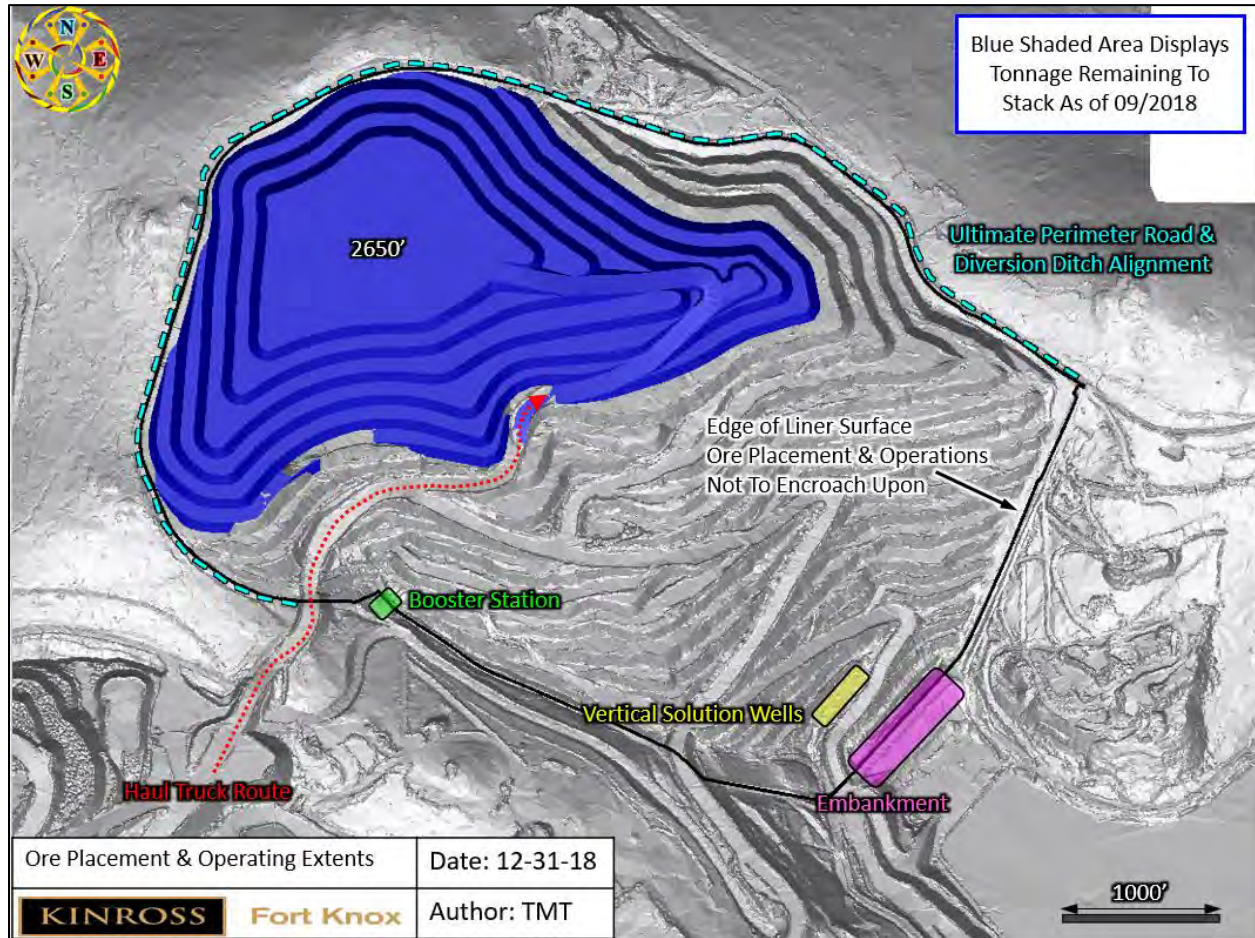


Ore is placed under leach at a rate of up to 20,000 gpm or up to a unit rate of 0.005 gpm/ft<sup>2</sup>. At any one time there can be up to 4.0M ft<sup>2</sup> of ore being leached at the prescribed unit rate. Under the direction of the Chief Metallurgist or their delegate, FGMI may choose to increase the amount of area under leach through the lowering of the application rate to less than 0.005 gpm/ft<sup>2</sup>. The amount of total solution applied to the pad shall not exceed 20,000 gpm.

Slope maintenance will include any activities required to maintain the slope of the ore and preserve the integrity of structure along the toe of the slope.

With the completion of liner construction through stage 10 in the 2018 construction season, the approved ore stacking and leaching area has been expanded. The current ore loading and leaching configuration is shown in Figure 3-3 and encompasses all liner stages constructed through stage 10. Note that the top elevation of material placement is limited to the 2650' elevation.

Figure 3-3 – Limits of Leaching and Ore Placement for Stage 10.



### 3.2.2 Inspections and Monitoring – Ore Heap

Mine Operations and/or Heap Leach personnel will monitor and check the following at least once per day. See Appendix B for a copy of the WCHL inspection form.

- Verify that ore is not placed outside limits of the mine plan or approved limits of liner and overliner
- Verify that ore loading is occurring in an up-slope direction where possible. This is especially important on the face of the pad. Dumping perpendicular to the final face increases the potential for a dump layer to act as a slip plane for a scarp to slip out on.
- Monitor for any indications of slope instability such as slipping, movement, cracking or bulging of the slope or similar movements at the toe of the slope or above the level of the stacked ore
- Monitor for any indications of erosion, sloughing or other movements of the overliner
- Verify that ore placement on the overliner is not damaging the overliner or underlying solution collection pipework or liner system.
- Verify the alkalinity of the leachate solution is maintained at about 10.2 pH
- Verify that solution distribution lines are working properly
- Monitor for any ponding of leach solution on the heap surface, if more than a minimal amount is present an action plan to resolve the issue must be put into place.
- Monitor for any wildlife that has entered the site and report if there has been a wildlife mortality

### 3.3 The WCHL Embankment & Spillway

Once the embankment is constructed, it is not “operated” since it is a stationary structure designed primarily for solution retention.

Embankment maintenance involves maintaining the crest road, concrete portion of the spillway, and repairing any erosion of the slopes. Slope erosion should be minimal since the rockfill embankment is highly resistant to erosion. Other maintenance will be to clear the “v-ditch” or swale area of accumulated sediment, snow, or other obstructions, which might substantially infringe into the designed capacity.

#### 3.3.1 Inspections and Monitoring – Embankment & Spillway

Visual inspections of the embankment will be conducted on a daily basis and recorded on the HL form presented in Appendix B. The key areas of observation and things to inspect for include:

##### Embankment crest

- Signs of settlement that would potentially reduce the freeboard level
- Horizontal displacements in the downstream direction that would indicate instability
- Condition of the crest road

##### Upstream slope

- Overliner drain aggregate condition. Ensure that it has not eroded away from the slope to expose the LLDPE geomembrane primary liner below.
- Signs of slope movement such as slumping, cracking or bulging

##### Downstream slope, Abutments, Downstream of Toe

- Signs of slope movement such as slumping, cracking or bulging
- Signs of seepage, erosion or deformation

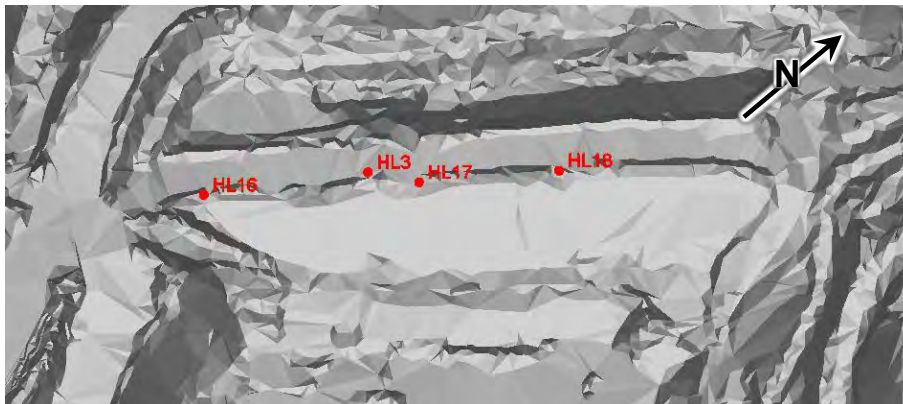
##### Spillway & Downstream Channel – Must be inspected if a rainfall event of 0.5” over 24 hrs occurs

- Signs of settlement including cracking or misalignment
- Signs of deterioration of the concrete inlet, riprap or channel. This includes any exposure of the reinforcing elements in the concrete.
- Accumulation of silt or other blockage in the channel

In the event that a stability or seepage related item is identified, the location, extent, and size of the slump or associated seepage, as well as the pond level will be reported within the same day of identification to a representative of the environmental department.

Seven survey monuments are installed to enable monitoring of embankment movements. Three are located on the 50-foot-wide bench at the top of the base platform. Surveying the four embankment monuments will be on a quarterly basis. These are also to be surveyed following any significant seismic event. Data will be reviewed by the Engineer of Record (EOR) at a minimum of once per year. Review by the EOR will occur more frequently if movements in any direction exceed 0.05 foot from the movements reported in the previous annual inspection. FGMI’s survey department records survey data in a spreadsheet which is entered into the Fulcrum database.

**Figure 3-4 – WCHL Embankment Prisms**



### 3.4 In-Heap Storage Pond & Composite Liner System

The Composite Geomembrane Liner System is an integral part of the solution collection system and once covered with ore will not be available for maintenance. Where covered by overliner and not ore it will be available for repair should the need arise. From a practical standpoint, maintenance will be limited to the exposed overliner. If the overliner is eroded, it must be replaced. If the liner system is damaged it must be repaired.

#### 3.4.1 Operation and Maintenance – Internal In-heap Storage Pond

The in-heap storage pond is contained in the heap itself behind the embankment to avoid the freezing potential associated with an exposed pond. The available water storage capacity is located in the interstitial pore spaces between the individual ore particles of the ore in the heap contained behind the embankment and bounded on the sides by the ridges forming the valley.

Surpluses or deficits of water on the pad are possible over the expected operating life of the facility. This is largely due to seasonal changes in climatic conditions throughout the year. Heap leach operators and their corresponding management must consider when to act and start removal of water from the heap leach pond to maintain the designed operating levels of the in-heap storage facility. Addition of water to the pad to maintain an appropriate operating pond depth must also be considered but is of lesser importance relative to the embankment.

Detailed information about the volumetric components of the in-heap storage pond is available in the previous Section 2.4.

#### **Normal Operating Pond by Stage**

The following are the stage by stage pond operating levels at an application rate of 20,000 gpm that should not be exceeded under normal operations in order that the required storm water, draindown and freeboard component allowances are always maintained.

Recirculation of solution to the top of WCHL from the pond under emergency power is an effective means of extending the time it will take for draindown solution to fill the in-heap pond. This can aid in reducing solution encroachment into storm volume or even delay its approach into the spillway elevation.

Flow Rate = 20,000 gpm and draindown considers 8,000 gpm recirculation:

- Ore Stacking on Stage 10 or lower – 1612.5' Maximum Normal Operating Pond Level

Flow Rate = 20,000 gpm and draindown considers No recirculation:

- Ore Sacking on Stage 10 or lower– 1602.1' Maximum Normal Operating Pond Level

#### **Important In-Heap Pond Freeboard Levels**

- **1648'** is the bottom of the in-heap pond freeboard. This is the maximum water level elevation prior to encroachment into the freeboard allowance. The bottom of the in-heap pond swale/V-ditch is well below 1648' and allows for visual monitoring of encroachments into the pond freeboard allowance.
- **1650.5'** is the invert of the in-heap pond emergency spillway. During extreme conditions, flow will begin to pass through the spillway when water levels within the pond rise above this elevation. This occurrence could be from the design storm event acting on frozen ground conditions, or it could be due to a storm event that exceeds the established 100-yr/24-hr design event.
- **1652.5'** is the bottom of the freeboard within the emergency spillway. This is the water surface level within the spillway when the design 100-yr/24-hr storm results in discharge through the spillway.
- **1653'** is the crest of the embankment. This is the maximum water level within the WCHLF in-heap pond prior to overtopping of the dam.

**Table 3-1 In-Heap Pond Storage Component No Recirculation and 20,000 gpm flow**

Stage	10	
2-Dimensional Pad Area	18.43 M sf	
Component	Elev (fmsl)	Storage (M gal)
Maximum Normal Operating Level (8,000 gpm recirc)	1612.5	38.1
100-yr/24-hr Storm Event (8,000 gpm recirc)	1612.5 to 1641	45.7
24-hr Emergency Draindown (8,000 gpm recirc)	1641 to 1648	17.3
Maximum Normal Operating Level (no recirculation)	1602.1	26.6
100-yr/24-hr Storm Event (no recirculation)	1602.1 to 1635.2	45.7
24-hr Emergency Draindown no recirculation)	1635.2 to 1648	28.8
Freeboard Allowance (to spillway invert)	1648 to 1650.5	7.6
Freeboard Allowance (above spillway invert)	1650.5 to 1653	8.1
Total		116.8

Figure 3-5 – Stage Pad Areas vs. Pond Elevations @ 20,000gpm

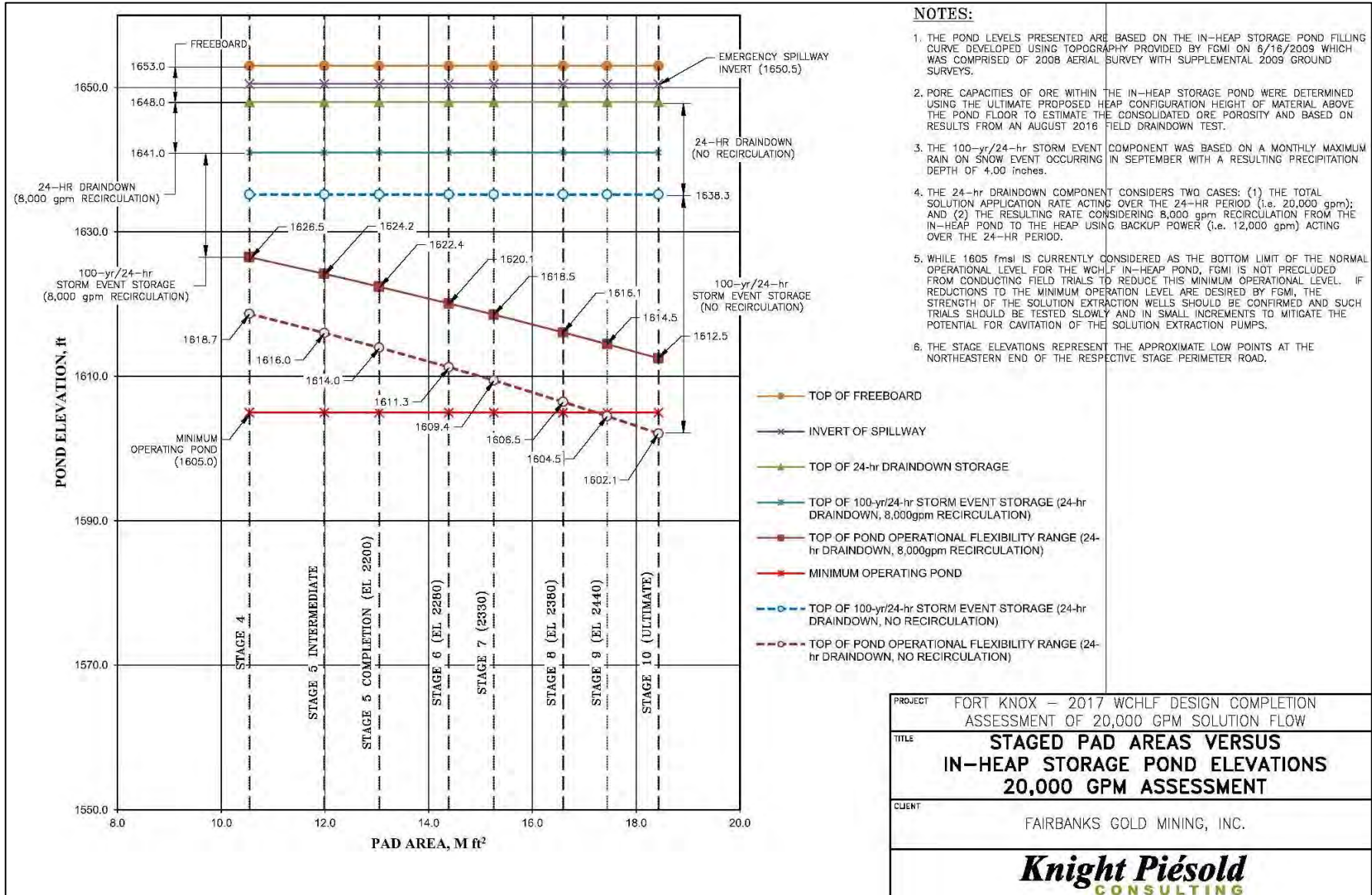


Figure 3-6 – Stage Pad Areas vs. Pond Volumes @ 20,000gpm

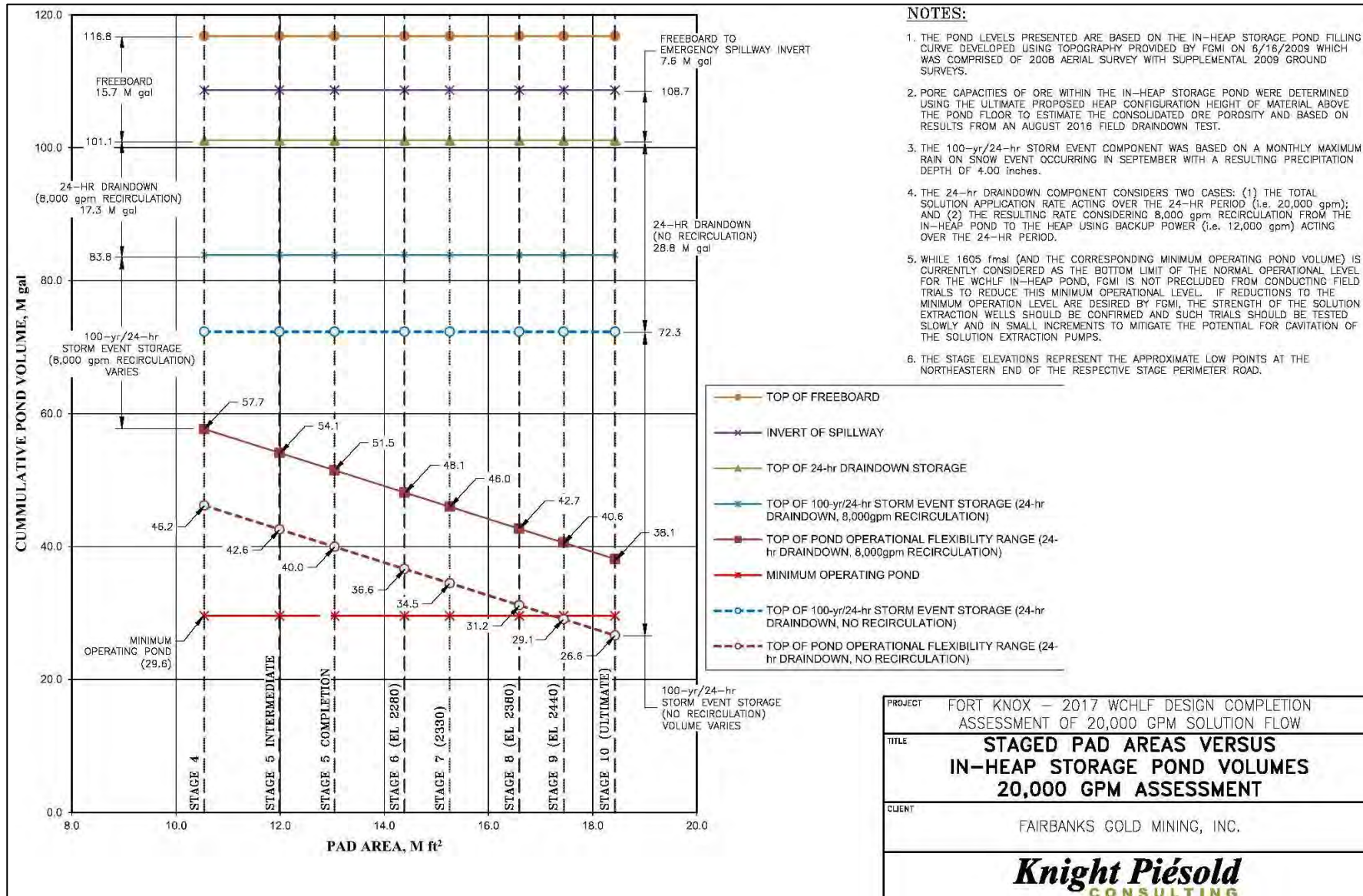
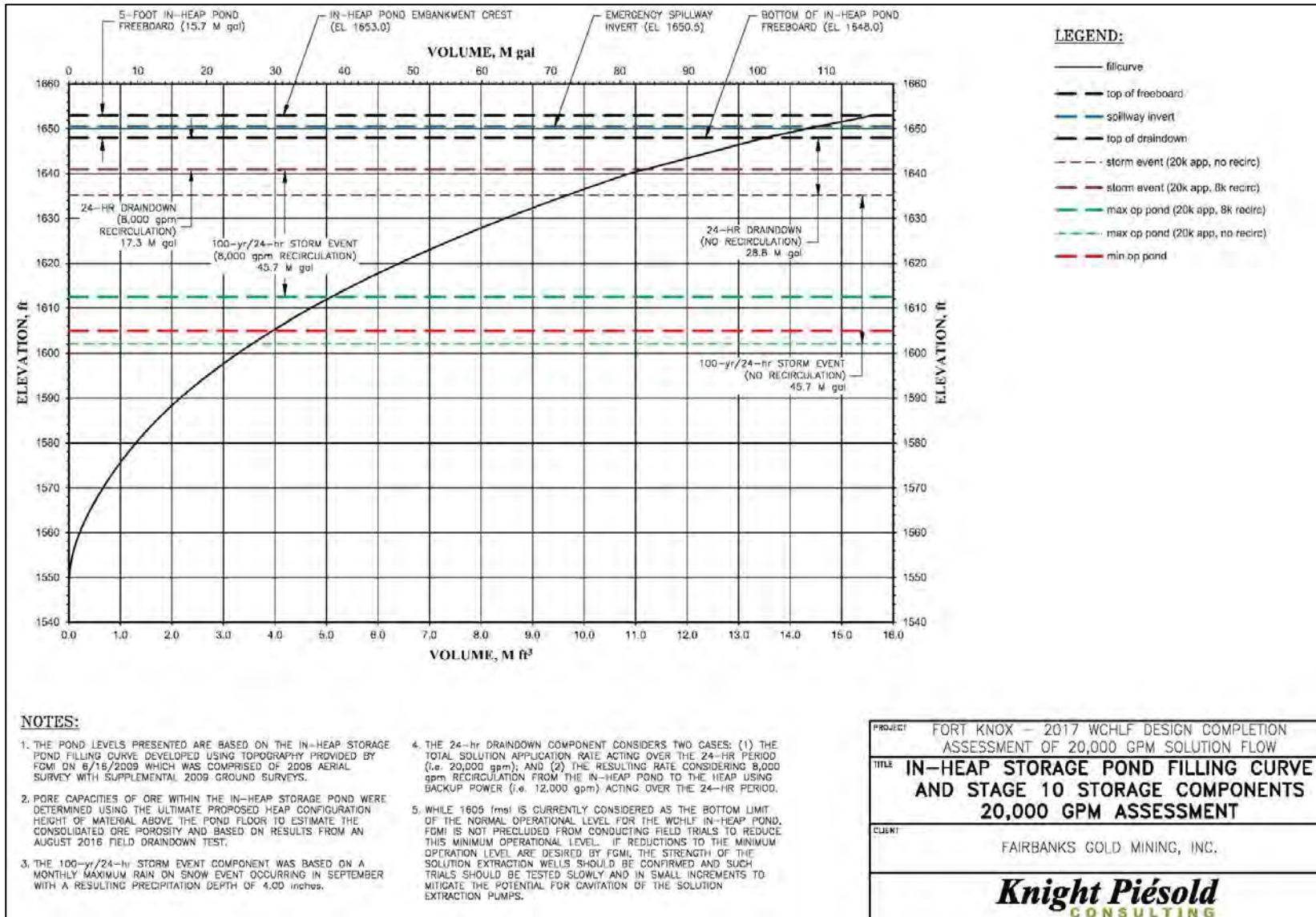


Figure 3-7 – Stage 10 Filling Curve @ 20,000gpm



**Pad Operations At Reduced Flow Rates**

While FGMI is currently permitted to operate the WCHL facility at a flow rate of 20,000 gpm, the operation may choose to operate the pad at the reduced flow rate of 16,000 gpm. With prolonged operation at the reduced rate, there is additional flexibility in the operating pond and the maximum allowable normal operating level of the pond increases. Before the higher elevation operating levels can be used, one month of operation at 16,000 gpm is required when transitioning from the higher flow rate of 20,000 gpm down to 16,000 gpm. This transition period is to allow for solution drain down to occur in those areas of the pad that were operated at higher flow rates.

**The information displayed in the table below is only applicable if the operation has operated at a reduced flow rate of 16,000 gpm for a continuous period of at least one month.**

**Table 3-2 – Stage Storage Components @ 16,000 gpm**

Stage	10	
2-Dimensional Pad Area	18.43 M sf	
Component	Elev (fmsl)	Storage (M gal)
Maximum Normal Operating Level (8,000 gpm recirc)	1617	43.9
100-yr/24-hr Storm Event (8,000 gpm recirc)	1617 to 1643.3	45.7
24-hr Emergency Draindown (8,000 gpm recirc)	1643.3 to 1648	11.5
Maximum Normal Operating Level (no recirculation)	1607.6	32.4
100-yr/24-hr Storm Event (no recirculation)	1607.6 to 1638.3	45.7
24-hr Emergency Draindown no recirculation)	1638.3 to 1648	23
Freeboard Allowance (to spillway invert)	1648 to 1650.5	7.6
Freeboard Allowance (above spillway invert)	1650.5 to 1653	8.1
Total		116.8

### 3.4.2 Inspections and Monitoring – Internal In-heap Storage Pond

Daily inspection and monitoring of the In-heap Storage Pond consists of:

- Visual inspection of the pumps and piping associated with collection wells.
- Measurement of the solution level in the pond, done by reading and converting the reported values from vibrating wire piezometers 9 & 10.
- Measurement of the flow and water depths at the solution collection pumps.
- Visual inspection of the PCMS for evidence of solution leakage in the liner system.
- Inspection of the LCRS for evidence of solution leakage

Weekly inspection and monitoring tasks include:

- Reading the vibrating wire piezometers 9-14, discussed below

### 3.4.3 Inspections and Monitoring – Liner and In-Heap Pond Piezometers

The proper function of the liner system above the in-heap pond is determined by the presence of a less than one foot of head, or solution depth on the primary liner. Head on liner is measured by piezometer pairs installed throughout WCHL, which are read weekly through the use of a VW Mini-logger. The logged frequencies are recorded on the inspection form presented in Appendix B and entered into FULCRUM.

Piezometer Pairs Are Listed Below

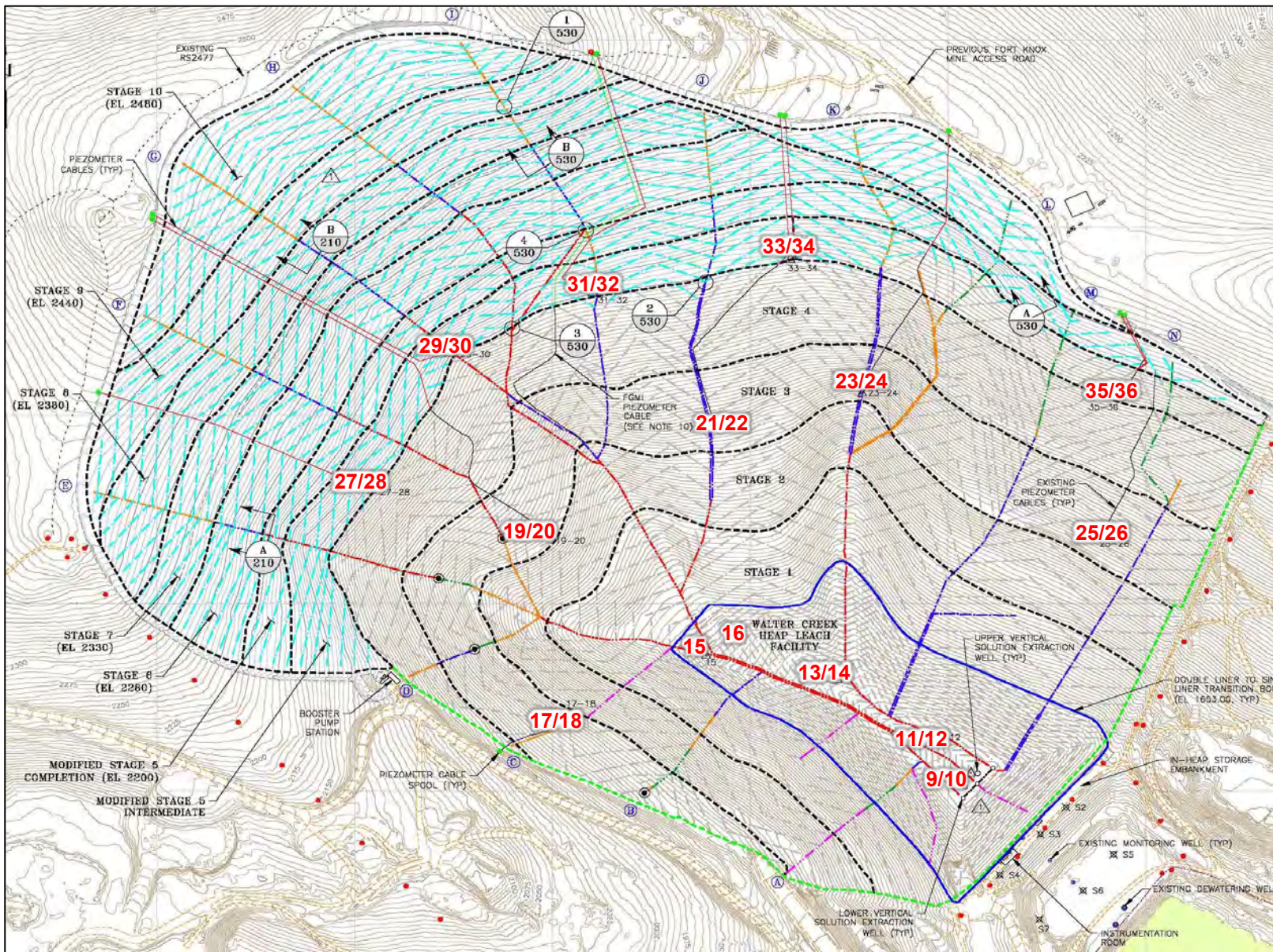
- Pairs 9-14 are installed in the in-heap pond area
- Pairs 15-16 are installed above the in-heap pond in stage 1 overliner
- Pairs 17-26 are installed in the stage 3 overliner
- Pairs 27-36 are installed in the stage 5 overliner

See Figure 3-8 – Vibrating Piezometer Locations on the next page for location

It was discovered that piezometers 21-26 were inadvertently left uncovered in the overliner material through the winter of 2012/2013 after being installed. This likely caused water to freeze in the diaphragm, damaging the piezometers. Readings for these piezometers will continue to be manually read with a data logger on a monthly basis in the event the piezometers start providing valid data.

The leads from vibrating wire piezometers 9-16 are extended to a single monitoring location located on the right abutment of the in-heap storage embankment. These piezometers are also hardwired to the mill to allow for continuous and instantaneous readings.

Figure 3-8 – Vibrating Piezometer Locations



### 3.5 Leachate Collection and Recovery System (LCRS)

#### 3.5.1 Operation and Maintenance – LCRS

The LCRS monitors and collects process solution passing through the primary liner of the in-heap pond. It is buried beneath the pond so there is no practical way to perform maintenance. The estimated leakage rate to the LCRS at the long term normal operating pond level was expected to be 330 gpm during design of the WCHL. A pond level at elevation 1648 feet was expected to result in an estimated 520 gpm. Actual leakage rates have been much smaller and are on the order of 0.05 gpm.”

Currently, the LCRS is pumped once a week due to low volumetric flow of solution into the sump. Any flow is pumped back into the in-heap pond and flow volume is determined by an automatic recording device. Operation and maintenance of the piping and pumping systems will be according to the manufacturer’s recommendations and FGMI’s scheduled maintenance.

Three pairs of vibrating wire piezometers numbered 3-8, are located within the LCRS to monitor the hydraulic head acting on the secondary liner of the in-heap storage pond. Additionally, one pair, numbered 1&2, is located in the center of the LCRS sump to monitor fluid depths in the sump and the head acting on the liner. The leads from piezometers 1-8 have also been extend to the centralized monitoring station located on the in-heap storage embankment, which transmits data to the mill.

#### 3.5.2 Inspections and Monitoring – LCRS

Daily monitoring & Inspection consists of:

- Inspections of the LCRS piping and pumping system
- Record the solution elevation in the LCRS

Weekly monitoring consists of:

- Recording flow pumped from the sump
- Water levels at the pump
- Water quality sampling and analysis of sump water for WAD Cyanide.

**Figure 3-9 – LCRS Solution Collection Pipes**



### 3.6 Process Component Monitoring System (PCMS)

#### 3.6.1 Operation and Maintenance - PCMS

The only accessible portion of the PCMS are the outlet monitoring points located in the northeast corner of the in-heap storage pond along the slope just behind the spillway. The outlet monitoring points are exposed and will discharge any flows directly onto the double lined pond area. The PCMS outlets have heat traces at the ends of the pipes that will be maintained as part of the routine FGMI maintenance program.

**Figure 3-10 – Close-up View of the PCMS Outlets**



### 3.6.2 Inspections and Monitoring – PCMS

On a daily basis, heap leach operators will:

- The PCMS outlets will be monitored and inspected
- Record any observed flow by measuring the time it takes to fill a container of known size and calculating the flow rate in gpm. If flows continue an automated flow measuring devices may be installed.
- Ensure that any observed flow reports to the in-heap pond area

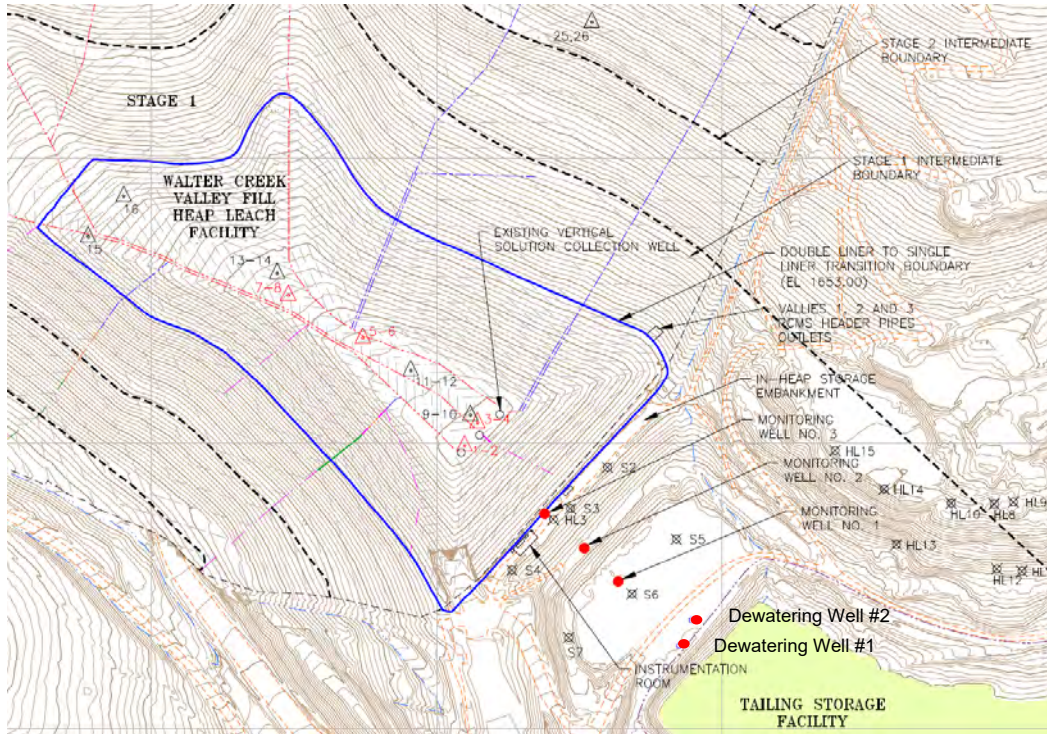
On a weekly basis, a representative of the environmental department will sample the PCMS for WAD Cyanide and pH if there is measureable flow.

On a quarterly basis, the environmental department will submit PCMS reports to the ADEC.

### 3.7 Underdrain Collection System, Dewatering and Monitoring Wells

#### 3.7.1 Operation and Maintenance - Underdrain Dewatering and Monitoring Wells

The surface around the monitoring wells shall be maintained such that ready access is available for reading water levels and water sampling. This includes snow management and removal from around the wells so that the above ground casing extensions are clearly visible to avoid damage. The above ground casing on all wells must be well marked and/or painted to be highly visible to an equipment operator.

**Figure 3-11 – Monitoring & Dewatering Wells**

### 3.7.2 Inspections and Monitoring - Underdrain Dewatering and Monitoring Wells

The underdrain monitoring wells are provided for obtaining water quality samples, as well as measuring the water level in the drain. Three monitoring wells, seen above in Figure 3-11, are installed:

- (HL-1) Crest of the base platform random fill
- (HL-2) Pipe line bench on the downstream slope of the in-heap storage pond embankment
- (HL-3) Crest of the in-heap storage pond embankment

On a quarterly basis, the Environmental Department will measure water levels and collect samples from the monitoring wells. Samples taken will be analyzed by a third party quarterly for Profile II constituents.

If WAD cyanide is detected above a concentration of 0.2 mg/L, the ADEC must be notified within one working day of the discovery. If WAD CN is above the 10 ppm then underflow will need to be returned to the HLP. FGMI must then demonstrate to the ADEC's satisfaction that all underflow reports to the TSF.

If water quality does not meet required water quality standards, existing information demonstrating that the solution is contained in the TSF needs to be submitted to the state. In addition, a pump needs to be installed in HL-1 and operated to lower the groundwater level to form a cone of depression at the toe of the HLP such that the flows can be pumped back to the HLP. A flow measuring device will be installed on the pump to provide a record of flows pumped back to the HLP.

Monitoring well water level readings are recorded in an electronic format. The pump flows shall be recorded on the form presented in Appendix B.

## 3.8 CIC Booster Station

### 3.8.1 Operation and Maintenance – CIC Booster Station

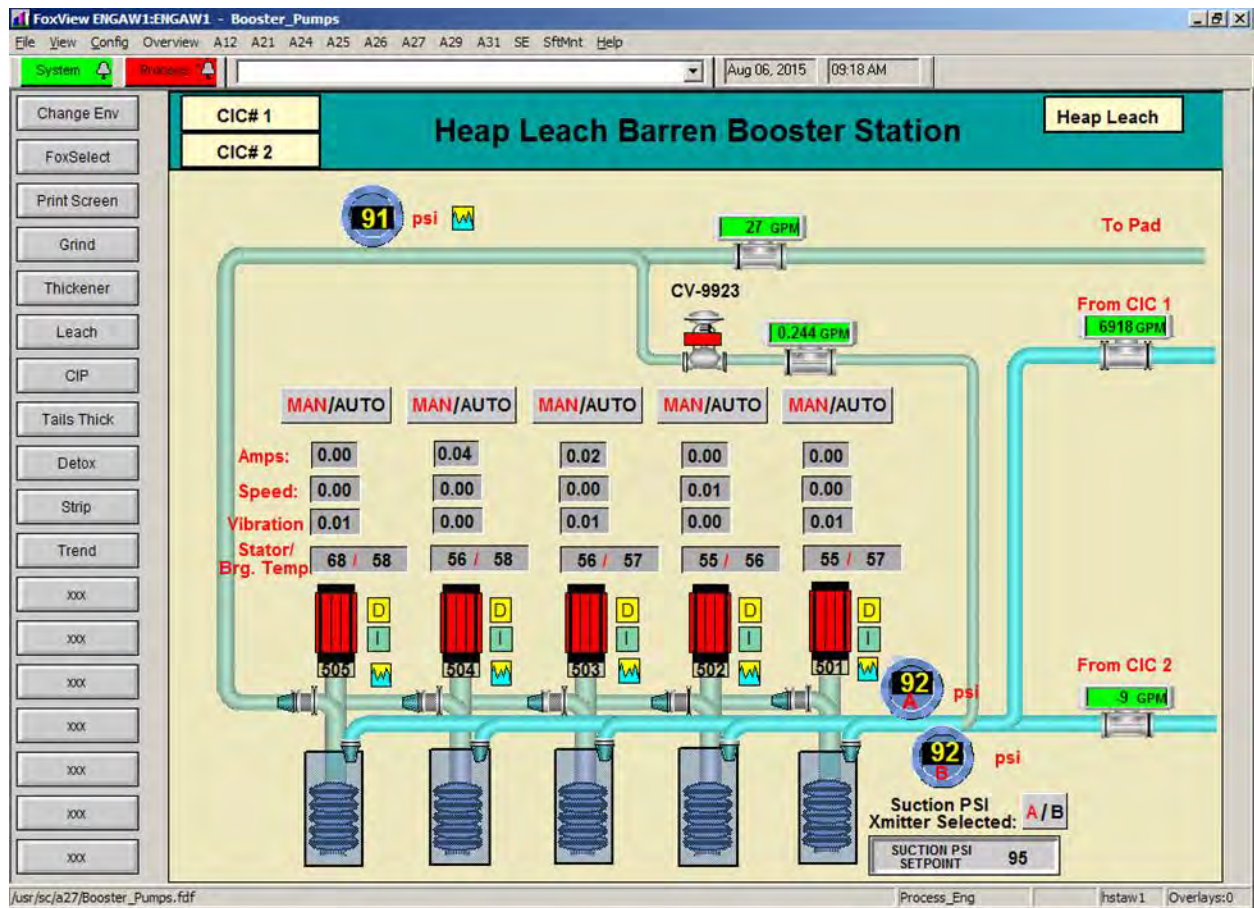
Each pump can be operated in manual or automatic mode. In manual mode, the pump speed and start/stop values are controlled by the corresponding inputs of the operator. In auto mode the pump speed and start/stop are automatically controlled by the process logic controller (PLC). Generally, active

operation/oversight of the booster station is done remotely through the Data Collection System (DCS) interface in the mill control room. A picture of the DCS interface is seen in the following Figure 3-12.

The automatic start/stop logic for the booster pumps is directed by pressure seen at the inlet. Once the interlock checks have been satisfied and the station is calling for an automatic start, it will start the first available pump in the sequence and ramp it up/down to control suction pressure to the defined set point, which is adjustable by the operator. Once a pump reaches maximum speed output and the suction pressure reaches the upper limit, the next available pump will start at full speed and the lead pump will self-modulate to control pressure. This cycle continues until the station is online at full capacity. The logic for stopping pumps follows a last on first off sequence to modulate inlet pressure.

A recirculation valve has been installed to protect the equipment associated with the booster station, named CV-9923 in the DCS system. This valve is controlled by mechanical pressure and the indicator seen in the DCS is for the pilot solenoid that enables it. If the inlet pressure drops below 30 psi or any pump is placed into manual mode, whether it be at the local hand station or on the DCS, the pilot valve will open and allow operation of the recirculation valve. The indicator on the DCS screen does not indicate whether the valve is open or closed, just if it is enabled.

Figure 3-12 – CIC Booster Station DCS Interface



### 3.8.2 Inspections and Monitoring – CIC Booster Station

Operators will inspect the booster station on a daily basis and perform maintenance as needed according to manufactures specifications. The barren solution application rate reports to the DCS and is read by the control room operator. The application rate is to be recorded on the HL daily inspection form.

### 3.9 On Pad Pipelines & The Pipeline Corridor

#### 3.9.1 Operation and Maintenance - Pregnant and Barren Pipeline Corridor

All pipe crossings will be maintained to prevent crushing of the doubled lined pipes or damage to the liner. Piping will be maintained according to the manufacturer's specifications.

In the event of a damaged 12" feed pipe, the line will be isolated until a repair section can be made and brought in for replacement. This should occur usually within 12 hours of discovery. After the line is repaired and recharged, the pipeline will be walked to check for leaks.

In the event a 24" feed line fails or is damaged, a large decrease in indicated pressure in the control room will be seen on either the mill barren or booster station lines. Upon discovering or receiving notification of such an event, the control room operator will shut down flow to the appropriate system. The damaged section will be isolated by closing the feed valve and locking it out. Once damaged or compromised sections have been repaired with new piping, a check for leaks will be conducted when flow is restored to the system.

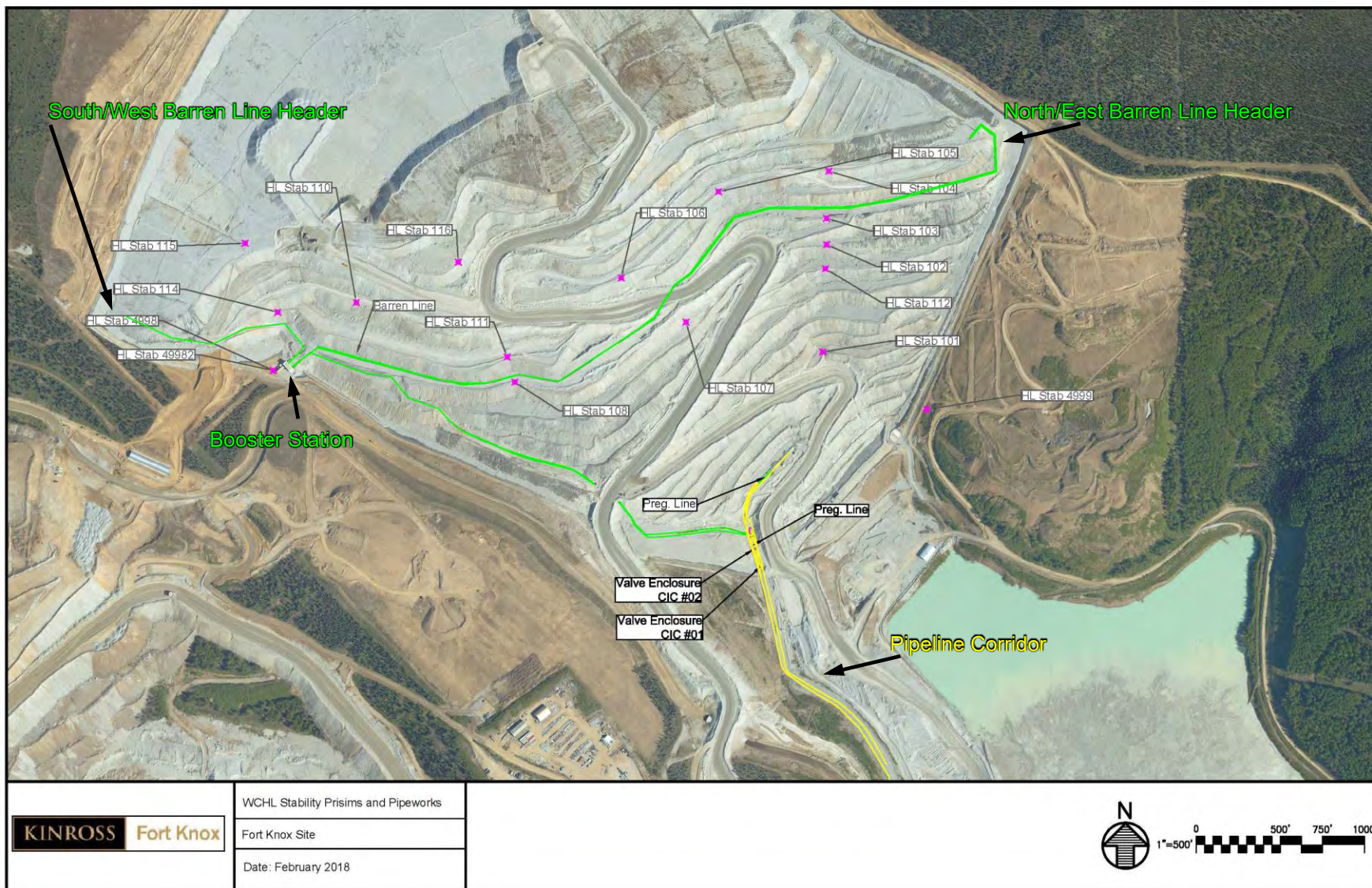
#### 3.9.2 Inspections and Monitoring – On Pad Pipelines & Pipeline Corridor

On a daily basis the heap leach operators will visually inspect the on-pad pipelines. The mill control room operator will actively monitor the pressures in the barren and booster station feed lines.

The piping corridor will be inspected on a daily basis by the heap leach operators. Inspections will include observation for any:

- Surface movements which indicate problems with the pipe in the trench, or the trench itself
- Excessive snow loads that need clearing/removal
- Erosion of the trench or supporting ground area
- Maintenance needed for the corridor
- Discharge/flow from the end of corridor shall be monitored. It will not be unusual to see flows resulting from rainfall or snowmelt. However, if the flows persist at a near constant or increasing rate, water quality samples shall be taken and analyzed to determine if the flows are from leaks in the pipes. If they are from leaks in the pipes, the pipes shall be repaired.

Figure 3-13 – On Pad Major Pipelines & Pipeline Corridor



3.10 Surface Water Control System

3.10.1 Operation and Maintenance – Surface Water Control System

Diversion channels should be cleared of materials or maintained in the manner described in Table 3-3 if:

- Channel flow is restricted by substantial accumulation of debris, vegetation, or sediment
- Areas of significant erosion are present and/or the riprap has been displaced
- Any required maintenance will be reported on the HL form presented in Appendix B

**Table 3-3 – Surface Water Controls – Maintenance Procedures**

<b>Issue</b>	<b>Response</b>
Erosion	Regrading to Original Lines and Grades Replacement of Removed Riprap
Accumulation of Debris/Other	Remove Debris Remove Sediment in Retention Structures
Culvert Blockage from Sediment / Debris	Schedule to have blockage removed Remove Unsuitable Sediment from Road
Impaired Access	Regrade Road to Original Lines and Grades
Liner System Integrity is Compromised	Schedule Liner Repairs
Settlement	Regrade Channel to Original Grade

3.10.2 Inspections and Monitoring – Surface Water Control System

The condition of the surface water diversion channels and culverts will be inspected weekly or after rainfall of greater than 0.5 inches in a 24-hour period. FGMI personnel will monitor the condition of the surface water diversions and sediment retention structures as a part of normal operating procedures.

The minimum formal diversion channel inspection schedule is summarized below in Table 3.4. Inspection findings or observations shall be recorded on the HL form.

**Table 3-4 – Inspection Schedule for the Walter Creek HLP Surface Water Controls**

<b>ACTIVITY</b>	<b>INSPECTION FREQUENCY</b>
Excessive Erosion / Repair	Weekly <sup>1</sup>
Debris Removal	Weekly <sup>1</sup>
Diversion Berms	Weekly <sup>1</sup>
Integrity of Liner System	Weekly <sup>1</sup>
Visual inspection of channels & culverts	Weekly <sup>1</sup>
Ice Jam Inspection	Weekly (winter months only) <sup>1</sup>

<sup>1</sup> FGMI personnel will provide informal inspections on a daily basis as part of normal operating procedures.

3.11 Photographs

Taking photographs of conditions needing repair, the repair process, or completed repairs is encouraged to provide a visual record of the conditions and the repair. This is especially important when design of the repair may involve personnel who are offsite. Photographs of areas that are taking more than routine maintenance help to provide insight on potential design modifications that will reduce maintenance costs.

### 3.12 Data Interpretation

Data collected by heap leach operators will be reviewed by their supervisors. A designee from the environmental department will conduct secondary review of this information. The environmental department will also collect and manage all data for reporting to agencies. Should an issue be identified, the appropriate area manager and the engineer of record will be notified.

This manual provides the guidelines for a consistent method for monitoring and inspecting the facilities. It also, in many cases, includes the “trigger” that initiates actions based on the results of the monitoring and inspection. However, in a number of cases making consistent plots of data versus time provide a useful way to examine the changes over time. It is strongly suggested that a consistent program of filing and storing the Daily Field Reports and summarizing key data graphically on a time basis be established and maintained. The entire system is set up in an electronic format, FULCRUM a web-based program that provides ready access to the results of the observations. Trigger levels have been developed to alert personnel by email notification.

Areas that would benefit from graphical summaries include but are not limited to the following:

- Graphs of piezometer readings versus time
- Graphs of water levels in the monitoring wells versus time
- Graphs of pumping rates for the LCRS and sump at the toe of the base platform fill versus time
- Graphs of water chemistry versus time

## Section 4.0 - Event Detection

This section is a tool to identify potential situations before they become critical events. Much of this material is taken from the Fort Knox Emergency Action Plan and the Fort Knox Emergency Management Plan. Refer to those plans for additional information.

### 4.1 Event Detection

This step describes the detection of an unusual or emergency event and provides information to assist the Dam Operator in determining the appropriate emergency classification level for the event. Unusual or emergency events may be detected by:

1. Observations by FGMI personnel or contractors
2. Observations at or near the dam by government personnel (local, state, or federal), landowners, visitors to the dam, or the public
3. Evaluation of instrumentation data
4. Earthquakes felt or reported in the vicinity of the dam
5. Forewarning of conditions that may cause an unusual event or emergency event at the dam (for example, a severe weather or flash flood forecast)

#### 4.1.1 Level 1 Non-Failure

A non-failure emergency is an unusual condition. They are conditions or situations that differ from the normal or expected condition of the dam and impoundment. These unusual conditions may indicate problems needing investigation or corrective measures.

#### 4.1.2 Level 2 Potential Failure

A potential failure emergency level indicates that conditions are developing at the dam that could lead to a failure. A potential failure means that time is available for analyses, decisions, and actions prior to a failure. A failure may occur but predetermined response actions may moderate the extent or alleviate the failure. This also includes any situation where water is at the WCHL spillway invert and a release to the TSF is imminent.

#### 4.1.3 Level 3 Imminent Failure

The imminent failure emergency level indicates that time has run out for analysis/study, and the dam has failed, is failing or about to fail

**Table 4-1 – Event Detection**

Event	Situation Details	Level
Spillway flow	Walter Creek Heap Leach any amount is reportable to DEC	1
Embankment overtopping	WCHL 1648' (5 feet below dam crest) Water level is encroaching on the freeboard	1
	WCHL 1650.5' Water is at the spillway invert and a release to the tailings is imminent	2
	Water level has exceeded the freeboard and water is flowing over the dam failure is imminent.	3
Seepage	New seepage areas in or near the dam	1
	Increase in new or existing seepage rates. New or existing seepage have a cloudy discharge or increasing flow rate.	2
	Is the new or existing seepage cloudy and the discharge flow rate is rapidly increasing. Surface cracks are developing. Notable and unusual conditions are occurring.	3
Earthquake	Minor Earthquake as defined Table 4-2	1
	Major Earthquake as defined in Table 4-2	2
	Earthquake resulting in uncontrolled release of water from the dam	3

Event	Situation Details	Level
Embankment cracking	New cracks in the embankment less than ¼-inch wide without seepage	1
	New cracks in the embankment greater than ¼-inch wide without seepage	2
	Cracks in the embankment with seepage	3
Embankment movement	Small movement detectable by instruments	1
	Slightly larger movement/slippage that is visually observable	2
	Sudden or rapidly proceeding slides of the embankment slopes	3
Instruments	Increase in instrument readings	1
	Instrumentation readings beyond predetermined values	2
	Instrument readings that continue to increase from the expected norm	2
	Elevated instrument readings in conjunction with other elevated event detection situations	3
Boils & Sinkholes	Observation of new sinkhole in reservoir area or on embankment. Observation of a boil down stream of the toe	1
	A boil is noticed with the formation of a silty soil cone around the outlet of the boil Enlarging sinkhole	2
	Rapidly enlarging sinkhole with or without a drop in pond water elevation	3
Security threat	Vague or unverified bomb threat	1
	Verified bomb threat that, if carried out, could result in damage to the dam	2
	Detonated bomb that has resulted in damage to the dam or appurtenances	3
Sabotage/ vandalism	Damage to dam or appurtenance with no impacts to the functioning of the dam	1
	Modification to the dam or appurtenances that could adversely impact the functioning of the dam	2
	Damage to dam or appurtenances that has resulted in a dam safety issue	3

#### 4.2 Conditions and Evaluation

The potential emergency conditions or unusual occurrences are covered in this section. Measures to mitigate the effects of the emergency condition are in Section 4.3.

##### 4.2.1 Extreme Runoff from Rainfall or Snowmelt

On a heavy rain warning from the National Weather Service, the water level in the impoundment and in-heap pond will be monitored closely and the facilities will be maintained as necessary during the event.

After any major storm or thaw runoff event, a thorough inspection of all ditches, culverts, ponds, and other water-related facilities will be completed. Necessary repairs will be completed as soon as is reasonably possible to reduce the chance of additional damage during subsequent storm events.

##### 4.2.2 Increase in Seepage

Observations of water levels and flow rates on the piezometers, seepage reclaim sump, and interceptor and monitoring wells should be evaluated to determine if there are any significant changes in seepage rates associated with any of the dams. If an increase in seepage is detected, the flow will be examined to see if it is cloudy or clear and a determination of the reason for the increase in seepage will be made. Water quality analyses must also be performed to help determine the source of the water.

The identification of unanticipated seepage from the abutments or toe will be investigated, monitored, evaluated, and steps taken to control it. Monitoring will be conducted daily and will include visual inspection to determine if the water is clear or cloudy. Quantity measurements and water quality samples will be taken as required provided conditions are not prohibitive.

The engineer of record will be advised of new seeps, significant or sudden increases in seepage rates, changes in seepage color or cloudiness, or identification of new surface seeps.

Measures to control the seepage will be based on planned investigations and studies. Investigations will be carefully designed to provide information that can be used to analyze and evaluate the nature of the seepage.

4.2.3 Earthquakes

Earthquakes are classified as insignificant, minor, or major, with regard to the WCHL embankment. A seismic event that results in a Peak Ground Horizontal Acceleration (PGHA) greater than 0.05g will trigger mandatory actions. Any necessary repairs will be completed as soon as practical

In addition to the above, the Guidelines for Cooperation with the Alaska Dam Safety Program outlines the reporting requirements for distance from an epicenter in the following Table 4-3.

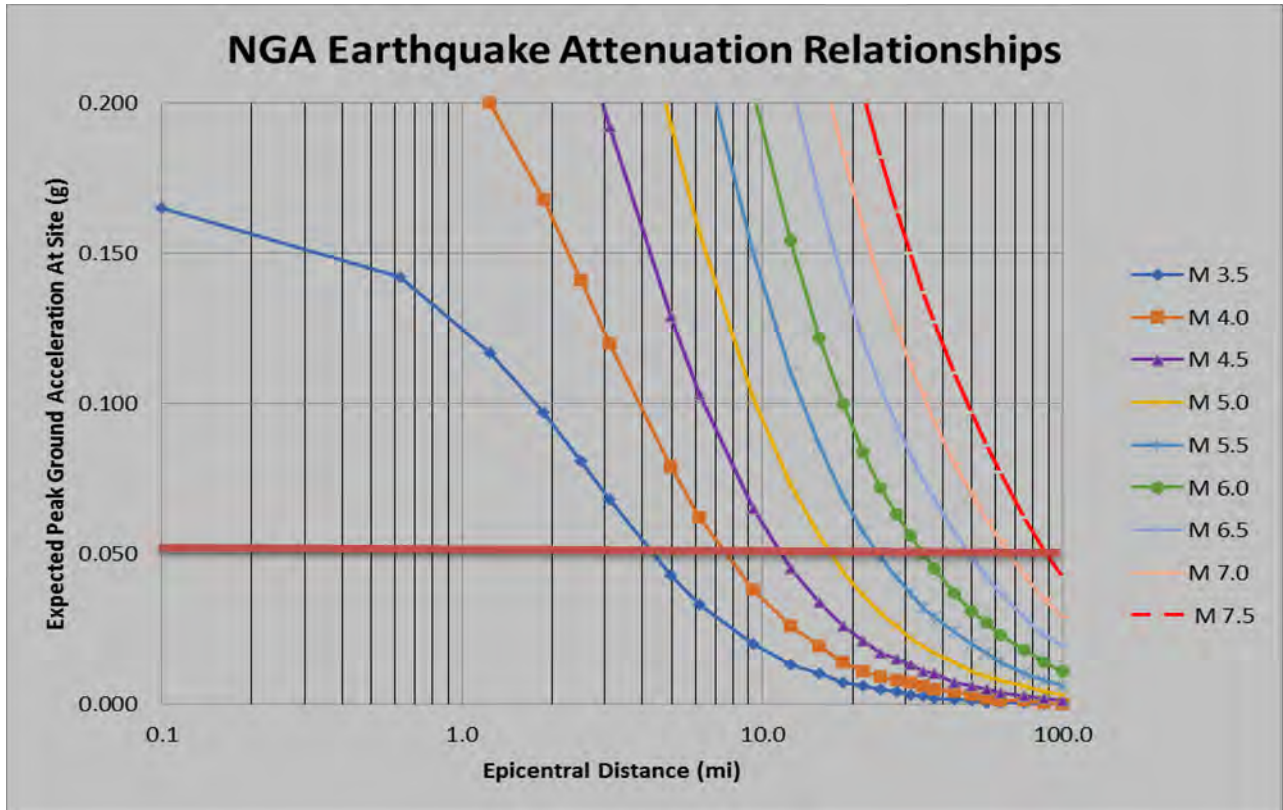
**Table 4-2 – Recognition and Action for Seismic Event**

Earthquake	Description & Action Items
Insignificant	Magnitude less than 3.5
	No special actions or inspections. Continue daily inspections and report any deformation or movement (cracking, slump, seep, etc.).
Minor PGHA <0.05g	No special actions or inspections. Continue daily inspections and report any deformation or movement (cracking, slump, seep, etc.).
Major PGHA >0.05g	If safe to do so, immediately inspect the main embankment for obvious deformation or movement (cracking, slump, seep, etc.).
	If safe to do so, immediately inspect all pipelines and the pump stations for rupture, leakage, or other obvious damage.
	Immediately stop the pumping of reclaim water and all process solutions if problems are discovered during the inspections.
	As soon as possible, survey the prisms on the embankment
	Notify the Engineer of Record and schedule an inspection if required
	Check monitoring wells for any indication of changes in ground water elevations
	For a two-week period after an earthquake classified as major, the piezometers should be read daily by an Environmental Technician or Engineer. After data reduction, water levels should be graphically displayed on a summary graph to track any unusual changes piezometer readings

**Table 4-3 – Alaska Dam Safety Guidelines: Required Reporting Distances**

Magnitude	Miles Away		
5.0	15		
5.2	17		
5.4	19		
5.6	21	Magnitude	Miles Away
5.8	22	7.8	50
6.0	24	8.0	53
6.2	27	8.2	57
6.4	29	8.4	62
6.6	32	≥8.5	63
6.8	34		
7.0	37		
7.2	40		
7.4	43		
7.6	47		

Figure 4-1 NGA Earthquake Attenuation Relationships



**Table 4-4 – Required Inspection Based on Peak Ground Acceleration (> 0.05g)**

Epicentral Distance	Miles	0.1	0.6	1.2	1.9	2.5	3.1	4.1	5.0	6.2	7.8	9.3	10.2	12.4	15.5	10.8
<b>Peak Horizontal Ground Acceleration (PHGA) Expected at Mine Site (g)</b>																
<b>Earthquake Magnitude</b>	<b>M 3.5</b>	0.165	0.142	0.117	0.097	0.081	0.068	0.050	0.043	0.033		0.020		0.013	0.010	
	<b>M 4.0</b>	0.275	0.239	0.200	0.168	0.141	0.120		0.079	0.062	0.050	0.038		0.026	0.019	
	<b>M 4.5</b>	0.411	0.361	0.307	0.260	0.223	0.192		0.129	0.103		0.065	0.050	0.045	0.034	
	<b>M 5.0</b>	0.555	0.494	0.426	0.368	0.318	0.278		0.193	0.157		0.102		0.073	0.056	0.050
	<b>M 5.5</b>	0.698	0.630	0.552	0.483	0.424	0.375		0.269	0.222		0.150		0.110	0.086	
	<b>M 6.0</b>	0.811	0.740	0.658	0.584	0.520	0.465		0.345	0.291		0.204		0.154	0.122	
	<b>M 6.5</b>	0.922	0.851	0.768	0.691	0.623	0.565		0.432	0.370		0.269		0.208	0.169	
	<b>M 7.0</b>	0.969	0.905	0.827	0.754	0.689	0.631		0.498	0.434		0.327		0.260	0.215	
<b>M 7.5</b>	0.993	0.935	0.866	0.799	0.739	0.685		0.557	0.494		0.384		0.314	0.266		
<b>Peak Horizontal Ground Acceleration (PHGA) Expected at Mine Site (g)</b>																
Epicentral Distance	Miles	18.6	21.7	24.9	28.0	31.1	34.2	37.3	43.5	49.7	55.9	62.1	65.0	74.6	87.0	100.0
<b>Peak Horizontal Ground Acceleration (PHGA) Expected at Mine Site (g)</b>																
<b>Earthquake Magnitude</b>	<b>M 3.5</b>	0.007	0.006	0.005	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.000		0.000	0.000	0.000
	<b>M 4.0</b>	0.014	0.011	0.009	0.008	0.007	0.006	0.005	0.004	0.003	0.002	0.001		0.001	0.000	0.000
	<b>M 4.5</b>	0.026	0.021	0.017	0.015	0.013	0.011	0.010	0.007	0.006	0.005	0.004		0.003	0.002	0.001
	<b>M 5.0</b>	0.044	0.036	0.030	0.026	0.022	0.019	0.017	0.014	0.011	0.009	0.008		0.006	0.004	0.003
	<b>M 5.5</b>	0.069	0.057	0.049	0.042	0.037	0.032	0.029	0.024	0.020	0.017	0.014		0.010	0.008	0.006
	<b>M 6.0</b>	0.100	0.084	0.072	0.063	0.056	0.050	0.045	0.037	0.031	0.027	0.023		0.018	0.014	0.011
	<b>M 6.5</b>	0.141	0.121	0.105	0.093	0.083	0.075	0.068	0.057	0.049	0.042	0.037		0.029	0.023	0.019
	<b>M 7.0</b>	0.183	0.159	0.140	0.125	0.113	0.103	0.094	0.080	0.070	0.061	0.054	0.050	0.043	0.035	0.029
<b>M 7.5</b>	0.230	0.203	0.182	0.164	0.150	0.137	0.127	0.110	0.097	0.086	0.077		0.062	0.051	0.042	
		No extra inspections required														

#### 4.2.4 Slumping of the Embankment

Any slumping or abnormal deformation of the embankment or adjacent areas is to be reported to the Ore Processing Manager and the Environmental Manager. The location, extent, and size of the slump are to be reported, as well as the pond level and any flow or seepage associated with the slump. The Engineer of Record must also be contacted.

#### 4.2.5 Unusual Instrument Readings

Initial instrument readings from piezometers and survey monuments must be compared with design limits to see any variation. Instrument readings when obtained will be compared with previous readings of the same instrument, as well as design limits. If the current readings differ significantly from previous readings, and have been taken under similar circumstances and conditions, an additional reading to verify the results will be taken as soon as possible.

#### 4.2.6 Avalanche or Debris Slide

No indications exist that natural avalanches or debris slides are of concern within the WCHL. However, operating personnel will always be alert to indications of slide movement such as the development of tension cracks or scarp faces on slopes, downhill movement of roads, pipelines, or other constructed elements, or the development of seepage at the base of slopes. In addition to debris slides, operators will be alert for any potential sliding of the overliner on the LLDPE primary geomembrane of the heap leach.

#### 4.3 Mitigation measures

The following actions describe some of the steps that could be taken at the embankment to prevent or delay failure after an emergency is first discovered. These actions should be performed with consultation from the Dam Safety Office, or other qualified engineers. It will be necessary halt material placement on WCHL if any of the emergency events listed below were to occur.

##### 4.3.1 Overtopping by Flood Waters

- Reduce the volume of water stored in the impoundment, if possible
- Install pumps in the original inclined wells located on the upstream side of the embankment
- Provide erosion-resistant protection to the downstream slope by placing plastic sheets or other materials over eroding areas
- Divert flood waters around the reservoir basin if possible
- Provide emergency siphons or pumps

##### 4.3.2 Reduction in Freeboard and/or Loss of Dam Crest Width

- Place additional rip rap or sandbags in damaged areas to prevent further embankment erosion
- Lower the water level to an elevation below the damaged area
- Restore freeboard with sandbags or earth and rock fill
- Continue close inspection of the damaged area until the storm is over
- Provide emergency siphons or pumps
- Install pumps in the original inclined wells located on the upstream side of the embankment

##### 4.3.3 Slide on the Upstream or Downstream Slope of the Embankment

- Lower the water level at a rate, and to an elevation, that is considered safe given the slide condition.
- Restore lost freeboard if required by placing sandbags or filling in the top of the slide.
- Stabilize slides on the downstream slope by weighting the toe area with additional soil, rock, or gravel
- Provide emergency siphons or pumps
- Install pumps in the original inclined wells located on the upstream side of the embankment

##### 4.3.4 Erosional Seepage or Leakage (Piping)

- Plug the flow with whatever material is available (hay bales, bentonite, or plastic sheeting if the entrance to the leak is in the reservoir)
- Lower the water level until the flow decreases to a non-erosive velocity or until it stops.
- Place a reverse filter directly against the soil from which the leakage is exiting.

- Provide emergency siphons or pumps

4.3.5 Failure of an Appurtenant Structure such as Inlet or Outlet Piping

- Discontinue pumping
- Identify cause of leak (pipe penetration, landslide, etc.)
- Repair damaged pipe and attended areas
- Provide emergency siphons or pumps

4.3.6 Mass Movement of the Dam on its Foundation

- Immediately lower the water level until excessive movement stops
- Continue lowering the water level until a safe level is reached
- Continue operation at a reduced level until repairs are made
- Place fill at the base of the movement
- Provide emergency siphons or pumps

4.3.7 Excessive Seepage and High Level Saturation of the Embankment

- Lower the water to a safe level
- Continue frequent monitoring for signs of slides, cracking, or concentrated seepage
- Continue operations at a reduced level until repairs are made

4.3.8 Excessive Settlement of the Embankment

- Lower the water level by releasing it by pumping, or siphoning
- If necessary, restore freeboard, preferably by placing sandbags
- Lower water to a safe level
- Continue operating at a reduced level until repairs can be made
-

## Section 5.0 - References

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- [1] Fairbanks Gold Mining, Inc., "Walter Creek Valley Fill Heap Leach Project Description", Fairbanks, Alaska, June 23, 2006.
- [2] "Guidelines for Cooperation with the Alaska Dam Safety Program", Alaska Department of Natural Resources, June 2017.
- [3] Knight Piésold and Co., "Walter Creek Valley Fill Heap Leach Pad Design Report", Denver, Colorado, April 2007.
- [4] Knight Piésold and Co., "Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Facility Stage 3, 2011 Construction Completion Report", Denver Colorado
- [5] Knight Piésold and Co., "Walter Creek Valley Fill Heap Leach Pre-Feasibility Study Rev 0", Denver Colorado, December 7, 2011.
- [6] Knight Piésold and Co., "Walter Creek Valley Fill Heap Leach Pre-Feasibility Study Rev 3", Denver Colorado, April 24, 2013
- [7] Knight Piésold and Co., "Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Facility Stage 5, 2015 Construction Completion Report Rev 0", Denver Colorado
- [8] Knight Piésold and Co., "Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Facility Stage 6 Phase 1, 2016 Construction Completion Report Rev 0", Denver Colorado
- [9] Knight Piésold and Co., "Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Facility Stage 6 Phase 2, 2016 Construction Completion Report Rev 0", Denver Colorado
- [10] Knight Piésold and Co., "Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Facility Expansion Report on Final Design Issued in Final Revision 0", Denver Colorado June 7, 2017
- [11] Knight Piésold and Co., "Fairbanks Gold Mining, Inc. Walter Creek Valley Fill Heap Leach Facility Expansion Report on 2017 Annual Inspection Issued in Final Revision 0", Denver Colorado December 27, 2017
- [12] Knight Piésold and Co., "2017 WCHLF Final Design Completion Assessment of 20,000 gpm Solution Flow, Rev 3", Denver Colorado May 18, 2018
- [13] Knight Piésold and Co., Fort Knox Project – "Walter Creek Heap Leach Facility Follow-up Support for Increase to 20,000 gpm Solution Flow, Rev 0", Denver Colorado May 18, 2018

## Section 6.0 - List of Revisions

This revision log is included to provide the manual user with a description of the revisions made to the manual. The manual should be reviewed on at least an annual basis. If updates are necessary, they should be made to the manual and a revised manual issued. The following revision log should be completed for each revision. It should include the revision number and date, as well as a description of the revision and the section number in the manual to which the revision was made. The revision number and date on the cover of the manual should be updated as well. Other than a file copy of the revised manual, outdated copies should be discarded and replaced with the latest revision.

<b>REVISION LOG</b>	
<b>REVISION NUMBER AND DATE</b>	<b>DESCRIPTION OF REVISIONS</b>
Revision 0 – September 2009	Initial issue of O&M Manual
Revision 1 – October 2010	Addition of Winter 2010/2011 operating levels Update / Clean up of Pump flow updates General editing
February 2011	Change in operating elevations with 9100 gpm pumping
Revision 2 - August 2011	Changes associated with increasing cyanide solution application rate Changes associated with increasing ore lifts
Revision 3 – March 2012	Changes associated with installing two solution collection wells, 16,000gpm pumping and general editing
Revision 4 – June 2013	Changes associated with the heap leach expansion and drawdown analysis. Appendix A Project data sheet will be revised as construction progresses.
Revision 5 – January 2014	Changes associated with the 2013 Periodic Dam Inspection and Stage 4 construction completion report. Updated EAP Plan. .
Revision 6 – June 2015	Added photos of the heap leach features Updated O&M to reflect current conditions Updated Section 4 Emergency Action Plan Added Emergency Action in Appendix D
Revision 7 – January 2016	Updated O&M to reflect current conditions including Stage 5 operating parameters and additional piezometer installation. Updated Section 4 Emergency Action Plan
Revision 8 – February 2016	Updated O&M to reflect current conditions including Stage 5 operation parameters and additional piezometer installation
Revision 9 – September 2016	Updated O&M to reflect current conditions including Stage 6 Phase 1 operation parameters and additional piezometer installation
REVISION LOG (continued)	

Revision 10-January 2017	Updated O&M to reflect current conditions including Stage 6 Phase 2 operating parameters and additional piezometer installation.
Revision 11-October 2017	Updates reflect expansion Stages 6-10 and current operations. Added Critical events pipeline and pumping. TSF/HL interface dewatering well operations. New operating levels based on updated porosity draindown and pad geometry date.
Revision 12-February 2018	Updated and added sections addressing Special Condition 6 of the temporary certificate No. FY2018-6-AK00310 dated November 8, 2017. Updated with 2017 engineers annual inspection report recommendations that were applicable.
Revision 13-May 2018	Updated O&M with 20,000 gpm operating limits. Sections 2.3, 2.5 and 3.2.
Revision 14-October 2018	Updated with stage 10 information where appropriate. Complete update and revision of all sections.
Revision 15 – March 2019	Updated Section 3.2.1 Operation and Maintenance – Ore Heap with slope regrade controls and protocols  Updated Section 3.4.1 Operation and Maintenance – Internal In-heap Storage Pond to include references for prolonged operation at reduced flow rates of 16,000 gpm
Revision 16 – February 2021	Updated based on the 2020 Annual Inspection
Revision 17 – December 2023	Minor updates for staffing and position changes and removal of the on-pad prism monitoring network.

## Section 7.0 - Acronyms and Abbreviations

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ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
CIC	Carbon-In-Columns
DCS	Data Collection System
EPA	Environmental Protection Agency
FGMI	Fairbanks Gold Mining, Inc.
GCL	Geosynthetic Clay Liner
HLP	Heap Leach Pad (Valley Fill)
HDPE	High Density Polyethylene
LCRS	Leachate Collection and Recovery System
LLDPE	Linear low density polyethylene
PCMS	Process Component Monitoring System
QA/QC	Quality Assurance/Quality Control
RO	Reverse Osmosis
TSF	Tailings Storage Facility
WAD CN	Weak Acid Dissociable Cyanide
WCHL	Walter Creek Heap Leach

## **Section 8.0 - Appendix A, B, C**

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# **Appendix A**

## **Project Data Sheets**

**Fort Knox Mine**  
**WALTER CREEK VALLEY FILL HEAP LEACH PAD**  
**PROJECT DATA SHEET**

**A. GENERAL**

Dam Name	Fort Knox Walter Creek Leach Facility Dam	
NID Number	AK00310	
Hazard Potential Class	III	
Purpose	Heap leach Solution Storage	
Year Built	2008/2009	
Year Modified	Dam has not been modified	
Location	Latitude 65°00'N Longitude 147°20'W	
Reservoir Name	Walter Creek Heap Leach Facility In-heap Pond	
River or Creek Name	Walter Creek	
Owner	Fairbanks Gold Mining Inc. (FGMI)	
Owner Contact	General Manager	

**B. DAM**

Type	Membrane Faced Rockfill	
Core Type	LLDPE Geomembrane-Two Layers With LCRS Between	
Crest Length	1,000	feet
Crest Width	50	feet
Crest Elevation	1,653	feet
Crest Height (from d/s toe)	113	feet
Hydraulic Height	110.5 to spillway invert	feet
Capacity	Approximately 15 M (in ore pore spaces)	cubic feet

**C. PRIMARY SPILLWAY**

	N/A	
Type		
Location		
Spillway Crest Elevation		feet
Top Width		feet
Bottom Width		feet
Length		feet
Discharge Capacity at Dam Crest		cfs

**D. EMERGENCY SPILLWAY**

Type	Overflow	
Location	North (left) abutment	
Spillway Crest Elevation	1,650.5	feet
Top Width	65	feet
Bottom Width	15	feet
Length	Approximately 50 (these dimensions are for concrete crest only)	feet
Discharge Capacity at Dam Crest	220	cfs

**E. OUTLET WORKS**

N/A – solutions removed by pumping from 5 sumps just upstream of dam

Type	_____	
Location	_____	
Inlet Invert Elevation	_____	feet
Outlet Invert Elevation	_____	feet
Diameter	_____	inches
Length	_____	feet
Outlet Type	_____	
Discharge Capacity at Dam Crest	_____	cfs

**F. RESERVOIR**

Normal Water Surface Elevation	Approximately 1,600 (water level at time of PDSI)	feet
Maximum Normal Storage Capacity (1)	210 (68.1 M gal) at water level 1629.8 ft	acre-feet
Maximum Normal Water Surface Elevation (1)	1,629.8	feet
Maximum Storage Capacity	370 (119.8 M gal) at water level 1653 ft (dam crest)	acre-feet
Maximum Surface Area at Dam Crest	31.27 at elev. 1653 ft. (this area is under the ore heap)	acres
Surface Area at Spillway Invert	30.14 at elev. 1,650.5 ft. (this area is under the ore heap)	acres

**G. HYDROLOGY**

Drainage Basin Area	0.3 (above the Stage 4 limits)	sq. miles
Average Annual Rainfall	16.5	inches
100 Year/24 Hour Rainfall (4)	4.14 (January rain on snow event)	inches
100 Year/24 Hour Flood	92 (29.9 M gal)	acre-feet
1/2 Probable Maximum Precipitation/24 Hour	5.5	inches
1/2 Probable Maximum Flood/24 Hour	217 based on a total catchment area of 20.6 M sf	acre-feet
Flood of Record	unknown	cfs
Inflow Design Flood	_____	cfs

# Appendix B

## Heap Leach Pad – Daily Inspection Form

Date:

Mechanic:

Yes	No	Active Dumping/Leaching Areas	Notes
<input type="checkbox"/>	<input type="checkbox"/>	Any signs of erosion, sloughing or other movement in the reject overliner?	
<input type="checkbox"/>	<input type="checkbox"/>	Has ore placement on the overliner caused damage to the liner or adjacent overliner areas?	
<input type="checkbox"/>	<input type="checkbox"/>	Are the solution distribution lines working properly?	
<input type="checkbox"/>	<input type="checkbox"/>	Is there substantial ponding of leach solution on the heap surface?	
<input type="checkbox"/>	<input type="checkbox"/>	Has a wildlife mortality occurred?	
pH:		What is the pH of the leachate solution?	
<input type="checkbox"/>	<input type="checkbox"/>	Is the pH within the desired operational range of 10-12pH?	
Yes	No	Embankment Inspection	
<input type="checkbox"/>	<input type="checkbox"/>	Is the crest road in good repair?	
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs of settlement/cracking/misalignment in the crest?	
<input type="checkbox"/>	<input type="checkbox"/>	Is the V-ditch in good repair?	
<input type="checkbox"/>	<input type="checkbox"/>	Is there standing water in the V-ditch that is not the result of active make-up water/solution addition?	
Yes	No	Spillway Inspection	
<input type="checkbox"/>	<input type="checkbox"/>	Is there easy access to the spillway?	
<input type="checkbox"/>	<input type="checkbox"/>	Is the spillway clear of silt/rock/other debris?	
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs of settlement/cracking/misalignment?	
<input type="checkbox"/>	<input type="checkbox"/>	Is there damage to the concrete channel and/or exposed in-concrete reinforcement?	
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs of erosion in the inlet or riprap lined channel?	
<input type="checkbox"/>	<input type="checkbox"/>	Has any excessive erosion occurred where the channel enters the TSF?	
Yes	No	Upstream Slope	
<input type="checkbox"/>	<input type="checkbox"/>	Is the upstream overliner in good repair?	
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs of settlement/bulging/sinkholes on the upstream slope?	
<input type="checkbox"/>	<input type="checkbox"/>	Does tree/brush cover obscure/hide a majority of the upstream slope?	
Yes	No	Downstream Slope & Abutments	
<input type="checkbox"/>	<input type="checkbox"/>	Is the downstream slope in good repair?	
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs of settlement/bulging/cracking/sinkholes on the downstream slope or it's abutments?	
<input type="checkbox"/>	<input type="checkbox"/>	Does tree/brush cover obscure/hide a majority of the downstream slope?	
<input type="checkbox"/>	<input type="checkbox"/>	Are there any animal burrows?	
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs of surface seepage or wet/damp areas on the downstream slope or it's abutments?	
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs of springs or boils at the downstream toe?	

Yes	No	In-Heap Pond & Solution Collection	Notes
<input type="checkbox"/>	<input type="checkbox"/>	Is there damage to the solution collection pipes/wells?	
<input type="checkbox"/>	<input type="checkbox"/>	What is the reading of piezometer pair 9/10?	
<input type="checkbox"/>	<input type="checkbox"/>	Is the reading above 1594 feet to prevent pump cavitation?	
<input type="checkbox"/>	<input type="checkbox"/>	For 20Kgpm operations is the reading below 1612.5 feet?	
<input type="checkbox"/>	<input type="checkbox"/>	If operating at 16Kpgm is the reading below 1617.0 feet?	
<input type="checkbox"/>	<input type="checkbox"/>	This is the maximum allowable operating pond	
<input type="checkbox"/>	<input type="checkbox"/>	What is the LCRS solution elevation?	
<input type="checkbox"/>	<input type="checkbox"/>	Are the LCRS pumps functioning properly?	
<input type="checkbox"/>	<input type="checkbox"/>	Is the pumping rate of the LCRS below 520gpm, the maximum design leakage rate?	

Yes	No	PCMS Header Outlet
<input type="checkbox"/>	<input type="checkbox"/>	Is there flow from any of the headers?
<input type="checkbox"/>	<input type="checkbox"/>	Is there damage to the header system?
<input type="checkbox"/>	<input type="checkbox"/>	Is there damage to the liner?

Yes	No	Pipeline Corridor
<input type="checkbox"/>	<input type="checkbox"/>	Is there easy access to the corridor?
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs of settlement/cracking/misalignment along the road next to the corridor?
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs of settlement/cracking/misalignment in the corridor?
<input type="checkbox"/>	<input type="checkbox"/>	Is there flow from the corridor indicating leakage from the pipes? Note: flow is expected after rain or snowmelt events, if flow does not decrease to zero after a reasonable time a water sample shall be collected and checked for CN.
<input type="checkbox"/>	<input type="checkbox"/>	Is the mechanical equipment operable?

Yes	No	Surface Water Controls
<input type="checkbox"/>	<input type="checkbox"/>	Are the perimeter diversion channels free of debris and/or ice jams?
<input type="checkbox"/>	<input type="checkbox"/>	Are there signs of settlement/cracking/misalignment in the perimeter diversion channels?
<input type="checkbox"/>	<input type="checkbox"/>	Is there any erosion or channel deterioration in the perimeter diversion channels?
<input type="checkbox"/>	<input type="checkbox"/>	Are the culverts crossing under the haul road above the booster station clear?
<input type="checkbox"/>	<input type="checkbox"/>	Are the culverts crossing under the old haul road clear?

**WCHL Daily Route**



Valve Enclosure Buildings	CIC 1		CIC 2		Total CIC 1 + CIC 2
	OK/Yes	Bad/No	OK/Yes	Bad/No	
Door access is clear?					
Housekeeping, Lights, and Heater On?					
Piping and valve leaks?					
Heat trace control box?					
Preg GPM					
Barren GPM					
Barren Temp					
Broom Present?					
Dust Pan Present ?					
Ice Melt Present?					
Housekeeping & Cleanliness?					

CIC 1 & 2 Electrical Enclosures & Generator	CIC 1		CIC 2	
	OK/Yes	Bad/No	OK/Yes	Bad/No
Door access is clear?				
Housekeeping, Lights, and Heater On?				
Enclosure Condition?				
Heat trace control box?				
Broom Present?				
Dust Pan Present ?				
Ice Melt Present?				
Housekeeping & Cleanliness?				
Generator Fuel Level (circle one)	1/2	3/4	Full	

Pregnant Pumps and Enclosures	F27PP201		F27PP202		Preg PSI
	OK/Yes	Bad/No	OK/Yes	Bad/No	
Motor Amps					
Access is clear?					
Housekeeping & Cleanliness?					
Heat, Vibration, and Noise?					
Piping and Valves?					

Pregnant Pumps and Enclosures	F27PP310		F27PP311		F27PP312	
	OK/Yes	Bad/No	OK/Yes	Bad/No	OK/Yes	Bad/No
Motor Amps						
Access is clear?						
Housekeeping & Cleanliness?						
Heat, Vibration, and Noise?						
Piping and Valves?						

## WCHL Daily Route

Lime Silo	OK/Yes	Bad/No
Travel ways clear of debris?		
Stairs, Grating & Handrails are good?		
Lighting working?		
Electrical Room in good order?		
Eye Wash Station Present/Working?		
Silo Tank and Supports in good order?		
Lime Build-up?		
Guards present & in good order?		
Skirting present & in good order?		
Pulleys in good order?		
Rollers in good order?		
Conveyor Belt and Clips in good order?		
Conveyor Motor & Drive Components?		
Hopper, Clamshell, and Hydraulics?		
Mirror is clean?		
Check Lime Silo Fill Hoses		
Broom Present?		
Shovel Present?		
Two Lime Buckets Present?		
Lime Barrel Present?		
Ice Melt Present?		
Housekeeping & Cleanliness?		
Rotary Valve Setting (seconds)		
Lime Silo Level (%)		
<b>Notes/Comments</b>		



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## Memorandum

To:  
From:  
CC:  
Date:  
RE:

---

**Location of Failure:**

**Date of Failure:**

**Time of Failure:**

**Central Coordinates of Failure:**

**Description of Failure:**

**Actions Taken:**

**Remediation Plan:**

**Screen Captures/Monitoring Data:**



# **Appendix C**

## **Analytical Profile Chemistry**

## *Analytical Profile II - Groundwater Inorganic Parameters*

---

<b>Major Ion Chemistry</b>	<b>Minor Ion Chemistry</b>	<b>Trace Ion Chemistry</b>
Lab pH	*Arsenic	*Antimony
Lab Conductivity	Cyanide	*Barium
Temperature (field)	Total	*Bismuth
Turbidity	WAD	*Cadmium
Total Suspended Solids	Fluoride	*Chromium
Total Dissolved Solids	*Iron	*Copper
*Calcium	*Manganese	*Lead
*Magnesium	Nitrogen, Ammonia	*Mercury
*Potassium	Nitrate as Nitrogen	*Nickel
*Silicon	Nitrite as Nitrogen	*Selenium
*Sodium	Total Phosphorus	*Silver
Chloride	Sulfide	*Zinc
Sulfate	TPH	
Alkalinity (as CaCO <sub>3</sub> )		
Bicarbonate		
Total		
Calcium Hardness		
Magnesium Hardness		

---

\* Dissolved

**APPENDIX B**

**BARNES CREEK HEAP LEACH PAD OPERATIONS & MAINTENANCE MANUAL**

**REV 4**

**KINROSS**

**Fort Knox**

**BARNES CREEK  
HEAP LEACH PAD  
OPERATIONS & MAINTENANCE MANUAL  
REVISION 4**

**Fairbanks Gold Mining, Inc.  
A Subsidiary of Kinross Gold Corporation  
P.O. Box 73726  
Fairbanks, Alaska 99707-3726**

**December 2024**

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# **Barnes Creek Valley Fill**

## **Heap Leach Pad**

### **Operations & Maintenance Manual**

#### **Preface**

---

This document is the Operations & Maintenance Manual (O&M Manual) for the Fairbanks Gold Mining, Inc. (FGMI) Barnes Creek Heap Leach Pad (BCHL) located near Fairbanks, Alaska in the North Star Borough. This O&M Manual has been prepared to facilitate both effective and efficient practices for the operation, maintenance, surveillance, and documentation of the facility. This document contains information and instructions that will assist FGMI operations and maintenance personnel in the performance of their duties; as well as contribute to their training in recommended procedures. Also included in this manual is an organizational chart showing key personnel, and a remedial action contingency plan that covers general emergency response and communication procedures.

Proper O&M is crucial for the BCHL to operate safely and efficiently, of which this manual is an essential component of the O&M program. Owing to the lengthy and cold winters experienced at the site, the BCHL was constructed to contain an internal process solution storage pond, which resides behind an embankment dam at the toe of the heap. This manual presents the procedures for operation of the pond under normal or extreme conditions and provides technical guidance and procedures for monitoring, inspection, and long-term maintenance programs. Also contained are descriptions of unusual conditions that might occur at the dam and the operating procedures and inspections that should be followed under those conditions.

As with any structure of this complexity, the operations manual may not foresee every potential problem. However, with a well-conducted training program, careful observation, and regular inspection, unusual circumstances will be identified and brought to management's attention to be appropriately addressed.

It should be noted that for the majority of the time over the life of the BCHL, the inspection and monitoring program will be routine and encounter no surprises. However, close attention and continued diligence on the part of the operation is required so that potential problems will be identified early and remediated prior to becoming significant. This can only be achieved with the ongoing commitment and support of operating personnel and management at all levels of the operation

Monitoring equipment, procedures, and instrumentation are required to accomplish the following:

- Confirm that the structure is performing in accordance with the design
- Determine if a problem exists that may require remediation
- Provide timely notice of an adverse change in the state of the dam or in-heap storage pond

The facility descriptions presented in this manual are summary descriptions designed to serve as a basis for presenting the O&M and monitoring procedures. The reader should refer to the more detailed descriptions presented in the design and record of construction reports as situations warrant.

In this manual figures are provided to aid in the understanding of the operation and maintenance of the BCHL facility and have been copied from drawings in:

- "Fairbanks Gold Mining, Inc. Barnes Creek Heap Leach Facility Report on Final Design Reissued in Final Revision 1 March 27, 2017 prepared by Knight Piésold and Co. of Denver, Colorado

## Section 1.0 - Introduction

---

### 1.1 Purpose and Objective

This O&M Manual exists to provide a description of the Barnes Creek Heap Leach (BCHL) facility and related methods and procedures that will help to ensure that each component of the facility is performing as designed and constructed. In addition, it will help to provide for early detection of component damage, degeneration and/or performance outside the limits of the design intent so that appropriate remedial measures and actions can be implemented.

### 1.2 Scope

This O&M Manual describes the roles of responsible parties and the procedures that will be used for the operation, maintenance, inspection, and monitoring of the BCHL. It specifically addresses components of the facility including: the in-heap storage embankment, the composite liner system, the foundation underdrain, the process component monitoring system (PCMS), the leachate collection and recovery system (LCRS), monitoring systems, surface water controls and related facilities. Also included within the manual is an emergency response plan that outlines responses for various emergency scenarios.

### 1.3 Overview of the Heap Leach Pad

The BCHL is a gold heap leach pad located in the upper end of the Barnes Creek drainage immediately upstream from the Fort Knox tailing impoundment facility. Run-of-mine ore from the Fort Knox pit will be stacked in a lined containment area located behind and above the in-heap storage embankment, which is constructed

As part of a robust design, extensive monitoring systems and flow controls are included in the design of the BCHL facility. The systems described below are highlights for ongoing and future verification that the facility is performing within design parameters.

1. A visual inspection and reporting program is developed. Participants in the program perform inspections and file reports at various routine and non-routine frequencies and include FGMI, the Engineer of Record, State of Alaska Dam Safety Engineer, Alaska Department of Natural Resources (ADNR) and the Alaska Department of Environmental Conservation (ADEC).
2. Vibrating wire piezometer installation follows the design and construction sequence plan. Piezometer data measures the fluid levels and the feet of pressure over a given area.
3. Survey monument on the in-heap embankment crest measures movement on the x, y, and z-axis.
4. Process component monitoring system (PCMS) measures the performance of the liner system upstream of the in-heap storage pond. Specifically the PCMS monitors for leaks through the liner beneath the solution collection headers, where concentrated solution flows are likely to occur.
5. The LCRS includes a pump back system that will collect and return any solution passing through the primary liner of the double lined pond back into the in-heap storage pond.
6. An underdrain system beneath the lined base of the BCHL in the valley bottom facilitates the capture and transport of flow from seeps and springs under the pad.

Gold recovery process during initial operation years 2020 – 2021 follows the general steps outlined below:

1. The application of lean solution, consisting of a dilute alkaline cyanide that migrates over the surface of the pad through a series of perforated pipes.
2. The barren solution saturates and fills the interstitial voids in the run of mine ore making up the in-heap pond and accumulates gold in solution.
3. Recovery of gold enriched (pregnant) solution from the in-heap storage pond is through three inclined solution collection wells. The well intakes are located near the lowest portion of the in-heap pond and continues up the embankment nestled in overliner until they connect to the pipeline corridor network.
4. Pregnant solution is pumped directly to the Carbon-in-Column (CIC) plants for gold recovery.

5. The now barren solution from the CIC plants is pumped back to the BCHL where it goes through an intermediate booster station and arrives back at the top of the active pad to start the process over again.

#### 1.4 Operator Training Program

An ongoing operator-training program is conducted for new employees. The program intent is to provide the employees who are responsible for the implementation of the O&M procedures with the expertise required for them to perform their respective duties. Training of new employees is conducted prior to them starting any duties.

#### 1.5 Assignment of Responsibilities and Procedures

A partial organization chart outlining relationships between personnel who are involved with operation of the BCHL is shown below in Figure 1-2. General responsibilities for positions can be seen on the following page.

Figure 1-1 Heap Leach Pad General Arrangement



**Table 1-1 – BCHL O&M Responsibilities**

<b>TITLE</b>	<b>RESPONSIBILITY</b>
General Manager	Overall Responsibility for Project
Environmental Affairs Director	Environmental Compliance and Permitting
Environmental Superintendent Engineers & Technicians	Read/Record Monitoring Data & Inspection
Operations Manager	
Ore Processing Manager	BCHL Management, Operation & Maintenance
Operators/Mechanics	Routine Maintenance & Inspection
Mine Manager	Ore Placement
Mine Supervisors/Operators	Active Dumping Operations
Technical Services Manager	Stacking Plan Design
Mine Engineers & Surveyors	Ore Placement Planning & Monitoring
FGMI and Consultants as Needed	Data Reduction/Interpretation & Inspections

Heap Leach Operators/Mechanics are responsible for conducting daily inspections and general monitoring of the operation of BCHL.

Mine Supervisors/Operators are responsible for conducting daily inspections and monitoring of the ore placement on the facility.

The Environmental Department Engineers will review the Heap Leach operator's daily inspection logs on a weekly basis. Additionally, the environmental department will ensure that collected data and operator logs are electronically filed and maintained. Agency requests for data will be provided in the form requested.

The Capital Project team is responsible to obtain all data requested from the design engineer.

The Environmental Department Technicians are responsible for collection of water quality samples from the monitoring wells, PCMS and LCRS. Also, Environmental Department Technicians take vibrating wire piezometer (VWP) readings.

The descriptions of emergencies and responses are in Section 4.0.

Any variances from the design basis such as higher than design water levels, signs of instability, improper ore placement, or other items with the potential that may adversely affect the facilities performance requires immediate notification to both the Environmental Affairs Director and General Manager.



## Section 2.0 - Description

### 2.1 General

Major design components of the BCHL consist of:

- in-heap storage embankment
- spillway and Fish Creek water detention basin
- internal in-heap storage pond
- composite geomembrane liner and solution collection system
- leachate collection and removal system (LCRS)
- process component monitoring system (PCMS)
- underdrain collection system
- ore heap
- surface water controls
- solution collection wells
- pipeline corridor

The following sections provide descriptions of these components to help understand the necessary operation and maintenance requirements.

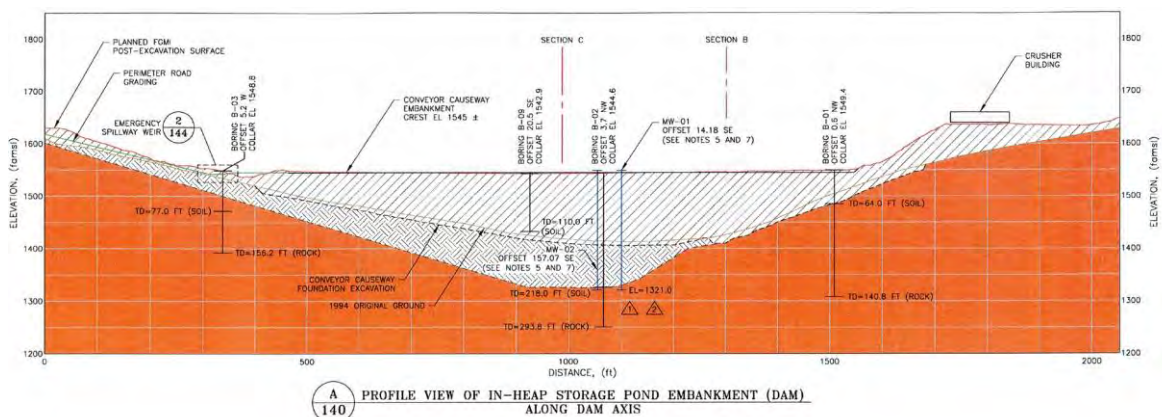
### 2.2 In-heap Storage Pond Embankment

By design, the in-heap storage pond embankment provides containment of process solution and any precipitation amounts up to a 100-year/24-hour design storm event.

During 1995 and 1996, a conveyor causeway was constructed crossing the mouth of the Barnes Creek valley, just west of the confluence with Fish Creek. Excavations for the construction of this structure ranged from several feet to 15 ft in depth.

The BCHL in-heap storage pond embankment uses the existing 200 to 250 foot wide conveyor causeway as its core element resulting in an approximate 95-foot embankment with a crest elevation of 1545 fmsl. Reference Figure 2-1. Due to prior loading against the conveyor causeway by both the Barnes Creek and Fish Creek stockpiles, no significant future deformations of the causeway are expected as a result of the planned BCHL development.

**Figure 2-1 In-Heap Storage Embankment**



### 2.2.1 Embankment Spillway and Fish Creek Storm Water Detention Basin

The in-heap storage pond includes an emergency spillway and outlet channel designed to accommodate overflow from the facility without overtopping the embankment. The site of the emergency spillway is on the northeast abutment of the in-heap storage pond embankment.

The spillway design flow is 220 cfs, the peak flow resulting from the January 100-yr/24-hr design storm event, acting on the final footprint of the pad. The flows collected from the outlet channel dump into the Fish Creek storm water detention basin.

Ancillary to the outlet channel is a perimeter diversion channel that merges with the outlet channel to convey flows collected around the pad perimeter to the Fish Creek detention basin.

In the event the heap pad surface is frozen, a swale is in place to store runoff from the pad. The swale is a relatively small impoundment area between the upstream slope of the in-heap pond embankment and the front face of the heap between the crest of Lift 2 and the toe of Lift 3. The storage volume between 1550 and 1552 (coinciding with the top of the in-heap pond and the spillway invert) provides an estimated storage capacity of approximately 0.10 M cubic feet (0.7 M gallons). See Figure 2-2 for Spillway layout, Figure 2-3 for spillway invert and Figure 2-4 for the Fish Creek storm water detention basin.

Figure 2-2 – Concrete Spillway

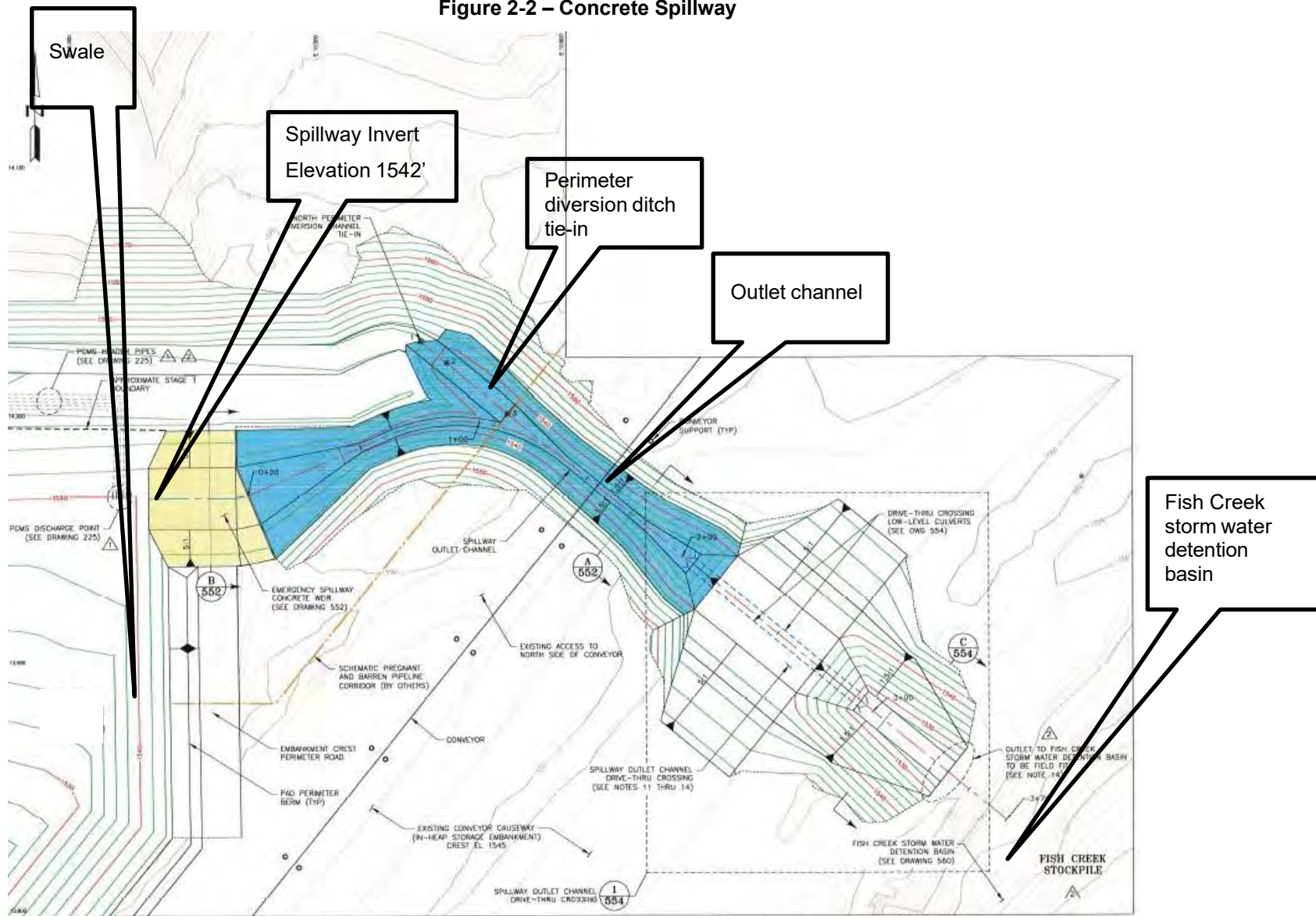
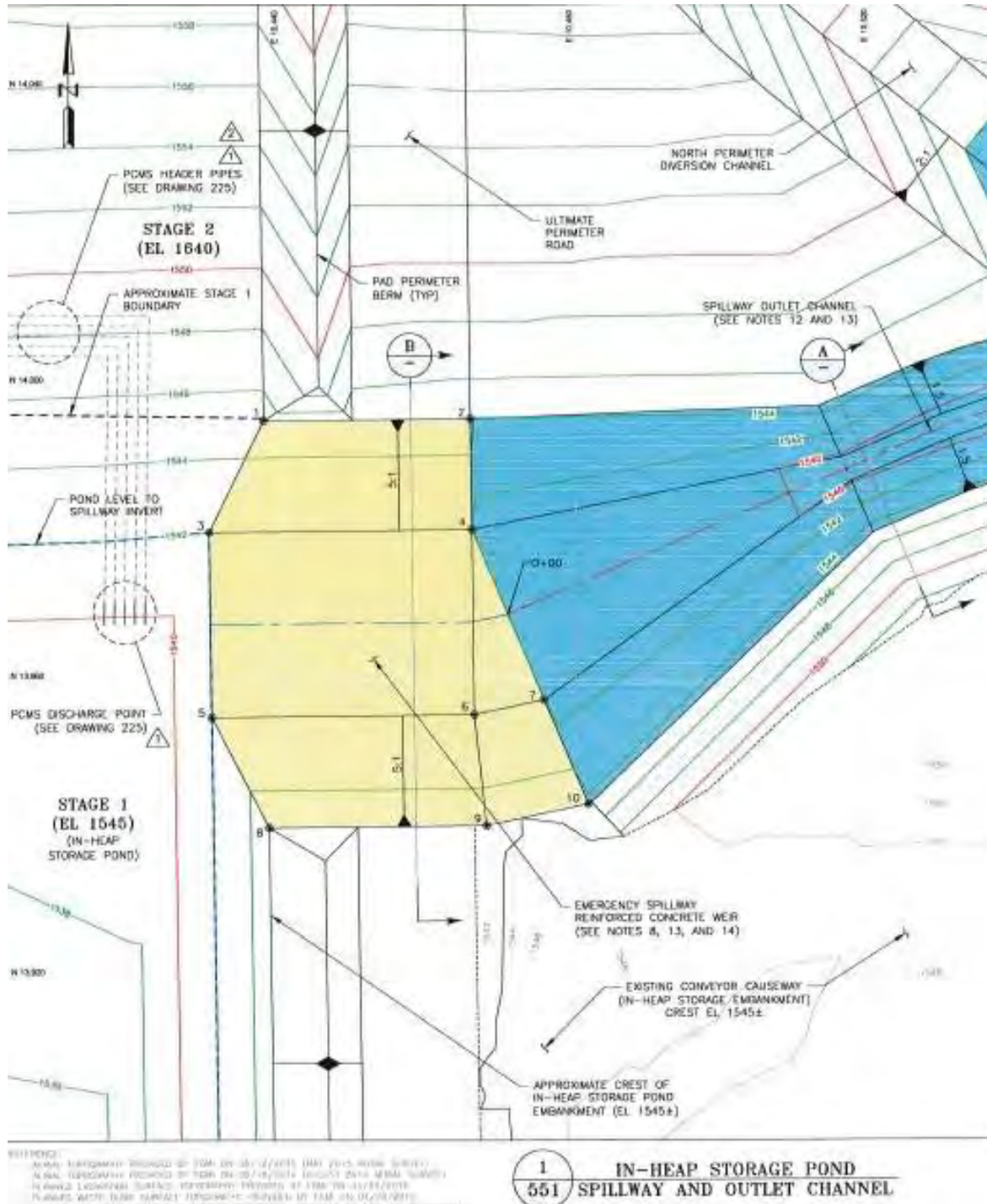
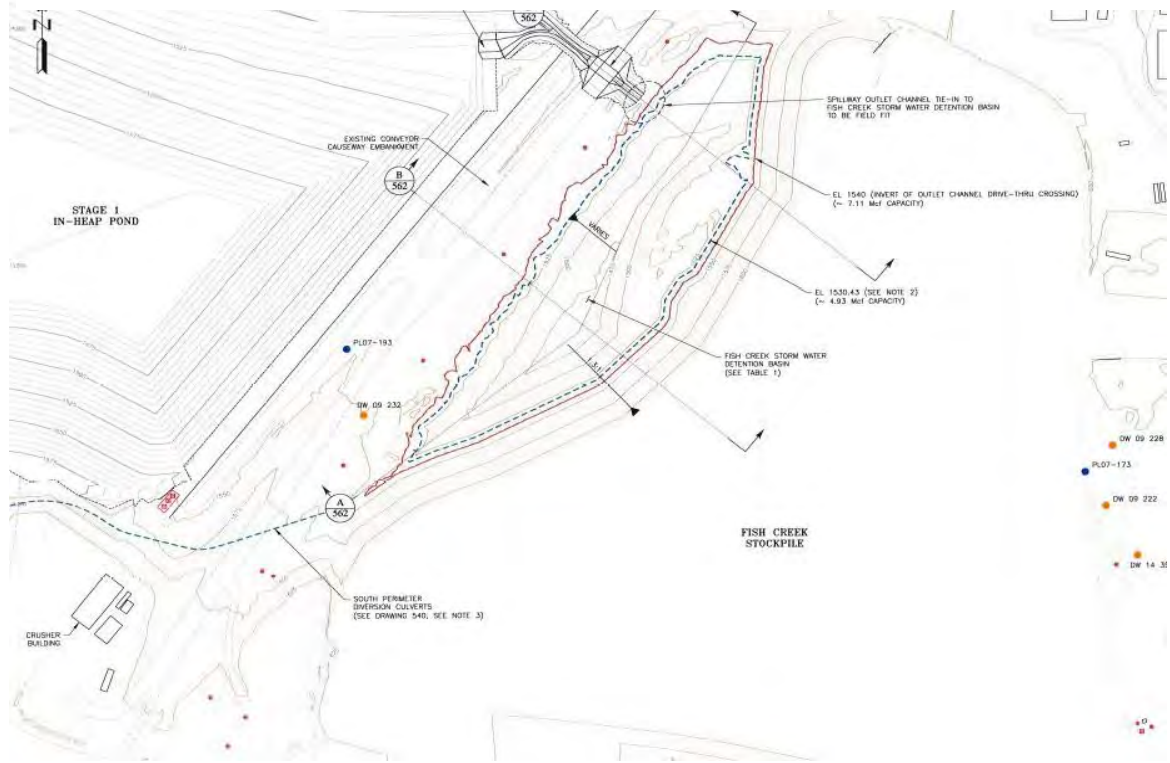


Figure 2-3 - Spillway Invert



**Figure 2-4 - Fish Creek Storm Water Detention Basin**

### 2.3 In Heap Storage Pond

Due to the Fort Knox project location that experiences cold weather conditions for significant periods each year, and to remain consistent with the operational success of the WCHLF, the BCHL has been designed with in-heap storage of process solution and storm water incident to the leach pad.

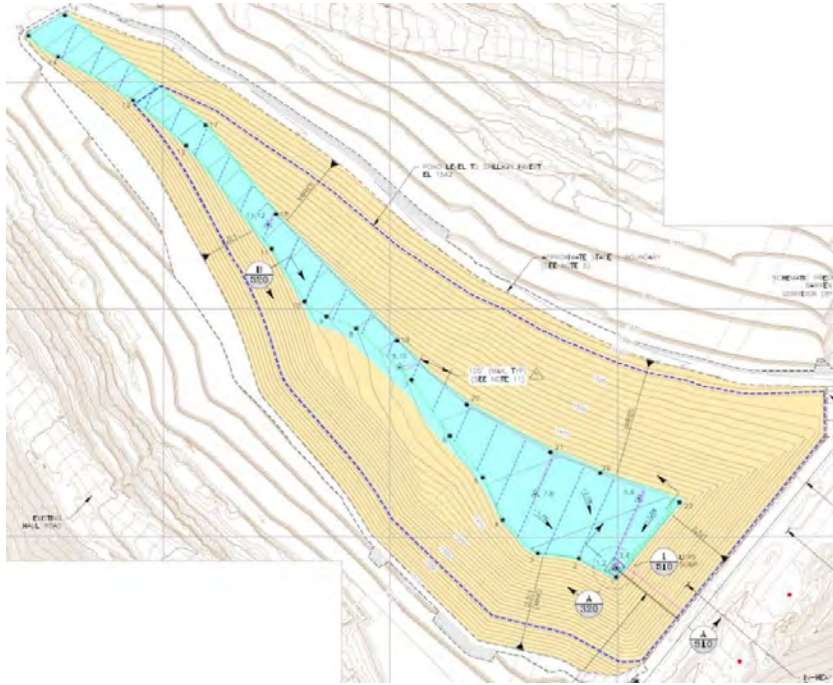
Process solution storage within the ore's interstitial pore spaces reduces the risk of freezing-related problems associated with open ponds and cold weather.

When discussing volume of the in-heap pond, it is with the understanding that solution storage is located within the interstitial pore spaces between ore particles.

Estimates of available solution storage consider settlement and consolidation that has occurred as of result of subsequent lifts being placed over the facility.

During full scale leaching operations, the design volume of the in-heap storage pond considers:

- Maximum normal operating level
- 24-hour draindown volume
- The 100-year/24-hour storm event potential contribution
- Freeboard on the embankment

**Figure 2-5 – In-heap Pond**

### 2.3.1 Maximum normal operating level

The assessment of the in-heap pond storage components and freeboard allowance, are the maximum normal operating levels that will be monitored and honored. These are the pond levels that will not be exceeded under normal operating conditions such that the required pond capacities for the design storm event, draindown, and freeboard allowance are always available if needed.

Staged full buildout maximum storage pond elevations are found in Table 3-1, Stage 1, 2 and 3 in-heap storage pond maximum normal operating levels are:

- Stage 1 – 1527.8 fmsl
- Stage 2 – 1525.3 fmsl
- Stage 3 – 1522.7 fmsl

### 2.3.2 24-hr Emergency Draindown

An emergency draindown condition could begin to occur on the BCHL facility if the power supply is interrupted or if one or more of the active solution extraction pumps are temporarily rendered inoperable. Either of these cases would result in reduced pumping capacity from the in-heap pond. The in-heap pond capacity allocated for this occurrence only accounts for the first 24 hours of draindown on the basis that normal operations will be resumed within 24 hours. A conservative draindown requirement can be estimated by multiplying the draindown duration by the solution flowrate supplied to the heap (i.e. 24 hours at the supply flowrate). In the event of an actual draindown occurrence, a transient flow condition would exist and the observed flow rate to the pond would gradually reduce over time as the draindown occurs.

The 24-hr draindown component corresponds to the flow rate supplied to the pad and will change the maximum normal operating pond volume, level, and operational flexibility.

### 2.3.3 BCHL pad 100-yr/24-hr Design Storm Event

As liner construction progresses, an increased amount of precipitation becomes available for capture by the facility. This results in the need to reduce the maximum normal operating level of the pond to accommodate the increased volume of the 100-year/24-hour design storm event.

The pond storage volume associated with the 100-yr/24-hr design storm event (September rain-on-snow) as estimated to vary between 5.2M and 31.2 M gallons, for the Stage 1 through Stage 6 configurations respectively

#### 2.3.4 Freeboard Allowance

The freeboard allowance is a vertical distance typically included as a contingency against overtopping of a dam. The design criteria for freeboard depth is 5 feet.

- 1540 fmsl is the bottom of the in-heap pond freeboard it coincides with the bottom of the swale formed along the front toe of the heap (between the crest of Lift 2 and the toe of Lift 3) and will allow for visual monitoring of encroachments into the pond freeboard allowance.
- 1542 fmsl is the invert of the in-heap pond emergency spillway. During extreme conditions, flow will begin to pass through the spillway when water levels within the pond rise above this elevation.
- 1545 fmsl is the crest of the embankment. This is the maximum water level within the BCHLF in-heap pond prior to overtopping of the dam.
- 1545 is the top of the in-heap pond.

By way of summary:

- The volume within the 5-ft freeboard (1540 to 1545 fmsl) is approximately 13.0 M gallons.
- The volume up to the spillway invert (1540 to 1542 fmsl) is approximately 5.1 M gallons.

#### 2.4 Leach Pad Liner Systems and Solution Collection Systems.

Beneath the in-heap storage pond, a double liner system includes a Leachate Collection Recovery System (LCRS). The LCRS serves as a monitoring and collection system for any process solution passing through the primary liner and provides a hydraulic break between the primary and secondary 80-mil LLDPE liners. Thus, the piezometric head acting on the primary liner at the base of the in-heap pond will be the depth of process solution. The piezometric head on the secondary liner will be significantly less.

Leakage through the primary geomembrane will report to the LCRS sump for removal. The LCRS sump is located near the upstream toe of the in-heap pond embankment in the southern corner.

A series of perforated collection pipes and drain aggregate are in place across the flatter grades of the pond floor to improve drainage within the LCRS and to reduce the potential for hydraulic head build-up.

Two distinct containment zones exist within BCHL. The first zone consists of the in-heap storage pond directly behind the embankment. The second zone comprises the elevations above the in-heap storage pond. Each zone will follow a specific construction plan consisting of different elements that build on top of each other; a cross-sectional view the liner system on slopes less than 10 percent and greater than 10 percent are shown in Figure 2-6 and Figure 2-7 respectively.

Zone 1: Double Lined & In-Heap Pond, starting from the site grading fill advancing upwards.

- 12-inch-thick low permeability prepared sub base
- 80-mil double-side textured Linear Low Density Polyethylene (LLDPE) geomembrane liner, this is a secondary containment layer
- A leachate collection recovery system (LCRS)
  - 3-foot thick layer of drain on slopes less than 10 percent
  - LCRS tri-planer geonet on slopes greater than 10 percent
- 80-mil double-side textured LLDPE geomembrane, this is the primary containment layer
  - on slopes less than 10 percent, an additional 16-Ounce Non-woven geotextile is placed over the primary containment layer above the footprint of the LCRS drain aggregate and an additional 12 inches of prepared subbase.
- 3-foot-thick overliner layer with solution collection pipe works buried within, the collection pipes are designed to promote solution flow to the solution collection wells located just upstream of the in-heap embankment

Zone 2: Stages above the double lined zone (1653' And Higher)..

- Cushioning layer of varying depths

- Geosynthetic Clay Liner
- 80-mil double-side textured LLDPE geomembrane
- 4" diameter perforated CPT
- 36" overliner

Figure 2-6 - In-heap liner on slopes less than 10 percent

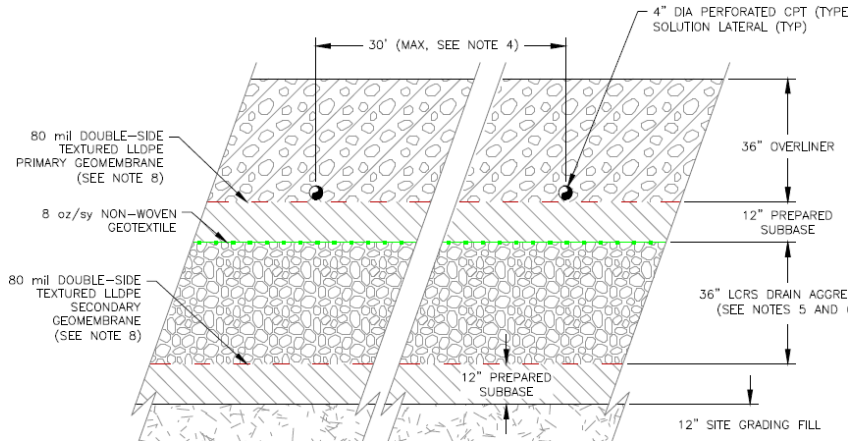


Figure 2-7 - In-heap liner on slopes greater than 10 percent

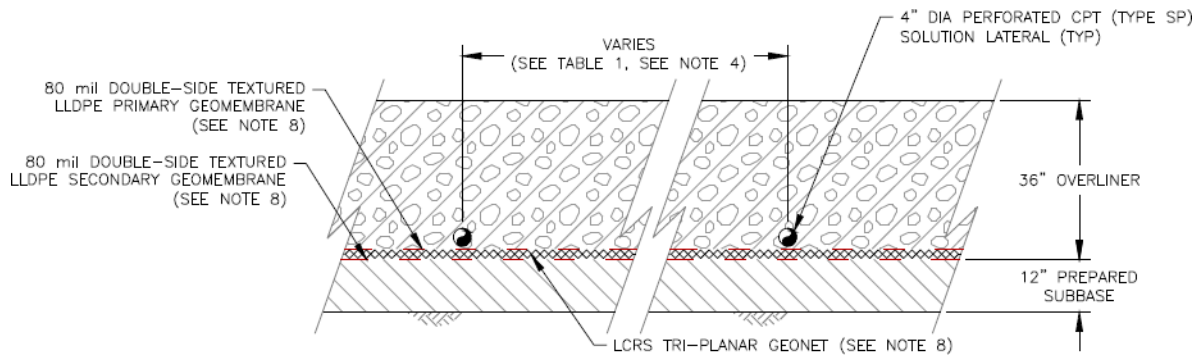
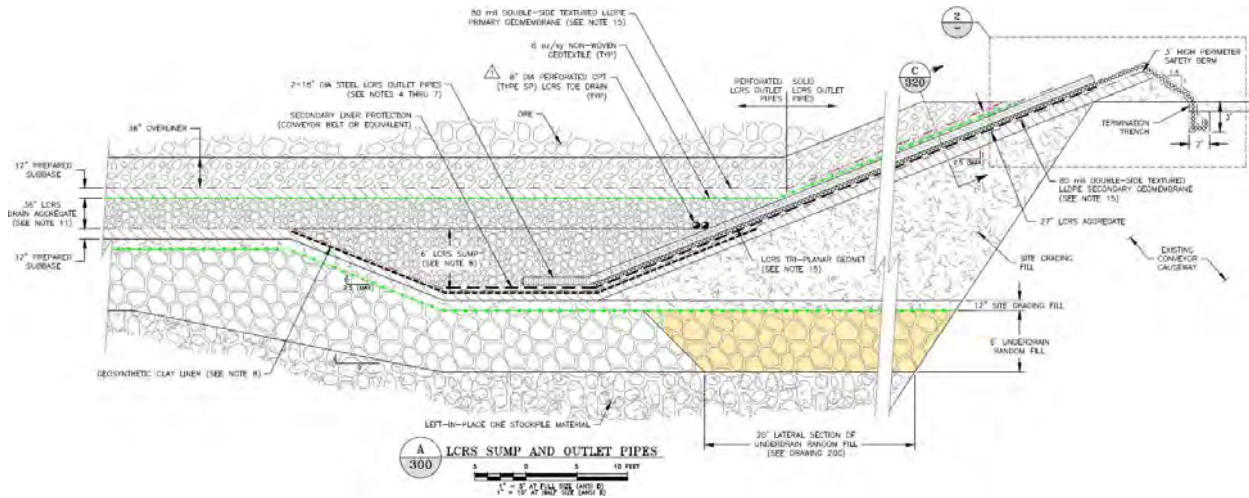


Figure 2-7a – Liner detail above double lined in heap pond



Figure 2-8 – LCRS Details



#### 2.4.2 Solution Collection System Pipeworks and Overliner

A key part of the BCHL design is the solution collection system. A 36-inch-thick overliner layer that blankets a network of solution collection pipes will overlie the leach pad composite liner system discussed in Section 2.4.

The combination of the overliner layer and solution collection pipework is designed to collect and convey process leach solution from the pad area to the in-heap storage pond, and solution extraction wells, while limiting the hydraulic head acting above the leach pad composite liner system.

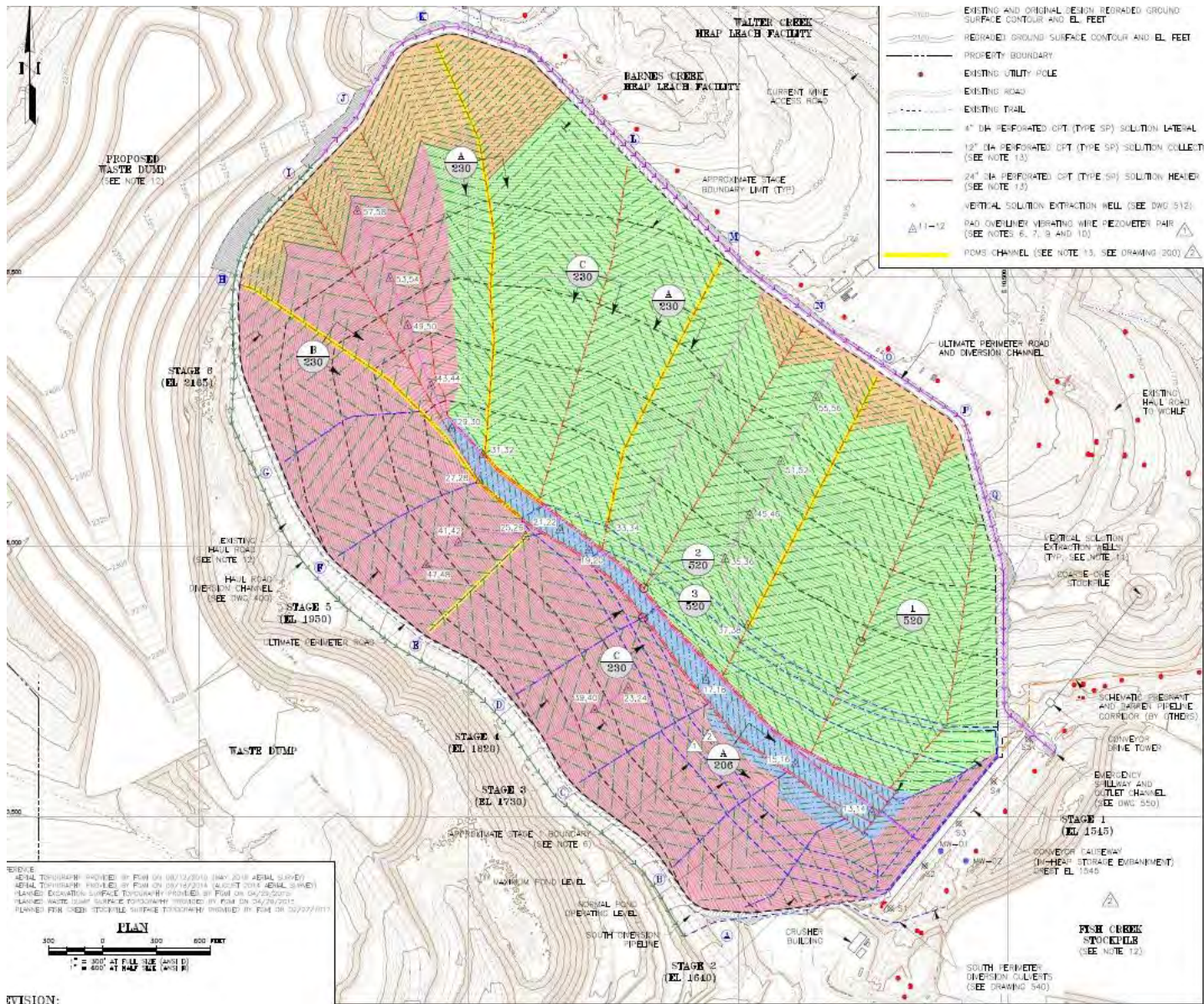
The solution pipework within the overliner layer will consist of perforated, smooth-interior, CPT (Type SP). Generally, 12- and 24-inch-diameter solution collectors and headers, respectively, are planned for installation within the BCHL basin area.

The overliner layer serves three primary functions:

- 1) To reduce head pressure on liner
- 2) Protection of the liner from damage during ore placement
- 3) Facilitate flow and recovery of the process solution

The planned solution flow to the BCHLF is 16,000 GPM, however the BCHLF solution collection headers have been designed to accommodate 24,000 gpm of total solution flow to the facility with the unit-area application rate of 0.005 gpm/ft<sup>2</sup>. See Figure 2-9 – Solution Collection System

Figure 2-9 – Solution Collection System



### 2.4.3 Solution Collection Wells

The purpose of the solution collections wells is to remove leachate from the in-heap storage pond.

Initial solution recovery is through three inclined wells that are installed up the northeast side-slope of the in-heap pond, directly adjacent to the abutment of the in-heap storage pond embankment. The 30 inch inclined wells are equipped with 4,000 gpm submersible pumps able to deliver up to 12,000 gpm of pregnant solution to the CIC circuit.

Five vertical extraction wells will be installed near the upstream toe of the in-heap storage pond for long-term solution recovery. These wells will be equipped with 4,000 gpm submersible pumps providing operational flexibility.

### 2.4.4 Solution Level Monitoring with Vibrating Wire Piezometers (VWPs)

Six (6) pairs of Vibrating Wire Piezometers (VWP) have been installed. Piezometers 1 through 12 are located within the LCRS to monitor the head acting on the secondary liner of the in-heap storage pond. Two pairs will be located within the bottom of the LCRS sump, while the other four pairs will be located within the LCRS along the base of the in-heap storage pond.

The design includes twenty-three pairs of VWP located within the overliner layer outside the limit of the in-heap storage pond.

Five of these pairs (piezometers 13 through 22) will be located in the base of the in-heap storage pond, within the Stage 1 leach pad, to monitor hydraulic pressures on the primary LLDPE liner and to estimate the water depth in the pond. Reference Figure 3-4

The remaining pairs (piezometers 23 through 58) will be located in the overliner layer outside the limit of the in-heap storage pond within Stages 2 through 6, to monitor hydraulic head conditions. Reference Figure 3-5

### 2.5 Process Component Monitoring System (PCMS)

The PCMS serves to monitor the performance of the liner system beneath the solution collection headers above the confines of the in-heap storage pond.

Five PCMS channels are located where solution flow may be present on a more consistent basis during operations. The solution that leaks through the geomembrane liner beneath the solution collection header collects in the PCMS channels.

Just above the limit of the in-heap storage pond, the flows within each PCMS channel transition through a small lined sump into a 4-inch-diameter solid-wall header pipe that directs the flow to the discharge and monitoring point in the northeast corner of the in-heap storage pond. See Figure 2-10

The four inch header pipes will follow an approximate one percent slope, and have a full-flow capacity of approximately 90 gpm; much greater than the estimated potential leakage rate that will report to the longest PCMS channel. To prevent icing in the winter each header pipe is designed with heat trace and resistance temperature detectors (RTD) loops (primary and secondary backup). The RTD and heat trace loops will be installed from the discharge/monitoring point upstream for an approximate length of seventy feet then overlain by approximately twenty-eight feet of cover material providing frost protection. PCMS plan is shown on Figure 2-11

Figure 2-10 – PCMS Discharge

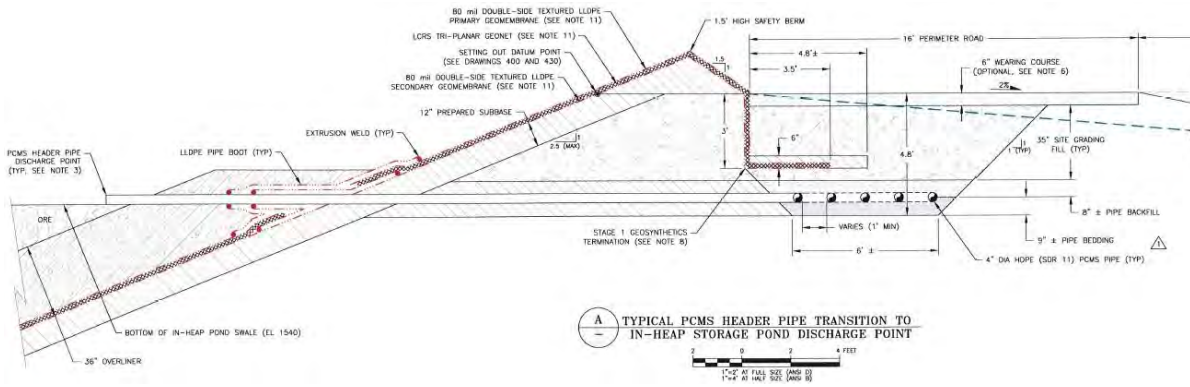
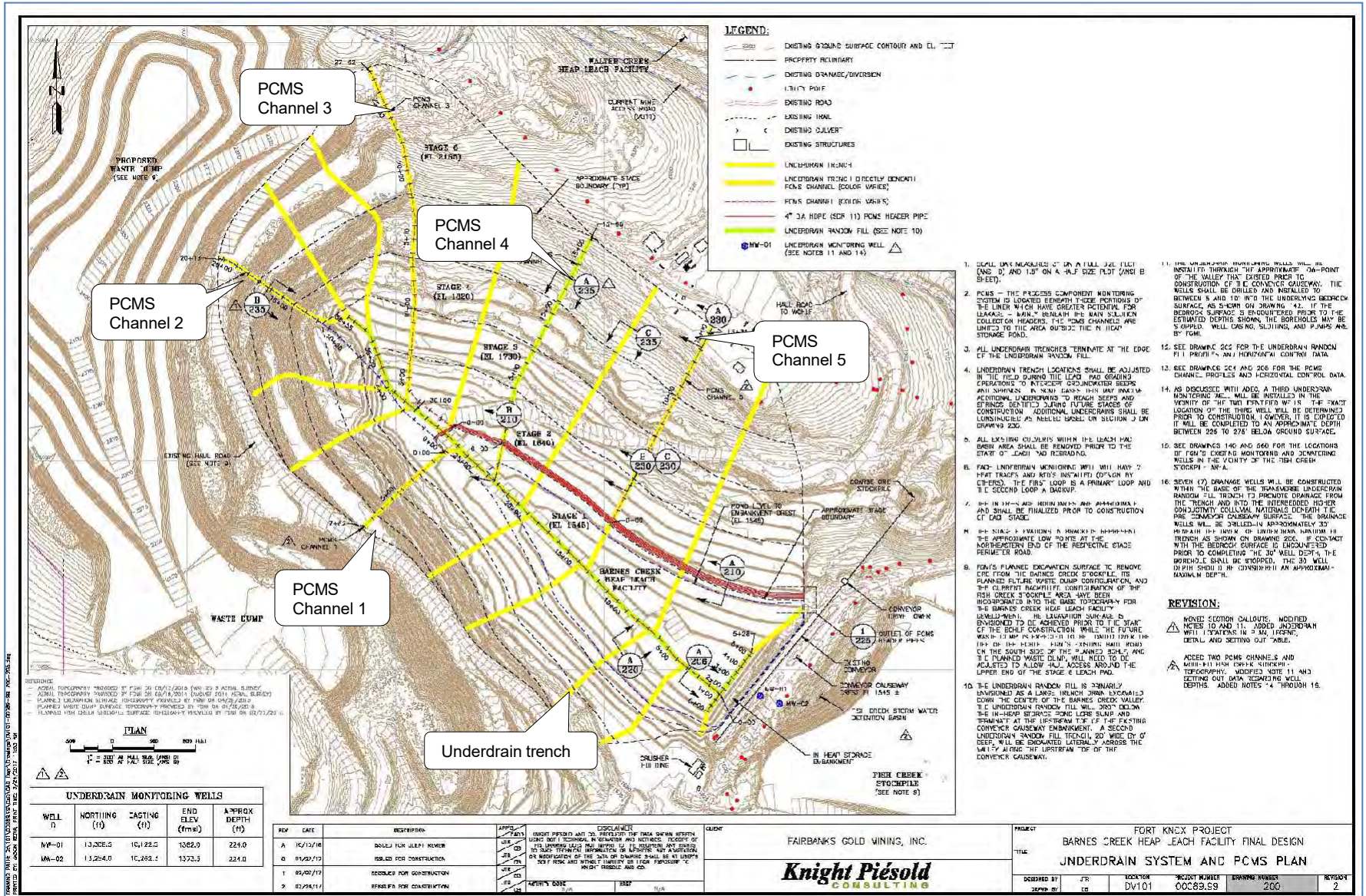


Figure 2-11 – PCMS and Underdrain System



## 2.6 Underdrain Collection System

An extensive underdrain system incorporating trenches and coarse rock fill has been included in every stage of liner construction including the region below the in-heap pond to intercept groundwater encountered in the valley and convey it to the base of the existing conveyor causeway for percolation under that structure. Reductions in flows captured by the underdrains will be realized as the leach pad as construction progresses reducing the areas contributing to groundwater recharge.

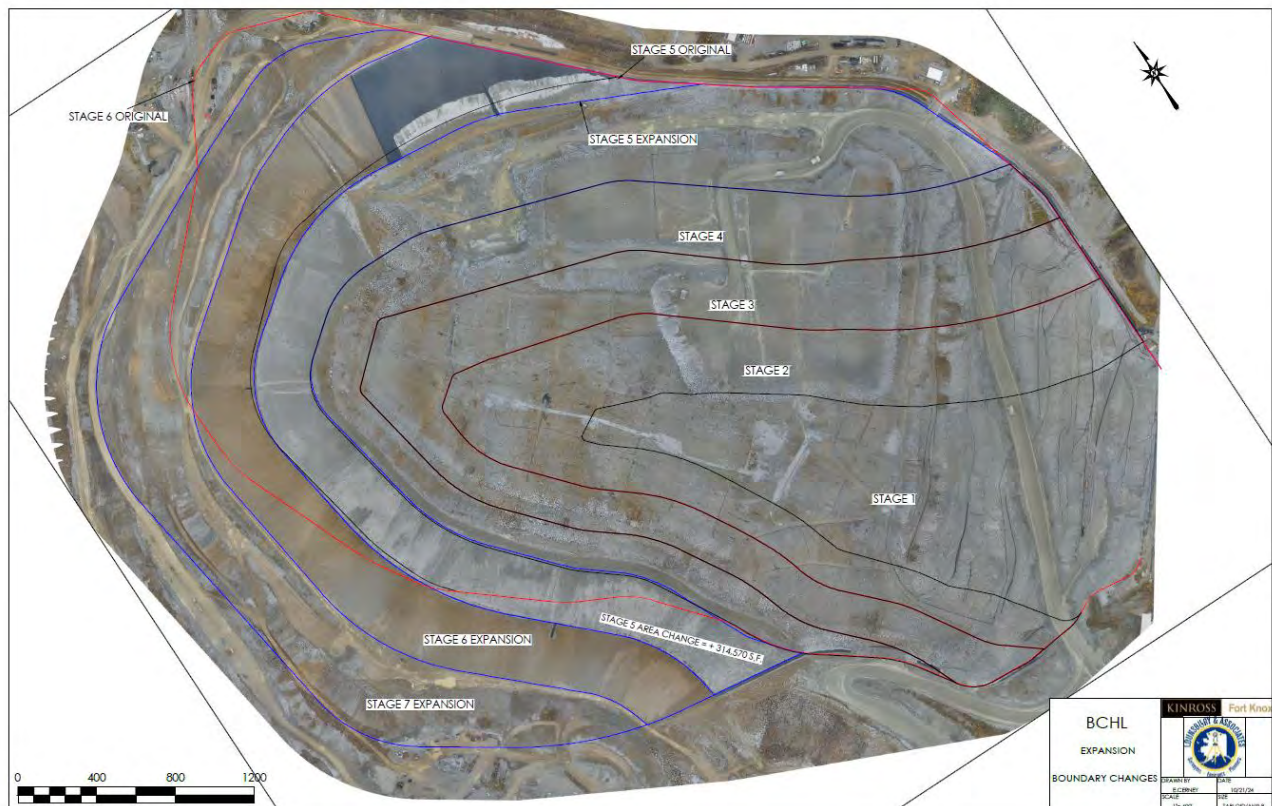
The underdrain trenches located up the valley side-slopes will flow into the large drain trenches. Additional finger underdrains will extend from the main underdrains to capture flows from isolated seeps and springs identified within the leach pad basin during construction.

The main underdrain trenches in the upper end of the valley are sized to pass a minimum of 500 gpm each. The main underdrains crossing beneath the flatter bottom of the in-heap storage pond were sized with minimum capacities of 300 gpm

## 2.7 Ore Heap

Run-of-mine ore from the Fort Knox pit is placed on the pad year-round and is stacked in lifts that are a nominal fifty feet. Material dumped out generally settles to an angle of repose slope of about 37.5° (1.3' Horizontal to 1' Vertical). Catch benches are included between each successive lift of ore such that the overall exterior slope is at a ratio of 3H:1V (18.4°). Stage 1 through Stage 5 ore configuration is shown in Figure 2-12

**Figure 2-12 Stage 1 and Stage 2 Ore Configuration**



## 2.9 Pregnant and Lean Solution Pipeline Corridor

Solution transport between BCHL and the CIC plants is through a 30-inch lean line and a 36-inch pregnant line located within a pipeline corridor that is approximately 3,700 lineal feet. The corridor is constructed either on the surface or subsurface (trench and buried). There are two small sections of pipeline, one leads off the inclined wells (used for startup and future emergency operations) and the other from the vertical solution collection wells (used for normal long term operations). The junction of these two sections is located on the north end of the embankment crest and is constructed on the surface. From there the corridor turns northerly following native ground passing under the conveyor belt heading northeasterly following the coarse ore stockpile bench until it arrests a short distance on the mill bench. This portion is a constructed trapezoidal trench. The pipeline is encircled with LLDPE liner filled with mill reject ore. The trench is backfilled with mill reject ore. From this point the corridor continues towards the CIC plants. This section is a field fit excavated trench. The pipeline is encircled in a LLDPE liner filled with mill reject ore. The trench is backfilled with cover material and asphalt. The pipeline ties into the CIC plant pipe network. See Figure 2-13 below

**Figure 2-13 Pipeline Corridor**



### 2.9.1 Carbon in Column Plants

Solution transportation between BCHL and the CIC plants is conducted through pipeline network which includes both the pregnant and lean solution pipelines.

### 2.10 Perimeter Roads and Surface Water Diversions

Perimeter roads and surface water diversions have been included in the design for each stage of the planned BCHL pad construction. The perimeter roads and surface water diversions are broken into two categories, inter-stage and ultimate. Ultimate perimeter roads and channels wrap around the ultimate pad footprint (through Stage 6), while the inter-stage perimeter roads and channels are located along the upstream edge of each stage of pad development where subsequent stages will be extended further up the valley

#### 2.10.1 Perimeter Roads

The inter-stage roads are considered temporary because they will eventually be regraded, backfilled, and incorporated into the footprint area of each subsequent stage of pad construction. Due to this temporary nature, the peak flows associated with the 100-yr/24-hr winter design storm event acting on upstream watersheds will typically be accommodated within soil-lined inter-stage road corridors in lieu of dedicated channels. Flows diverted by the inter-stage perimeter roads will typically be conveyed to permanent diversion channels that will be constructed along the ultimate pad perimeter.

The ultimate perimeter road will run along portions of each intermediate stage of development, and along the entire exterior perimeter of full buildout. The ultimate perimeter road has been designed with a 16-ft running width to provide construction and maintenance access. A diversion channel will typically run parallel to the ultimate perimeter road to convey runoff from upstream catchments around the facility. This ultimate perimeter diversion channel will receive flows conveyed by the inter-stage roads, but these flow contributions will reduce with each stage of pad construction.

The ultimate perimeter road will progressively be constructed with each stage of the pad development. During each stage of development, previously constructed tie-ins of the inter-stage and ultimate perimeter roads will be backfilled and the ultimate perimeter road and diversion channel will be extended to the tie-in with the next inter-stage perimeter road.

#### 2.10.2 Water Diversion Channels

**The diversion channel adjacent to the ultimate perimeter road is riprap-lined and has been sized to pass the peak flow associated with the 100-yr/24-hr design storm event. The design peak flows for the northeast and southwest ultimate perimeter diversions were estimated to be approximately 83 and 28 cfs, respectively.**

### 2.11 **Solution wells**

Solution wells are included in the BCHL to introduce barren solution on the Barnes Creek Heap Leach during summer 2024. Barren solution would be introduced on the wells a maximum rate of 500 gallons per minute. Barren solution addition via the drip tubes will be reduced when the solution wells are in operation to maintain total flows below 16,000 gallons per minute as specified by Waste Management Permit. Please see Attachment D for the well location, method of construction, depth of casing, and distance from well bottom to liner.

## Section 3.0 - Operation and Maintenance Procedures

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### 3.1 General

The O&M program includes a description of the parameters by which the BCHL is to be operated. As part of the BCHL operation, FGMI also conducts a monitoring program to ensure all elements of the facility are performing in accordance with their designs. The monitoring program includes both routine formal and informal inspections by FGMI personnel, the engineer of record, and state agencies.

### 3.2 The BCHL Embankment & Spillway

Once the embankment is constructed, it is not “operated” since it is a stationary structure designed primarily for solution retention.

Embankment maintenance involves maintaining the crest road, concrete portion of the spillway, and repairing any erosion of the slopes. Slope erosion should be minimal since the rockfill embankment is highly resistant to erosion. Other maintenance will be to clear the “v-ditch” or swale area of accumulated sediment, or other obstructions, which might substantially infringe into the designed capacity.

The spillway is a safety feature of the dam.

#### 3.2.1 Inspections and Monitoring – Embankment & Spillway

Visual inspections of the embankment will be conducted on a daily basis and recorded on the HL form presented in Appendix B. The key areas of observation and things to inspect for include:

##### **Embankment crest**

- Signs of settlement that would potentially reduce the freeboard level
- Horizontal displacements in the downstream direction that would indicate instability, use Belt 1 as an indicator of horizontal displacement
- Condition of the crest road

##### **Upstream slope**

- Overliner drain aggregate condition. Ensure that it has not eroded away from the slope to expose the LLDPE geomembrane primary liner below. Look for deformation at the anchor trench as an indicator of LLDPE instability
- Signs of slope movement such as slumping, cracking or bulging

##### **Spillway & Downstream Channel – Must be inspected if a rainfall event of 3.0” over 24 hrs occurs**

- Signs of settlement including cracking or misalignment
- Signs of deterioration of the concrete inlet, riprap or channel. This includes any exposure of the reinforcing elements in the concrete
- Accumulation of silt or other blockage in the channel

In the event that a stability or seepage related item is identified, the location, extent, and size of the slump or associated seepage, as well as the pond level will be reported within the same day of identification to a representative of the environmental department.

A series of four survey monuments are installed along the crest of the embankment to allow monitoring of potential movements. Reference Figure 3-1. The monuments will be read on a quarterly basis. These are also to be surveyed following any significant seismic event. Data will be reviewed by the Engineer of Record (EOR) at a minimum of once per year. Review by the EOR will occur more frequently if movements in any direction exceed 0.05 foot from the movements reported in the previous annual inspection. FGMI’s survey department records survey data in a spreadsheet that is maintained by the environmental department.

**Figure 3-1 Survey Monuments**

### 3.3 In-Heap Storage Pond & Composite Liner System

The Composite Geomembrane Liner System is an integral part of the solution collection system and once covered with ore will not be available for maintenance. Where covered by overliner and not ore it will be available for repair should the need arise. From a practical standpoint, maintenance will be limited to the exposed overliner. If the overliner is eroded, it must be replaced. If the liner system is damaged it must be repaired.

#### 3.3.1 Operation and Maintenance – Internal In-heap Storage Pond

The in-heap storage pond is contained with the interstitial pore space behind the embankment to avoid the freezing potential associated with an exposed pond. The available water storage capacity is located in the interstitial pore spaces between the individual ore particles of the ore in the heap contained behind the embankment and bounded on the sides by the ridges forming the valley.

Surpluses or deficits of water on the pad are possible over the expected operating life of the facility. This is largely due to seasonal changes in climatic conditions throughout the year. Heap leach operators and their corresponding management act and start removal of water from the heap leach pond to maintain the designed operating levels of the in-heap storage facility. Addition of water to the pad to maintain an appropriate operating pond depth must also be considered but is of lesser importance relative to the embankment.

The assessment of the in-heap pond storage components and freeboard allowance, are the maximum normal operating levels that will be monitored and honored. These are the pond levels that will not be exceeded under normal operating conditions such that the required pond capacities for the design storm event, draindown, and freeboard allowance are always available if needed. See Table 3-1, Figure 3-2 and Figure 3-3 for all stages.

### 3.3.2 Full Scale Leaching Operation

Prior to installation of the vertical wells the three inclined wells will be operated providing flows up to 12,000 gpm. When fully installed, the vertical wells (4) are designed to provide 16,000 gpm pregnant solution flow.

The gold recovery process follows the general steps outlined below:

- A non-gold enriched (barren) solution consisting of a dilute alkaline cyanide is applied to the surface of the WCHL pad through a network of drip tube emitters.
- The barren solution slowly percolates through the run-of-mine ore and collects in the WCHL in-heap pond. Along its journey through the ore, the barren solution leaches and accumulates gold in solution.
- The gold enriched (pregnant) solution from the WCHL pond is pumped up to the surface of the BCHL pad and is applied through a network of drip tube emitters.
- The solution slowly percolates through the run-of-mine ore and collects in the BCHL in-heap pond. Along its journey through the ore, the solutions leaches and accumulates additional gold in solution.
- Gold enriched (pregnant) solution is recovered from the BCHL in-heap storage pond through the operation of the vertical solution collection wells. These wells are located at the lowest portion of the in-heap pond, and are beside the upstream toe of the BCHL embankment.
- Pregnant solution is pumped directly to the Carbon-in-Column (CIC) plants for gold recovery.
- The now barren solution consisting of a dilute alkaline cyanide from the CIC plants can either be pumped directly to the BCHL or can be the WCHL pad where a portion of the flow passes through the booster station and arrives at the top of the pad to start the process over again. The remainder of the solution bypasses the booster station to leach the reggraded front slope of the pad

Table 3-1 – Stage Storage Components

Stage	1		2		3		4		5		6	
2-Dimensional Pad Area <sup>(1)</sup>	2.08 M ft <sup>2</sup>		4.19 M ft <sup>2</sup>		6.20 M ft <sup>2</sup>		8.20 M ft <sup>2</sup>		10.67 M ft <sup>2</sup>		12.58 M ft <sup>2</sup>	
Component	Elev (fmsl)	Volume (M gal)	Elev (fmsl)	Volume (M gal)	Elev (fmsl)	Volume (M gal)	Elev (fmsl)	Volume (M gal)	Elev (fmsl)	Volume (M gal)	Elev (fmsl)	Volume (M gal)
Maximum Normal Operating Level <sup>(2, 3)</sup>	1527.8	81.0	1525.3	75.8	1522.7	70.8	1520.1	65.8	1516.8	59.7	1514.0	54.9
100-yr/24-hr Storm Event <sup>(3)</sup>	1527.8 to 1530.2	5.2	1525.3 to 1530.2	10.4	1522.7 to 1530.2	15.4	1520.1 to 1530.2	20.4	1516.8 to 1530.2	26.5	1514.0 to 1530.2	31.2
24-hr Emergency Draindown <sup>(4)</sup>	1530.2 to 1540.0	23.0	1530.2 to 1540.0	23.0	1530.2 to 1540.0	23.0	1530.2 to 1540.0	23.0	1530.2 to 1540.0	23.0	1530.2 to 1540.0	23.0
Freeboard Allowance (to spillway invert)	1540.0 to 1542.0	5.1	1540.0 to 1542.0	5.1	1540.0 to 1542.0	5.1	1540.0 to 1542.0	5.1	1540.0 to 1542.0	5.1	1540.0 to 1542.0	5.1
Freeboard Allowance (above spillway invert)	1542.0 to 1545.0	7.9	1542.0 to 1545.0	7.9	1542.0 to 1545.0	7.9	1542.0 to 1545.0	7.9	1542.0 to 1545.0	7.9	1542.0 to 1545.0	7.9
Total		122.22		122.22		122.22		122.22		122.22		122.22

Notes: 1. The pad areas shown represent the cumulative 2-dimensional areas through each stage of the proposed BCHLF pad development, including FGMI's envisioned ultimate potential arrangement which includes expansion up to the valley ridgeline to the northwest and northeast of the currently defined Stage 6 footprint.

- The Maximum Normal Operating Level represents the maximum elevation the pond should be operated at any stage of the BCHLF development to maintain the necessary capacity above it for the 100-yr/24-hr Storm Event and 24-hour Emergency Draindown components, in addition to maintaining 5 ft of freeboard below the crest of the in-heap pond embankment. The storage volumes presented for the Maximum Normal Operating Level are the total volumes from the bottom of the in-heap storage pond (elevation 1450 fmsl) to the elevations shown.
- While the pond components associated with the Emergency Draindown and Freeboard allowance are assumed to remain constant throughout the life of the facility, the storage components associated with the Maximum Normal Operating Level and the 100-yr/24-hr Storm Event are inversely related to each other. As the pad area grows with each stage of development, the 100-yr/24-hr Storm Event component increases and reduces the Maximum Normal Operating Pond Level. It is expected that with on-going operational experience, FGMI will be able to readily adapt to this reducing level.
- The 24-hr Emergency Draindown component provides storage for a condition where the power supply is interrupted or if pumps are temporarily rendered inoperable; both of which would result in reduced pumping capacity from the in-heap pond and its subsequent filling. Unlike the WCHLF, and as requested by FGMI and the ADNR, no recirculation of solution has been considered for the BCHLF emergency draindown condition. The BCHLF emergency draindown component is instead based on a drainage rate equal to the full solution supply rate of 16,000 gpm for entire 24-hr period.

Figure 3-2 – Stage Pad Areas vs. Pond Elevations

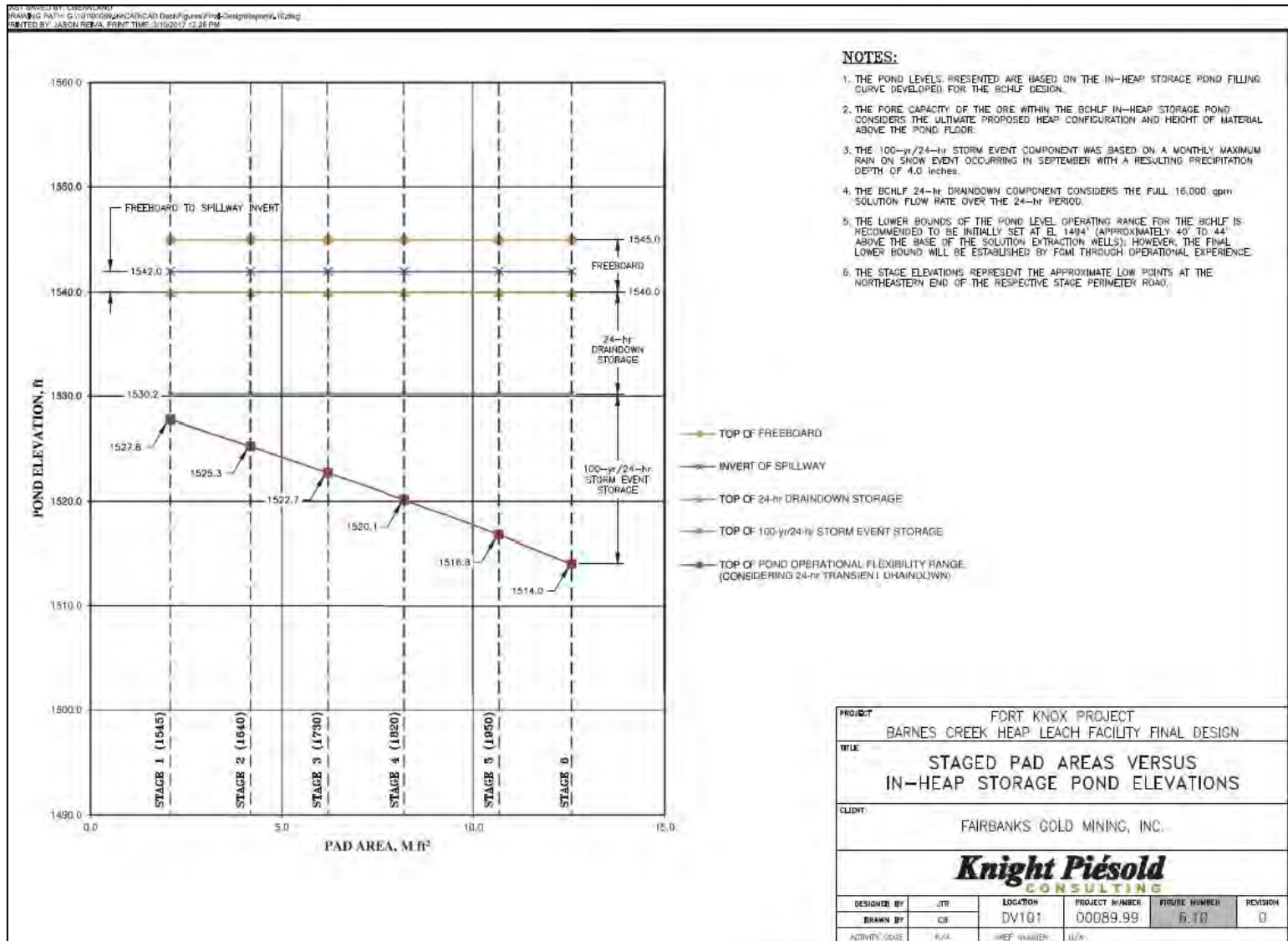
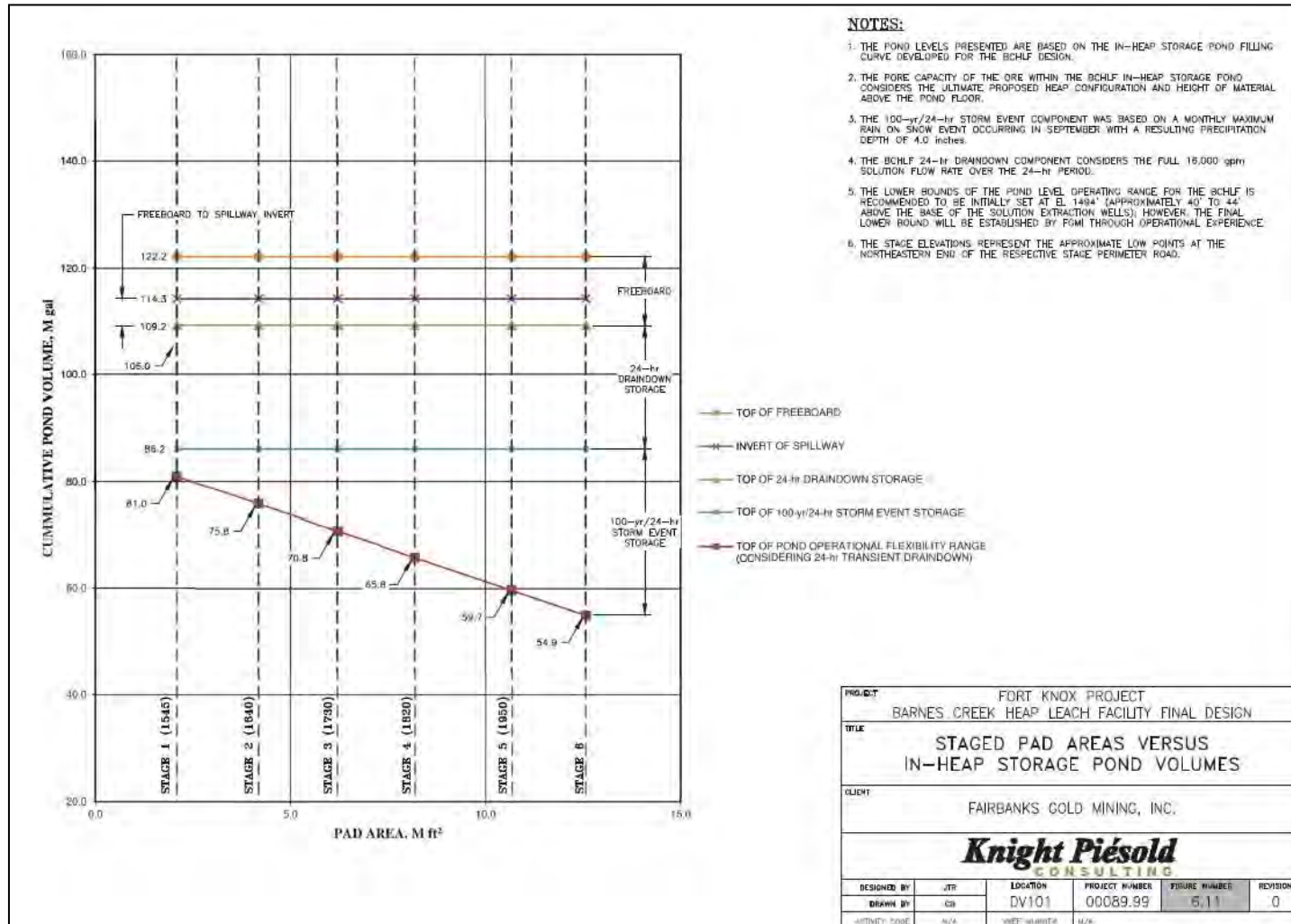


Figure 3-3 – Stage Pad Areas vs. Pond Volumes



### 3.3.3 Inspections and Monitoring – Internal In-heap Storage Pond

Daily inspection and monitoring of the In-heap Storage Pond consists of:

- Visual inspection of the pumps and piping associated with collection wells
- Measurement of the solution level in the pond
- Measurement of the flow and water depths at the solution collection pumps

Weekly inspection and monitoring tasks include:

- Visual inspection of the PCMS for evidence of solution leakage in the liner system when operations starts within the single liner area
- Inspection of the LCRS for evidence of solution leakage
- Reading the vibrating wire piezometers 1-22 during Stage 1 and 2 operations

### 3.3.4 Inspections and Monitoring – Liner and In-Heap Pond Piezometers

The proper function of the liner system above the in-heap pond is determined by the presence of a less than one foot of head, or solution depth on the primary liner. Head on liner is measured by piezometer pairs installed throughout BCHL, which will be recorded weekly and reviewed on a quarterly basis by the design engineers. See Figure 3-4 and Figure 3-5

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Figure 3-4 LCRS Vibrating Wire Piezometer Locations

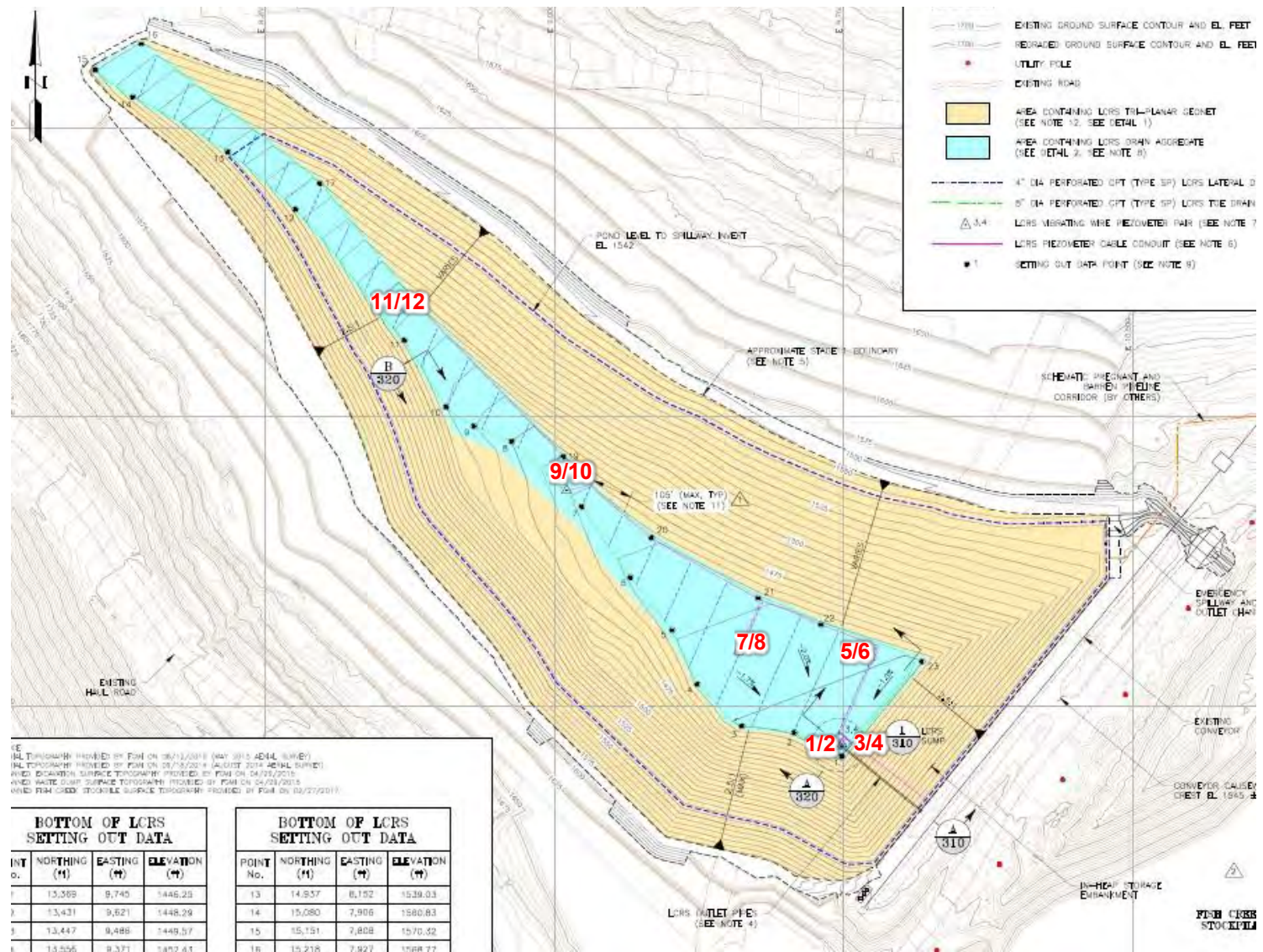
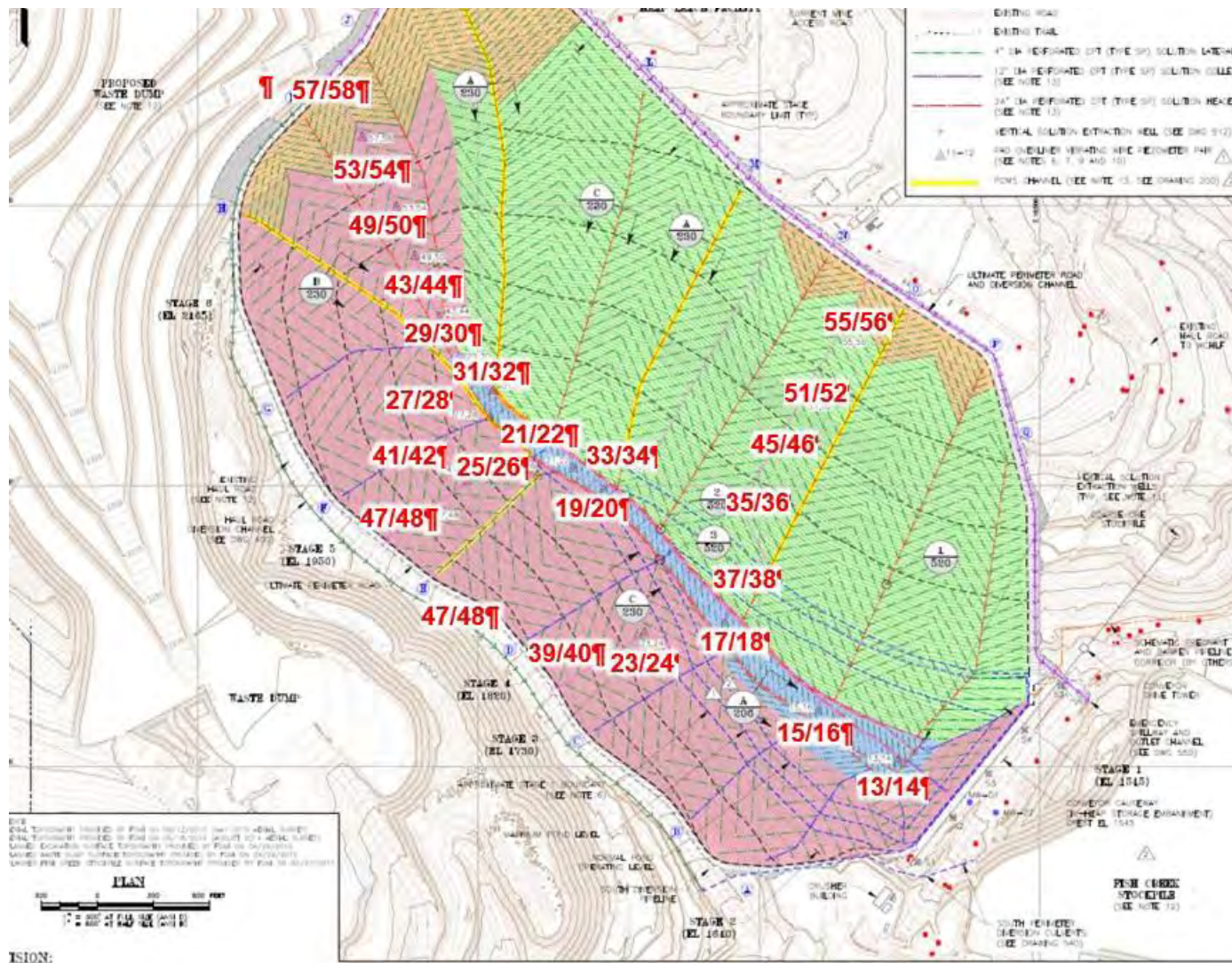


Figure 3-5 Piezometer Plan



### 3.4 Leachate Collection and Recovery System (LCRS)

#### 3.4.1 Operation and Maintenance – LCRS

The LCRS monitors and collects process solution passing through the primary liner of the in-heap pond. It is buried beneath the pond so there is no practical way to perform maintenance. The estimated leakage rate to the LCRS at the long term normal operating pond elevation of 1527.7 fmsl is 281 gpm.

The flow rate through the primary liner into the secondary liner shall not exceed the design flow rate of 450 gpm or exhibit a statistically significant increase in the flow rate. If these conditions are exceeded, ADEC must be verbally notified no later than the end of the next working day after discovery.

The LCRS may be pumped once a week under low flow scenarios or pumped continuously if steady flows are observed. Solution is pumped back into the in-heap pond and the volume is determined by an automatic recording device. Operation and maintenance of the piping and pumping systems will be according to the manufacturer's recommendations and FGMI's scheduled maintenance.

Five pairs of vibrating wire piezometers numbered 1 through 12, are located within the LCRS to monitor the hydraulic head acting on the secondary liner of the in-heap storage pond.

Piezometers 1 through 4 are located in the LCRS sump to monitor fluid depths in the sump. The LCRS sump will be maintained with a hydraulic head (piezometric elevation) of no more than seven feet on the secondary liner in the LCRS sump.

Inspections and Monitoring – LCRS Daily monitoring & Inspection consists of:

- Record the solution elevation in the LCRS

Weekly monitoring consists of:

- Recording flow pumped from the sump
- Inspections of the LCRS piping and pumping system
- Water quality sampling and analysis of sump water for WAD Cyanide (WAD CN)

### 3.5 Process Component Monitoring System (PCMS)

#### 3.5.1 Operation and Maintenance - PCMS

The only accessible portion of the PCMS are the outlet monitoring points located in the northeast corner of the in-heap storage pond along the slope just behind the spillway. The outlet monitoring points are exposed and will discharge any flows directly onto the double lined pond area. The PCMS outlets have heat traces at the ends of the pipes that will be maintained as part of the routine FGMI maintenance program.

#### 3.5.2 Inspections and Monitoring – PCMS

On a daily basis, heap leach operators will:

- The PCMS outlets will be monitored and inspected starting with Stage 2 operations
- Record any observed flow by measuring the time it takes to fill a container of known size and calculating the flow rate in gpm. If flows continue an automated flow measuring devices may be installed
- Ensure that any observed flow reports to the in-heap pond area

On a weekly basis, a representative of the environmental department will sample the PCMS for WAD CN and pH if there is measureable flow.

If WAD CN concentration above 10 mg/L is detected in the heap's PCMS sumps, then all sump water must remain contained within heap leach system, ADEC must be notified within one working day of discovery. The frequency and location of monitoring in the underdrain system must be expanded as approved by the department.

On a quarterly basis, the environmental department will submit PCMS reports to the ADEC.

### 3.6 Monitoring Wells

#### 3.6.1 Operation and Maintenance - Monitoring Wells

The surface around the monitoring wells shall be maintained such that ready access is available for reading water levels and water sampling. This includes snow management and removal from around the wells so

that the above ground casing extensions are clearly visible to avoid damage. The above ground casing on all wells must be well marked or painted to be highly visible to an equipment operator.

### 3.6.2 Inspections and Monitoring - Monitoring Wells and Underdrain Pump

Monitoring well BCMW-01 has been installed, a former dewatering well is converted to BCMW-2 See Figure 3-6 for locations.

The Environmental Department will measure water levels and collect samples from the monitoring and underdrain wells on a quarterly basis. Samples taken will be analyzed by a third party for Profile II constituents.

If WAD CN is detected above a concentration of 0.2 mg/L, ADEC must be notified within one working day of the discovery. If WAD CN is above the 10 ppm then underflow will need to be returned to pad. FGMI must then demonstrate to the ADEC's satisfaction that all underflow reports to the TSF.

Monitoring well water levels are recorded in an electronic format.

**Figure 3-6 Monitoring Wells**



### 3.7 Ore Heap

Run-of-mine ore from the Fort Knox pit is placed on BCHL year-round and is stacked in lifts that are a nominal fifty feet. Material dumped out generally settles to an angle of repose slope of about 37.5° (1.3' Horizontal to 1' Vertical). Catch benches are included between each successive lift of ore such that the overall exterior slope is at a ratio of 3H:1V (18.4°).

As the active dump face advances, ripping of the area behind the face with a dozer loosens the surface compaction created by heavy equipment traffic. Ripping enables the barren solution flowing through feedline pipes and drip tube emitters to infiltrate the ore that minimizes surface ponding, and provides an interlocking surface for the subsequent lift.

#### 3.7.1

### 3.7.2 Normal Operations

Phased new construction occurs simultaneously with the operation of previously constructed heap leach infrastructure. Throughout the construction season portions of the heap leach are deemed complete by the Projects Manager. The project team is responsible for compilation of a Construction Completion Report (CCR) for this work. The CCR is provided to the Environmental Manager for review and submittal to the Department of Natural Resources for review and approval by the state Dam Safety Engineer. Authorization comes in the form of a Certificate to Operate. Upon receipt of each Certificate to Operate, the Environmental Manager will ensure that coordinates of stacking boundaries is provided to the Technical Service Team. The Technical Services Manager ensures that all relevant stacking boundaries and rip restrictions are loaded into the equipment CAES files and that all old boundaries are removed from the system. These boundaries should be depicted on stacking maps distributed daily.

As the active dump face advances, ripping of the area behind the face with a dozer loosens the surface compaction created by heavy equipment traffic. Ripping enables the barren solution flowing through feedline pipes and drip tube emitters to infiltrate the ore that minimizes surface ponding, and provides an interlocking surface for the subsequent lift. Reference Figure 2-12

Slope maintenance will include any activities required to maintain the slope of the ore and preserve the integrity of structure along the toe of the slope.

Operation of the heap leach pad involves ore placement on lifts that are up to 50 feet tall. The exterior slope of the lift, including the active dump face will settle, or be dozed down, to maintain an angle of repose between 36°-38°. The overall pad has been designed to maintain a 3:1 slope and limits ore thickness to a maximum of approximately 500' above the liner surface. To ensure these design criteria are maintained, the FGMI Mine Operations and Technical Services delegates will implement controls to ensure reasonable compliance to the design limits. The current controls are listed below:

- The Technical Services delegate will ensure that the ore Stack plan is in the CAES system delineating ore fill boundary and a “no-rip” zone
- Mine operators will use the CAES system to provide real-time information on their elevation and location on the BCHL
- Technical Services delegate, designated by the Chief Mine Engineer, will be responsible for providing and updating CAES projects to delineate the dump limits and other critical information.

After ore placement has been completed for a given lift, the mine may decide to reduce the final slopes of the dump down to the reclamation slope angle of 3:1. In the interest of operational efficiency, FGMI may defer this work until multiple lifts are available for re-contouring or until the reclamation & closure period. In order to minimize risks to critical infrastructure while the pad is in operation, FGMI will only re-contour final slopes to within one lift above liner or above sensitive areas. Examples of sensitive areas are primary header pipelines or the vertical solution wells.

#### Operations during re-sloping activity

- Prior to starting or continuing work on active re-contouring of an area
  - The Chief Surveyor or a Technical Services delegate will ensure that the desired project area is delineated and displayed on a plan view map. The map will clearly show the assigned CAES project name and indicate the location of major pipelines, electrical infrastructure, stability monuments and liner relative to the project area. The map will be distributed electronically to the Mine Operations, Heap Leach Operations and Environmental group at least 1 week prior to work starting.
  - A CAES project will be created that delineates the project area and the desired final slope configuration.
  - Equipment operators will conduct an in-field risk analysis with their supervisor and will be provided a copy of the plan view map referenced above.
  - Equipment operators will be trained on proper slope construction and sloping techniques
- While active re-contouring of an area is occurring
  - A visual inspection of the work area and work progress will be made by a representative from the Technical Services department on a daily basis.
  - Equipment operators will utilize the designated CAES project for the area. At no time will equipment work on a re-sloping project without an operational CAES and GPS unit.

- After re-contouring of an area is complete
  - A safety berm will be placed at the toe of the re-contoured slope. The berm must be of sufficient size to stop rolling and/or falling rocks from continued travel down the slope.
  - The area will be surveyed and an as-built file created. This information will be compiled and incorporated into mine as-built topography files as appropriate.
  - At the mines discretion, drip tube emitters may be placed or ripped into regraded slopes to allow for active leaching of the area.

### 3.7.3 Inspections and Monitoring – Ore Heap

Mine Operations and/or Heap Leach personnel will monitor and check the following at least once per day. See Appendix B for a copy of the BCHL inspection form.

- Verify that ore is not placed outside limits of the mine plan or approved limits of liner and overliner
- Verify that ore loading is occurring in an up-slope direction where possible. This is especially important on the face of the pad. Dumping perpendicular to the final face increases the potential for a dump layer to act as a slip plane for a scarp to slip out on
- Monitor for any indications of slope instability such as slipping, movement, cracking or bulging of the slope or similar movements at the toe of the slope or above the level of the stacked ore
- Monitor for any indications of erosion, sloughing or other movements of the overliner
- Verify that ore placement on the overliner is not damaging the overliner or underlying solution collection pipework or liner system.
- Verify the alkalinity of the leachate solution is maintained at about 10.2 pH
- Verify that solution distribution lines are working properly
- Monitor for any ponding of leach solution on the heap surface, if more than a minimal amount is present an action plan to resolve the issue must be put into place
- Monitor for any wildlife that has entered the site and report if there has been a wildlife mortality

## 3.8 On Pad Pipelines and the Pipeline Corridor

### 3.8.1 Operation and Maintenance - Pregnant and Lean Pipeline Corridor

All pipe crossings will be maintained to prevent crushing of the doubled lined pipes or damage to the liner.

In the event of a damaged 12" feed pipe, the line will be isolated until a repair section can be made and brought in for replacement. This should occur usually within 12 hours of discovery. After the line is repaired and recharged, the pipeline will be walked to check for leaks.

In the event a 24" feed line fails or is damaged, a large decrease in indicated pressure in the control room will be seen on either the mill barren or booster station lines. Upon discovering or receiving notification of such an event, the control room operator will shut down flow to the appropriate system. The damaged section will be isolated by closing the feed valve and locking it out. Once damaged or compromised sections have been repaired with new piping, a check for leaks will be conducted when flow is restored to the system.

### 3.8.2 Inspections and Monitoring – On Pad Pipelines & Pipeline Corridor

On a daily basis the heap leach operators will visually inspect the on-pad pipelines. The mill control room operator will actively monitor system pressures for both pregnant and lean lines.

The piping corridor will be inspected on a daily basis by the heap leach operators. Inspections will include observation for any:

- Surface movements which indicate problems with the pipe in the trench, or the trench itself
- Erosion of the trench or supporting ground area
- Maintenance needed for the corridor
- Discharge/flow from the end of corridor shall be monitored. It will not be unusual to see flows resulting from rainfall or snowmelt. However, if the flows persist at a near constant or increasing

rate, water quality samples shall be taken and analyzed to determine if the flows are from leaks in the pipes. If they are from leaks in the pipes, the pipes shall be repaired.

3.9 Surface Water Control System

3.9.1 Operation and Maintenance – Surface Water Control System

Diversion channels should be cleared of materials or maintained in the manner described in Table 3-2 if:

- Channel flow is restricted by substantial accumulation of debris, vegetation, or sediment
- Areas of significant erosion are present and/or the riprap has been displaced
- Any required maintenance will be reported on the HL form presented in Appendix B

**Table 3-2 – Surface Water Controls – Maintenance Procedures**

<b>Issue</b>	<b>Response</b>
Erosion	Regrading to Original Lines and Grades Replacement of Removed Riprap
Substantial Accumulation of Debris/Other	Remove Debris Remove Sediment in Retention Structures
Culvert Blockage from Sediment / Debris	Schedule to have blockage removed Remove Unsuitable Sediment from Road
Impaired Access	Regrade Road to Original Lines and Grades
Liner System Integrity is Compromised	Schedule Liner Repairs
Settlement	Regrade Channel to Original Grade

3.9.2 Inspections and Monitoring – Surface Water Control System

The condition of the surface water diversion channels and culverts will be inspected weekly or after rainfall of greater than 0.5 inches. FGMI personnel will monitor the condition of the surface water diversions and sediment retention structures as a part of normal operating procedures.

The minimum formal diversion channel inspection schedule is summarized below in Table 3-3. Inspection findings or observations shall be recorded on the HL form.

**Table 3-3 – Inspection Schedule for the Barnes Creek HLP Surface Water Controls**

<b>ACTIVITY</b>	<b>INSPECTION FREQUENCY</b>
Excessive Erosion / Repair	Weekly <sup>1</sup>
Debris Removal	Weekly <sup>1</sup>
Diversion Berms	Weekly <sup>1</sup>
Integrity of Liner System	Weekly <sup>1</sup>
Visual inspection of channels & culverts	Weekly <sup>1</sup>
Ice Jam Inspection	Weekly (winter months only) <sup>1</sup>

<sup>1</sup> FGMI personnel will provide informal inspections on a daily basis as part of normal operating procedures.

3.10 Photographs

Taking photographs of conditions needing repair, the repair process, or completed repairs is encouraged to provide a visual record of the conditions and the repair. This is especially important when design of the repair may involve personnel who are offsite. Photographs of areas that are taking more than routine maintenance help to provide insight on potential design modifications that will reduce maintenance costs.

### 3.11 Data Interpretation

Data collected by heap leach operators will be reviewed by their supervisors. A designee from the environmental department will conduct secondary review of this information. The environmental department will also collect and manage all data for reporting to agencies. Should an issue be identified, the appropriate area manager and the engineer of record will be notified.

## Section 4.0 - Event Detection

This section is a tool to identify potential situations before they become critical events. Much of this material is taken from the Fort Knox Emergency Action Plan and the Fort Knox Emergency Management Plan. Refer to those plans for additional information.

### 4.1 Event Detection

This step describes the detection of an unusual or emergency event and provides information to assist the Dam Operator in determining the appropriate emergency classification level for the event. Unusual or emergency events may be detected by:

1. Observations by FGMI personnel or contractors
2. Observations at or near the dam by government personnel (local, state, or federal), landowners, visitors to the dam, or the public
3. Evaluation of instrumentation data
4. Earthquakes felt or reported in the vicinity of the dam
5. Forewarning of conditions that may cause an unusual event or emergency event at the dam (for example, a severe weather or flash flood forecast)

#### 4.1.1 Level 1 Non-Failure

A non-failure emergency is an unusual condition. They are conditions or situations that differ from the normal or expected condition of the dam and impoundment. These unusual conditions may indicate problems needing investigation or corrective measures.

#### 4.1.2 Level 2 Potential Failure

A potential failure emergency level indicates that conditions are developing at the dam that could lead to a failure. A potential failure means that time is available for analyses, decisions, and actions prior to a failure. A failure may occur but predetermined response actions may moderate the extent or alleviate the failure. This also includes any situation where water is at the BCHL spillway invert and a release to the TSF is imminent.

#### 4.1.3 Level 3 Imminent Failure

The imminent failure emergency level indicates that time has run out for analysis/study, and the dam has failed, is failing or about to fail

**Table 4-1 – Event Detection**

Event	Situation Details	Level
Spillway flow	Barnes Creek Heap Leach any amount is reportable to ADEC	1
Embankment overtopping	BCHL 1540' (5 feet below dam crest) Water level is encroaching on the freeboard	1
	BCHL 1542' Water is at the spillway invert and a release to the tailings is imminent	2
	Water level above 1545. Dam failure is imminent.	3
Seepage	New seepage areas in or near the dam	1
	Increase in new or existing seepage rates. New or existing seepage have a cloudy discharge or increasing flow rate.	2
	Is the new or existing seepage cloudy and the discharge flow rate is rapidly increasing. Surface cracks are developing. Notable and unusual conditions are occurring.	3
Earthquake	Minor Earthquake as defined Table 4-2	1
	Major Earthquake as defined in Table 4-2	2
	Earthquake resulting in uncontrolled release of water from the dam	3
	New cracks in the embankment less than ¼-inch wide without seepage	1

Event	Situation Details	Level
Embankment cracking	New cracks in the embankment greater than ¼-inch wide without seepage	2
	Cracks in the embankment with seepage	3
Embankment movement	Small movement detectable by instruments	1
	Slightly larger movement/slippage that is visually observable	2
	Sudden or rapidly proceeding slides of the embankment slopes	3
Instruments	Increase in instrument readings	1
	Instrumentation readings beyond predetermined values	2
	Instrument readings that continue to increase from the expected norm	3
	Elevated instrument readings in conjunction with other elevated event detection situations	3
Boils & Sinkholes	Observation of new sinkhole in reservoir area or on embankment. Observation of a boil down stream of the toe	1
	A boil is noticed with the formation of a silty soil cone around the outlet of the boil Enlarging sinkhole	2
	Rapidly enlarging sinkhole with or without a drop in pond water elevation	3
Security threat	Vague or unverified bomb threat	1
	Verified bomb threat that, if carried out, could result in damage to the dam	2
	Detonated bomb that has resulted in damage to the dam or appurtenances	3
Sabotage/ vandalism	Damage to dam or appurtenance with no impacts to the functioning of the dam	1
	Modification to the dam or appurtenances that could adversely impact the functioning of the dam	2
	Damage to dam or appurtenances that has resulted in a dam safety issue	3

4.2 Conditions and Evaluation

The potential emergency conditions or unusual occurrences are covered in this section. Measures to mitigate the effects of the emergency condition are in Section 4.3.

4.2.1 Extreme Runoff from Rainfall or Snowmelt

On a heavy rain warning from the National Weather Service, the water level in the impoundment and in-heap pond will be monitored closely and the facilities will be maintained as necessary during the event.

After any major storm or thaw runoff event, a thorough inspection of all ditches, culverts, ponds, and other water-related facilities will be completed. Necessary repairs will be completed as soon as is reasonably possible to reduce the chance of additional damage during subsequent storm events.

4.2.2 Earthquakes

Earthquakes are classified as insignificant, minor, or major, with regard to the BCHL embankment. A seismic event that results in a Peak Ground Horizontal Acceleration (PGHA) greater than 0.05g will trigger mandatory actions. Any necessary repairs will be completed as soon as practical

In addition to the above, the Guidelines for Cooperation with the Alaska Dam Safety Program outlines the reporting requirements for distance from an epicenter in the following Table 4-3.

**Table 4-2 – Recognition and Action for Seismic Event**

Earthquake	Description & Action Items
Insignificant	Magnitude less than 3.5
	No special actions or inspections. Continue daily inspections and report any deformation or movement (cracking, slump, seep, etc.).

Minor PGHA <0.05g	No special actions or inspections. Continue daily inspections and report any deformation or movement (cracking, slump, seep, etc.).
Major PGHA >0.05g	If safe to do so, immediately inspect the main embankment for obvious deformation or movement (cracking, slump, seep, etc.). If safe to do so, immediately inspect all pipelines and the pump stations for rupture, leakage, or other obvious damage. Immediately stop the pumping of reclaim water and all process solutions if problems are discovered during the inspections. As soon as possible, survey the monuments on the embankment
	Notify the Engineer of Record and schedule an inspection if required
	Check monitoring wells for any indication of changes in ground water elevations
	For a two-week period after an earthquake classified as major, the piezometers should be read daily by an Environmental Technician or Engineer. After data reduction, water levels should be graphically displayed on a summary graph to track any unusual changes piezometer readings

**Table 4-3 – Alaska Dam Safety Guidelines: Required Reporting Distances**

Magnitude	Miles Away		
5.0	15		
5.2	17		
5.4	19		
5.6	21	Magnitude	Miles Away
5.8	22	7.8	50
6.0	24	8.0	53
6.2	27	8.2	57
6.4	29	8.4	62
6.6	32	≥8.5	63
6.8	34		
7.0	37		
7.2	40		
7.4	43		
7.6	47		

Table 4-4 – Required Inspection Based on Peak Ground Acceleration (> 0.05g)

Epicentral Distance	Miles	0.1	0.6	1.2	1.9	2.5	3.1	4.1	5.0	6.2	7.88	9.3	11.0	12.4	15.5	110.8
<b>Peak Horizontal Ground Acceleration (PHGA) Expected at Mine Site (g)</b>																
Earthquake Magnitude	M 3.5	0.165	0.142	0.117	0.097	0.081	0.068	0.055	0.043	0.033	0.020	0.020	0.013	0.010		
	M 4.0	0.275	0.239	0.200	0.168	0.141	0.120	0.095	0.079	0.062	0.045	0.038	0.026	0.019		
	M 4.5	0.411	0.361	0.307	0.260	0.223	0.192	0.155	0.129	0.103	0.065	0.050	0.045	0.034		
	M 5.0	0.555	0.494	0.426	0.368	0.318	0.278	0.225	0.193	0.157	0.102	0.073	0.056	0.040		
	M 5.5	0.698	0.630	0.552	0.483	0.424	0.375	0.305	0.269	0.222	0.150	0.110	0.086			
	M 6.0	0.811	0.740	0.658	0.584	0.520	0.465	0.375	0.345	0.291	0.204	0.154	0.122			
	M 6.5	0.922	0.851	0.768	0.691	0.623	0.565	0.455	0.432	0.370	0.269	0.208	0.169			
	M 7.0	0.969	0.905	0.827	0.754	0.689	0.631	0.505	0.498	0.434	0.327	0.260	0.215			
M 7.5	0.993	0.935	0.866	0.799	0.739	0.685	0.555	0.557	0.494	0.384	0.314	0.266				
<b>Peak Horizontal Ground Acceleration (PHGA) Expected at Mine Site (g)</b>																
Epicentral Distance	Miles	18.6	21.7	24.9	28.0	31.1	34.2	37.3	43.5	49.7	55.9	62.1	65.0	74.6	87.0	100.0
<b>Peak Horizontal Ground Acceleration (PHGA) Expected at Mine Site (g)</b>																
Earthquake Magnitude	M 3.5	0.007	0.006	0.005	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000
	M 4.0	0.014	0.011	0.009	0.008	0.007	0.006	0.005	0.004	0.003	0.002	0.001	0.001	0.001	0.000	0.000
	M 4.5	0.026	0.021	0.017	0.015	0.013	0.011	0.010	0.007	0.006	0.005	0.004	0.003	0.002	0.001	0.001
	M 5.0	0.044	0.036	0.030	0.026	0.022	0.019	0.017	0.014	0.011	0.009	0.008	0.006	0.004	0.003	0.003
	M 5.5	0.069	0.057	0.049	0.042	0.037	0.032	0.029	0.024	0.020	0.017	0.014	0.010	0.008	0.006	0.006
	M 6.0	0.100	0.084	0.072	0.063	0.056	0.050	0.045	0.037	0.031	0.027	0.023	0.018	0.014	0.011	0.011
	M 6.5	0.141	0.121	0.105	0.093	0.083	0.075	0.068	0.057	0.049	0.042	0.037	0.029	0.023	0.019	0.019
	M 7.0	0.183	0.159	0.140	0.125	0.113	0.103	0.094	0.080	0.070	0.061	0.054	0.043	0.035	0.029	0.029
M 7.5	0.230	0.203	0.182	0.164	0.150	0.137	0.127	0.110	0.097	0.086	0.077	0.062	0.051	0.042	0.042	
No extra inspections required																

#### 4.2.3 Slumping of the Embankment

Any slumping or abnormal deformation of the embankment or adjacent areas is to be reported to the Ore Processing Manager and the Environmental Manager. The location, extent, and size of the slump are to be reported, as well as the pond level and any flow or seepage associated with the slump. The Engineer of Record must also be contacted.

#### 4.2.4 Unusual Instrument Readings

Initial instrument readings from piezometers and survey monuments must be compared with design limits to see any variation. Instrument readings when obtained will be compared with previous readings of the same instrument, as well as design limits. If the current readings differ significantly from previous readings, and have been taken under similar circumstances and conditions, an additional reading to verify the results will be taken as soon as possible.

#### 4.2.5 Avalanche or Debris Slide

No indications exist that natural avalanches or debris slides are of concern within the BCHL. However, operating personnel will always be alert to indications of slide movement such as the development of tension cracks or scarp faces on slopes, downhill movement of roads, pipelines, or other constructed elements, or the development of seepage at the base of slopes. In addition to debris slides, operators will be alert for any potential sliding of the overliner on the LLDPE primary geomembrane of the heap leach.

#### 4.3 Mitigation measures

The following actions describe some of the steps that could be taken at the embankment to prevent or delay failure after an emergency is first discovered. These actions should be performed with consultation from the Dam Safety Office, or other qualified engineers. It will be necessary to halt material placement on BCHL if any of the emergency events listed below were to occur.

##### 4.3.1 Overtopping by Flood Waters

- Reduce the volume of water stored in the impoundment, if possible
- Install pumps in the original inclined wells located on the upstream side of the embankment
- Provide erosion-resistant protection to the downstream slope by placing plastic sheets or other materials over eroding areas
- Divert flood waters around the reservoir basin if possible
- Provide emergency siphons or pumps

##### 4.3.2 Reduction in Freeboard and/or Loss of Dam Crest Width

- Place additional rip rap or sandbags in damaged areas to prevent further embankment erosion
- Lower the water level to an elevation below the damaged area
- Restore freeboard with sandbags or earth and rock fill
- Continue close inspection of the damaged area until the storm is over
- Provide emergency siphons or pumps
- Install pumps in the original inclined wells located on the upstream side of the

##### embankment 4.3.3 Slide on the Upstream or Downstream Slope of the Embankment

- Lower the water level at a rate, and to an elevation, that is considered safe given the slide condition.
- Restore lost freeboard if required by placing sandbags or filling in the top of the slide.
- Stabilize slides on the downstream slope by weighting the toe area with additional soil, rock, or gravel
- Provide emergency siphons or pumps
- Install pumps in the original inclined wells located on the upstream side of the embankment

##### 4.3.4 Erosional Seepage or Leakage (Piping)

- Plug the flow with whatever material is available (hay bales, bentonite, or plastic sheeting if the entrance to the leak is in the reservoir)
- Lower the water level until the flow decreases to a non-erosive velocity or until it stops.
- Place a reverse filter directly against the soil from which the leakage is exiting.

- Provide emergency siphons or pumps

#### 4.3.5 Failure of an Appurtenant Structure such as Inlet or Outlet Piping

- Discontinue pumping
- Identify cause of leak (pipe penetration, landslide, etc.)
- Repair damaged pipe and attended areas
- Provide emergency siphons or pumps

#### 4.3.6 Mass Movement of the Dam on its Foundation

- Immediately lower the water level until excessive movement stops
- Continue lowering the water level until a safe level is reached
- Continue operation at a reduced level until repairs are made
- Place fill at the base of the movement
- Provide emergency siphons or pumps

#### 4.3.7 Excessive Seepage and High Level Saturation of the Embankment

- Lower the water to a safe level
- Continue frequent monitoring for signs of slides, cracking, or concentrated seepage
- Continue operations at a reduced level until repairs are made

#### 4.3.8 Excessive Settlement of the Embankment

- Lower the water level by releasing it by pumping, or siphoning
- If necessary, restore freeboard, preferably by placing sandbags
- Lower water to a safe level
- Continue operating at a reduced level until repairs can be made

## **Section 5.0 - References**

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- [1] Fairbanks Gold Mining, Inc., "Barnes Creek Valley Fill Heap Leach Project Description", Fairbanks, Alaska, June 23, 2006.

## Section 6.0 - List of Revisions

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This revision log is included to provide the manual user with a description of the revisions made to the manual. The manual should be reviewed on at least an annual basis. If updates are necessary, they should be made to the manual and a revised manual issued. The following revision log should be completed for each revision. It should include the revision number and date, as well as a description of the revision and the section number in the manual to which the revision was made. The revision number and date on the cover of the manual should be updated as well. Other than a file copy of the revised manual, outdated copies should be discarded and replaced with the latest revision.

<b>REVISION LOG</b>	
<b>REVISION NUMBER AND DATE</b>	<b>DESCRIPTION OF REVISIONS</b>
Revision 0 – November	Initial issue of O&M Manual
Revision 1 – November	Added BC Underdrain well
Revision 2 – July 2021	Updated Section 3.7.2 to include discussion of operational controls (issued as Draft).
Revision 3 – July 2022	Corrected typographical errors, minor edits to content, and issued as Final.
Revision 4- December 2024	Solution Wells included

## Section 7.0 - Acronyms and Abbreviations

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ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
BCHL	Barnes Creek Heap Leach
CIC	Carbon-In-Columns
FGMI	Fairbanks Gold Mining, Inc.
GCL	Geosynthetic Clay Liner
HDPE	High Density Polyethylene
LCRS	Leachate Collection and Recovery System
LLDPE	Linear low density polyethylene
PCMS	Process Component Monitoring System
RTD	Resistance Temperature Device
TSF	Tailings Storage Facility
WAD CN	Weak Acid Dissociable Cyanide

# Appendix A



## Alaska Dam Safety Program

### HAZARD POTENTIAL CLASSIFICATION AND JURISDICTIONAL REVIEW

This form is used to review and indicate the hazard potential classification of an artificial barrier in accordance with 11 AAC 93.157 and to determine if the barrier is a dam under the jurisdiction of the Alaska dam safety regulations, based on the definition articulated under Alaska Statute 46.17.900 (3), and summarized as follows:

- “Dam” includes an artificial barrier, and its appurtenant works, which may impound or divert water and which...
- has or will have an impounding capacity at maximum water storage elevation of 50 acre-feet and is at least 10 feet in height measured from the lowest point at either the upstream or downstream toe of the dam to the crest of the dam; or
  - is at least 20 feet in height measured from the lowest point at either the upstream or downstream toe of the dam to the crest of the dam; or
  - poses a threat to lives and property as determined by the department after an inspection.

In accordance with 11 AAC 93.151, an artificial barrier with a Class I or Class II designation is determined to meet the third definition of a dam, regardless of its geometry.

*Please complete items 1 through 20. Attach additional information as necessary. This form must be certified and stamped on page 3 by an Alaska-registered professional engineer, qualified in accordance with 11 AAC 93.193.*

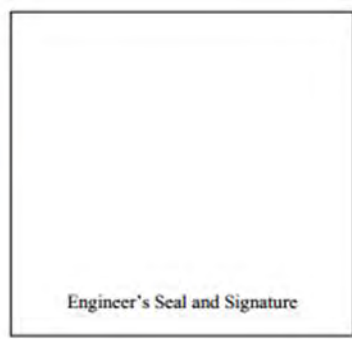
- Name of barrier: Barnes Creek Heap Leach Pad Dam  
National Inventory of Dams (NID) number: AK00315 (Assigned by Department)  
Name of stream: na  
General location and region: 16 miles northeast of Fairbanks  
Legal location: Township 2N Range 2E Section 8,9,16,17 Meridian Fairbanks  
Purpose and type of barrier: Mine Process Solution Containment  
This barrier is:  Existing  Proposed  Under construction  
Current hazard potential classification:  I  II  III  Not assigned
- Owner: Kinross Fort Knox Mine  
Address: #1 Fort Knox Road  
Fairbanks, AK 99721  
Contact name: Jason Perino  
Phone: Capital Projects Manager
- Is barrier federally owned, or regulated by the Federal Energy Regulatory Commission?  
 Yes (stop here)  No (complete form)

4. Maximum crest height of barrier: 20 feet  
 Measured from:  Upstream toe  Downstream toe  Offstream toe  
 Basis of height:  Conceptual design drawing  Detailed design drawing  
 As-built drawing  Field measurement  NID data
5. Maximum impoundment volume: 381 acre-feet  
 Surface area of reservoir at maximum storage: no open water acres  
 Average depth of reservoir above bottom of barrier: 40 (90 feet max) feet (live storage)  
 Basis of volume estimate:  Surface area multiplied by average depth  
 Bathymetry  
 NID data  
 Other: Calculated from pore space
6. Downstream development:  Yes  No  Unknown  
 Type of development (check all that apply):  
 Homes  Power or communication utilities  
 School  Water or wastewater treatment facilities or lines  
 Community halls, churches, etc.  Overnight campgrounds  
 Industrial or commercial property  Public parks or trails  
 Major highway  Fish hatchery or processor  
 Primary roads  Barrier owner's property or facilities  
 Secondary or rural roads  Other utilities: \_\_\_\_\_  
 Railroads  Other development: \_\_\_\_\_
- Basis of observations:  Ground reconnaissance  Aerial reconnaissance  
 Aerial photo  Other: \_\_\_\_\_  
 Date of observations: September 2021
7. Proximity of development to downstream channel (add maps or other information as necessary):  
 Distance downstream from barrier: na  
 Distance from stream bed: na  
 Relative elevation above streambed: na
8. Is development in the inundation zone of a flood from an uncontrolled release of water from the barrier?  
 Yes  No  Unknown
9. Was a dam break analysis conducted?  Yes  No  
 What model was used to determine inundation zone: : \_\_\_\_\_  
 (Please attach calculations)  
 Maximum depth and velocity of flow through development: \_\_\_\_\_
10. Is development at risk from improper operation or a "sunny day" failure?  
 Yes  No  Unknown
11. Is development at risk from an incremental increase in the flood if the barrier fails under flood conditions?  
 Yes  No  Unknown  
 Flood condition evaluated:  100 year  ½ PMF  PMF  Other: \_\_\_\_\_

12. Could an uncontrolled release cause other significant property damage or loss?  
 Yes  No  Unknown  
 Description: \_\_\_\_\_
13. Could an uncontrolled release effect public health?  
 Yes  No  Unknown  
 Description: \_\_\_\_\_
14. Is the reservoir created by the barrier the primary water supply for a community of more than 500 residents?  
 Yes  No  Unknown  
 Is a backup water supply available?  Yes  No  Unknown  N/A
15. Is barrier located on waters important to anadromous fish?  Yes  No  Unknown  
 Are anadromous fish waters at risk of damage or loss if an uncontrolled release occurs?  
 Yes  No  Unknown  N/A
16. Does the barrier contain mine mill tailings, process water or contact water?  
 Yes  No
17. Proposed hazard potential classification:  Class I (High)  Class II (Significant)  Class III (Low)
18. Basis of classification:  Quantitative - Numerical dam break analysis conducted  
 Qualitative - Limited engineering calculations  
 Preliminary - No engineering calculations

19. Comments: Class II based on containment of process solutions.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

20. Certified by: Michael Henderson, PE (Print name)  
 Date: December 31, 2021  
 Company: Strata-Geo LLC  
 Phone: 720-280-9928



- Notes:
1. This form must be certified and stamped by an Alaska-registered professional engineer qualified in accordance with 11 AAC 93.193.
  2. The information presented in this form may be overruled based on current data that reveals a higher level of confidence in the quality of information necessary to make the appropriate determinations.
  3. Anadromous fish waters are determined in accordance with 11 AAC 195.010 (a).
  4. Alaska dam safety regulations are articulated under 11 AAC 93.151 through 11 AC 93.291 (Article 3).

**FOR DEPARTMENT USE ONLY**

**Jurisdictional Status of Barrier:**

Dam under state jurisdiction

Barrier is not a dam under state jurisdiction

Reasons:

- Height
- Height and storage volume
- Hazard potential classification
- Anadromous fish stream
- Other: \_\_\_\_\_

Reasons:

- Height
- Height and storage volume
- Hazard potential classification
- Federal ownership or regulation
- Other: \_\_\_\_\_

Concur with proposed hazard potential classification:  Yes  No

Hazard potential classification based on current information:  Yes  No

Official hazard potential classification:

- Class I (High)  Class II (Significant)  Class III (Low)

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Reviewed by: \_\_\_\_\_  
 Title: \_\_\_\_\_  
 Signature: \_\_\_\_\_  
 Date: \_\_\_\_\_

## **Appendix B**

## Details

Date: 06/01/2024  
Mechanic: Charles Ruerup

## BCHL Routes

### Active Dumping / Leaching Areas

Any signs of erosion, sloughing or other movement in the reject overliner?	No
Has ore placement on the overliner caused damage to the liner or adjacent overliner areas?	No
Are the solution distribution lines working properly?	Yes
Is there substantial ponding of leach solution on the heap surface?	No
Has a wildlife mortality occurred?	No
What is the pH of the leachate solution?	10.51
Is the pH within the desired operational range of 10-12pH?	Yes
Solution application rate (gpm)?	15933
Solution extraction rate (gpm)?	15615
What is the average PSI on active cells?	30
Do all roads that go past containment have a ditch to prevent solution from leaving containment?	Yes
If there is no drainage ditch Heap Leach and Pit supervisors must be contacted so that a drainage ditch can be installed. Also, until the ditch is installed, all live lines and cells in that area need to be turned off.	Yes
Are these ditches in good condition and free of debris?	Yes

If the drainage ditch is in bad condition or full of debris, it must be cleaned out right away. If the job needs larger equipment, contact Heap Leach Supervisor or Pit Supervisor so that the right equipment can clean or repair the ditch as soon as possible.

**Yes**

**Embankment Inspection**

Is the crest road in good repair? **Yes**

Are there signs of settlement/cracking/misalignment in the crest? **No**

**Upstream Slope**

Is the upstream overliner in good repair? **Yes**

Are there signs of settlement/bulging/sinkholes on the upstream slope? **No**

Does tree/brush cover obscure/hide a majority of the upstream slope? **No**

**In-Heap Pond & Solution Collection**

Is there damage to the solution collection pipes/wells? **No**

What is the in-heap pond elevation? **1517.4**

Is the pond level below 1525.3 feet? **Yes**

What is the LCRS solution elevation? **1447**

Are the LCRS pumps functioning properly? **Yes**

Is the pumping rate of the LCRS below 450 gpm, the maximum design leakage rate? **Yes**

**Pipeline Corridor**

Is there easy access to the corridor? **Yes**

Are there signs of settlement/cracking/misalignment along the road? **No**

Are there signs of settlement/cracking/misalignment in the corridor? **No**

Is there flow from the corridor indicating leakage from the pipes? **No**

Is the mechanical equipment operable? **Yes**

Surface Water Controls

Are the perimeter diversion channels free of debris and/or ice jams? **Yes**

Are there signs of settlement/cracking/misalignment in the perimeter diversion channels? **No**

Is there any erosion or channel deterioration in the perimeter diversion channels? **No**

BCHL Electrical Enclosures

Door access is clear? **Yes**

Housekeeping, Lights, and Heater On? **Yes**

Enclosure Condition? **Yes**

Broom Present? **Yes**

Dust Pan Present? **Yes**

Ice Melt Present? **Yes**

Housekeeping & Cleanliness? **Yes**

Valve Enclosure Building

Door access is clear? **Yes**

Housekeeping, Lights, and Heater On? **Yes**

Piping and valve leaks? **Yes**

Heat trace Breakers? **Yes**

Barren PSI **217**

Barren Temp in F **42.6**

Broom Present? **Yes**

Dust Pan Present ? **Yes**

Ice Melt Present? **Yes**

Housekeeping & Cleanliness? **Yes**

## Appendix C Analytical Profile Chemistry

**KINROSS** Fort Knox

Fairbanks Gold Mining, Inc.  
*A Kinross company*

21-M-0001

**Quote Number: PROFILE-II-GW-2017**

**Matrix:** Groundwater      **Analytical Profile II - Groundwater Inorganic Parameters**

Parameter	Method	Detection Limit
<b>Diskette/QC Summary</b>		
Quality Control Summary		
<b>Inorganic Prep</b>		
Cyanide, total	M335.4 - Manual Distillation	
Cyanide, WAD	SM4500-CN I- distillation	
Phosphorus, total	M365.1 - Auto Ascorbic Acid Digestic	
<b>Metals Analysis</b>		
Aluminum, dissolved	M200.7 ICP	0.05 mg/L
Antimony, dissolved	M200.8 ICP-MS	0.0004 mg/L
Arsenic, dissolved	M200.8 ICP-MS	0.0002 mg/L
Barium, dissolved	M200.7 ICP	0.007 mg/L
Bismuth, dissolved	M200.7 ICP	0.04 mg/L
Cadmium, dissolved	M200.8 ICP-MS	0.00005 mg/L
Calcium, dissolved	M200.7 ICP	0.1 mg/L
Chromium, dissolved	M200.7 ICP	0.01 mg/L
Copper, dissolved	M200.7 ICP	0.01 mg/L
Iron, dissolved	M200.7 ICP	0.03 mg/L
Lead, dissolved	M200.8 ICP-MS	0.0001 mg/L
Magnesium, dissolved	M200.7 ICP	0.2 mg/L
Manganese, dissolved	M200.7 ICP	0.01 mg/L
Mercury, dissolved	M245.1 CVAA	0.0002 mg/L
Nickel, dissolved	M200.7 ICP	0.008 mg/L
Potassium, dissolved	M200.7 ICP	0.2 mg/L
Selenium, dissolved	M200.8 ICP-MS	0.0001 mg/L
Silica, dissolved	M200.7 ICP	0.214 mg/L
Silicon, dissolved	M200.7 ICP	0.1 mg/L
Silver, dissolved	M200.7 ICP	0.01 mg/L
Sodium, dissolved	M200.7 ICP	0.2 mg/L
Zinc, dissolved	M200.7 ICP	0.01 mg/L
<b>Misc.</b>		
Electronic Data Deliverable		
Setup charge for ICP, dissolved		
<b>Wet Chemistry</b>		
Alkalinity as CaCO3	SM2320B - Titration	2 mg/L

21-M-0001

Cation-Anion Balance	Calculation	
Chloride	SM4500C-E	0.5 mg/L
Conductivity @25C	SM2510B	1 umhos/cm
Cyanide, total	M335.4 - Colorimetric w/ distillation	0.003 mg/L
Cyanide, WAD	SM4500-CN I,E-Colorimetric w/ distil	0.003 mg/L
Fluoride	SM4500F-C	0.11 mg/L
Hardness as CaCO3 (dissolved)	SM2340B - Calculation	Calculation
Hardness as Calcium	SM2340B - Calculation	Calculation
Hardness as Magnesium	SM2340B - Calculation	Calculation
Nitrate as N, dissolved	Calculation: NO3NO2 minus NO2	Calculation
Nitrate/Nitrite as N, dissolved	M353.2 - Automated Cadmium Redu	0.02 mg/L
Nitrite as N, dissolved	M353.2 - Automated Cadmium Redu	0.01 mg/L
Nitrogen, ammonia	M350.1 Auto Salicylate w/gas diffusi	0.05 mg/L
pH (lab)	SM4500H+ B	0.1 C
Phosphorus, total	M365.1 - Auto Ascorbic Acid (digest)	0.01 mg/L
Residue, Filterable (TDS) @180C	SM2540C	20 mg/L
Residue, Non-Filterable (TSS) @105C	SM2540D	5 mg/L
Sulfate	D516-02/-07/-11 - Turbidimetric	1 mg/L
Sulfide as S	SM4500S2-D	0.02 mg/L
TDS (calculated)	Calculation	Calculation
TDS (ratio - measured/calculated)	Calculation	Calculation
Turbidity	M180.1 - Nephelometric	0.1 NTU

**Appendix D Barnes Creek Heap Leach Solution Wells details**

October 31, 2024

Tim Pilon  
Engineer II

Wastewater Discharge Program  
Division of Water  
Alaska Dept. of Environmental Conservation  
610 University Avenue  
Fairbanks, AK 99709-3643

**Subject: Solution Wells  
Barnes Creek Heap Leach Facility, Fort Knox Gold Mine  
Waste Management Permit No. 2020DB0002  
Alaska Dam ID No. AK00315**

Dear Mr. Pilon,

Kinross Alaska Fairbanks Gold Mining, Inc. (FGMI) proposes to introduce barren solution into the solution wells installed on the Barnes Creek Heap Leach during summer 2024. Barren solution would be introduced on the wells a maximum rate of 500 gallons per minute. Barren solution addition via the drip tubes will be reduced when the solution wells are in operation to maintain total flows below 16,000 gallons per minute as specified by Waste Management Permit No. 2020DB002.

Specific information regarding the wells is provided on the following pages.

If you have any questions, comments or concerns, please do not hesitate to contact me directly.

Sincerely,

Bartly Kleven  
Kinross Alaska Environmental Affairs Director

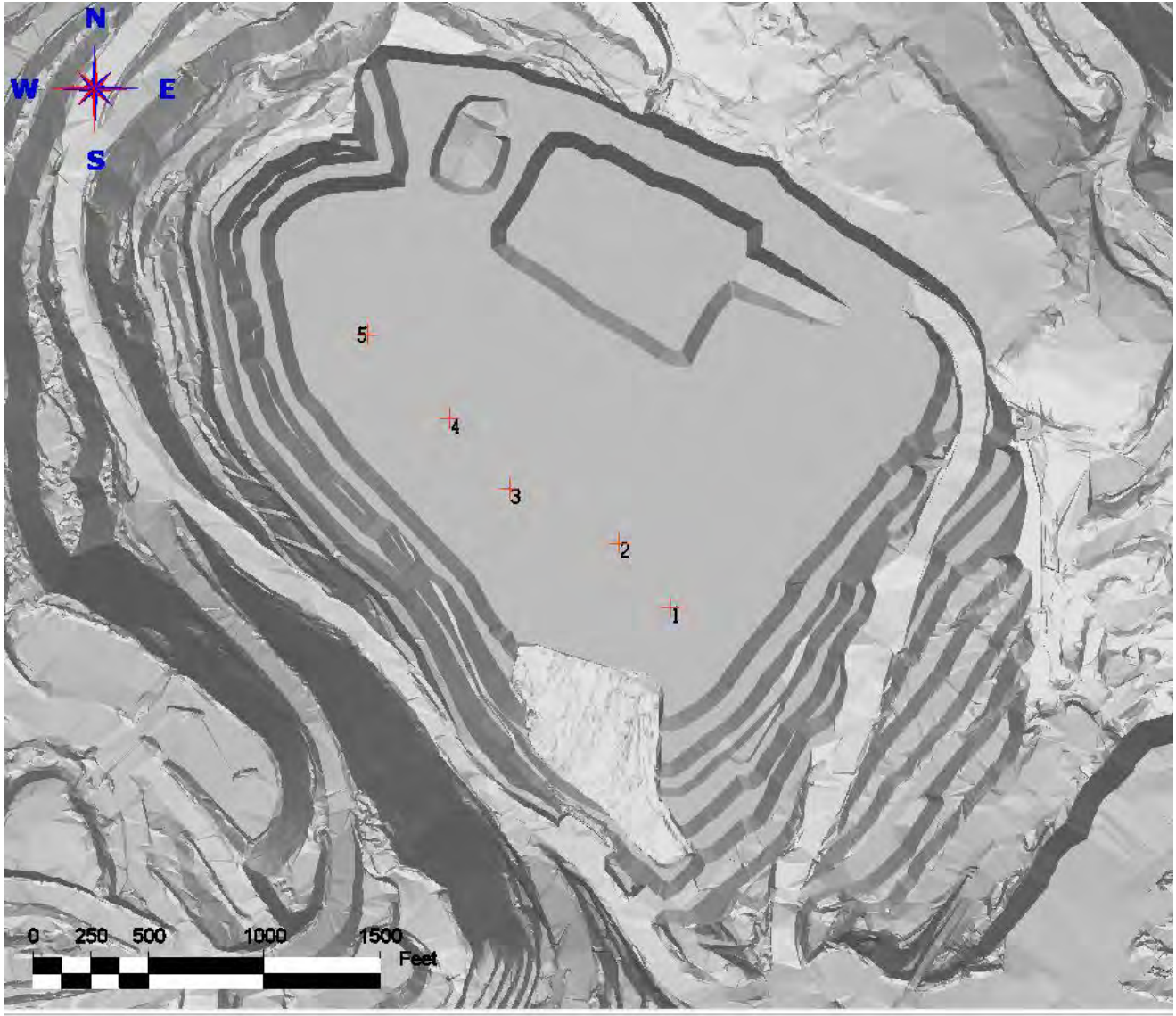
cc: Ben Wagner, Alaska Department of Natural Resources

a. Well location

Well ID	Latitude	Longitude	Elevation (feet amsl)
1	65.00368624	-147.3652378	1970
2	65.0044418	-147.3666857	1970
3	65.00507576	-147.3697574	1970

4	65.00589775	-147.3714288	1970
5	65.00688446	-147.3737406	1970

The wells are shown in the figure below.

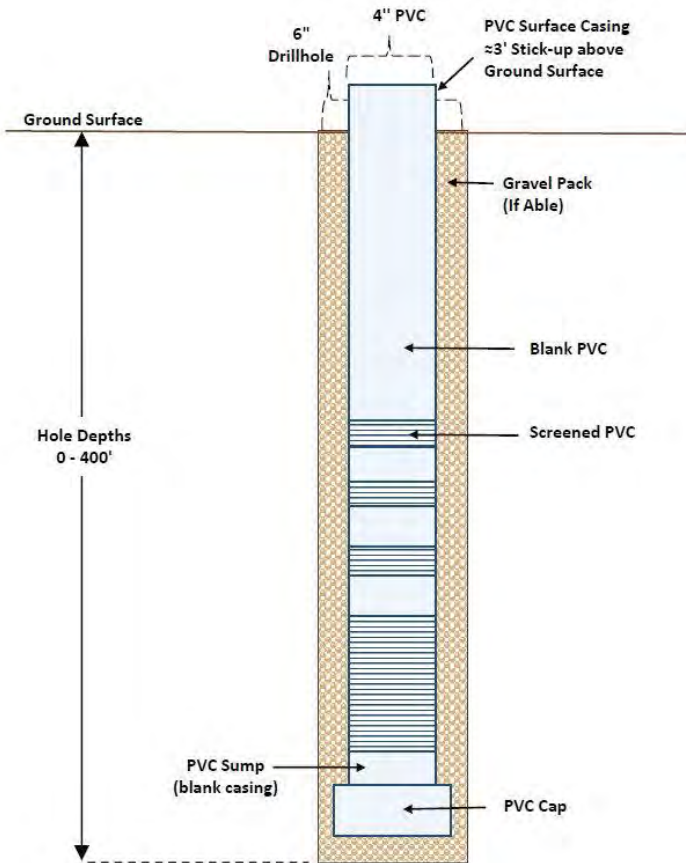


b. Well method of construction

The solution wells were installed using a six-inch bit. A 3-inch pvc drop pipe was installed along the full length of the six-inch hole. The annular space between the drop pipe and the undisturbed heap leach material was backfilled with pea gravel. The top 80 feet of pvc is solid with the remaining length screened. The drop pipe is capped at the bottom the screened section. A generalized schematic of the wells is provide below.

# Solution Well Diagram

Not to scale



c. Total depth of casing

Well ID	Well Depth (feet bgs)
1	323.2
2	301.2
3	260.1
4	240.9
5	183.6

d. Depth of gravel pack or grout collar

Well ID	Well Depth (feet bgs)	Gravel Pack (feet bgs)
1	323.2	323.2
2	301.2	301.2
3	260.1	260.1
4	240.9	240.9
5	183.6	183.6

e. Depth of screened section(s); and

Well ID	Well Depth (feet bgs)	Solid PVC Depth (feet bgs)	Screened Interval (feet bgs)
1	323.2	80	80 - 243.2
2	301.2	80	80 - 221.2
3	260.1	80	80 - 180.1
4	240.9	80	80 - 160.9
5	183.6	80	80 - 103.6

f. Distance from well bottom to liner.

Well ID	Well Depth (feet bgs)	Height Above Liner (feet)
1	323.2	150
2	301.2	150
3	260.1	150
4	240.9	150
5	183.6	150

g. Barren Solution will be introduced according to the following schedule:

SIMPLE GANTT CHART by Vertex42.com  
<https://www.vertex42.com/ExcelTemplates/simple-gantt-chart.html>

TASK	START	END
<b>Barnes creek</b>		
Solution well #1	11/18/24	12/2/24
Solution well #2	11/21/24	12/5/24
Solution well #3	11/27/24	12/11/24
Solution well #4	12/9/24	12/23/24
Solution well #5	12/12/24	12/26/24

Nov 18, 2024				Nov 25, 2024				Dec 2, 2024				Dec 9, 2024				Dec 16, 2024				Dec 23, 2024				Dec 30, 2024				Jan 6, 2025																											
18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12
M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S

- Flow rate not to exceed 500 gpm per well



**APPENDIX C**

**TAILINGS STORAGE FACILITY OPERATIONS AND MAINTENANCE MANUAL  
REV 12**

**KINROSS**

**Fort Knox**

**TAILINGS STORAGE FACILITY  
NID ID# AK00212  
OPERATIONS & MAINTENANCE MANUAL Rev. 13**

**Fairbanks Gold Mining, Inc.  
A Subsidiary of Kinross Gold Corporation  
P.O. Box 73726  
Fairbanks, Alaska 99707-3726  
November 2024**

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# Tailings Storage Facility Operations & Maintenance Manual

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# **Tailings Storage Facility**

## **Operations & Maintenance Manual**

### **Preface**

---

This document is the Operations & Maintenance Manual (O&M Manual) for the Fairbanks Gold Mining, Inc. (FGMI) Tailings Storage Facility (TSF) located near Fairbanks, Alaska in the North Star Borough. This O&M Manual has been prepared to facilitate both effective and efficient practices for the operation, maintenance, surveillance, and documentation of the facility. This document contains information and instructions that will assist FGMI operations and maintenance personnel in the performance of their duties; as well as contribute to their training in recommended procedures. Included in this manual is an organizational chart showing key personnel, and a remedial action contingency plan that covers general emergency response and communication procedures.

Proper O&M is crucial for the TSF to operate safely and efficiently, of which this manual is an essential component of the O&M program. This manual presents the procedures for operation of the TSF under normal or extreme conditions and provides technical guidance and procedures for monitoring, inspection, and long-term maintenance programs. Also contained are descriptions of unusual conditions that might occur at the dam and the operating procedures and inspections that should be followed under those conditions.

As with any structure of this complexity, the operations manual may not foresee every potential problem. However, with a well-conducted training program, careful observation, and regular inspection, unusual circumstances will be identified and brought to management's attention to be appropriately addressed.

Take note that the majority of the time over the life of the TSF, the inspection and monitoring program is routine and encounter no surprises. However, close attention and continued diligence on the part of the operation is required so that potential problems will be identified early and remediated prior to becoming significant. This can only be achieved with the ongoing commitment and support of operating personnel and management at all levels of the operation

Monitoring equipment, procedures, and instrumentation are required to accomplish the following:

- Confirm that the structure is performing in accordance with the design
- Determine if a problem exists that may require remediation
- Provide timely notice of an adverse change in the state of the dam

The facility descriptions presented in this manual are summary descriptions designed to serve as a basis for presenting the O&M and monitoring procedures. The reader should refer to the more detailed descriptions presented in the design and record of construction reports as situations warrant.

# Section 1.0 - INTRODUCTION

---

## 1.1 Purpose and Objective

This O&M Manual exists to provide a descriptions of the Tailings Storage Facility (TSF) facility and related methods and procedures that will help to ensure that each component of the facility is performing as designed and constructed. In addition, it will help to provide for early detection of component damage, degeneration and/or performance outside the limits of the design intent so that appropriate remedial measures and actions can be implemented.

## 1.2 Scope

This O&M Manual describes the roles of responsible parties and the procedures that will be used for the operation, maintenance, inspection, and monitoring of the TSF. It specifically addresses components of the facility including: the tailings storage embankment, tailing discharge lines, the barge and pipeline, Pearl Creek Causeway, seepage collection pump and pipeline, interceptor wells, monitoring wells and the Phase 1 Causeway. Also included within the manual is an event detection section that outlines responses for various emergency scenarios.

## 1.3 Overview of the Tailings Storage Facility

The TSF is located within the Fish Creek drainage and the embankment is downstream from the open pit mine and its associated facilities. With exceptions for the two Fort Knox heap leaches and some localized diversion channels, all upstream water flows are impounded within the facility. Water is captured by intercepting subsurface seepage and ground water flows along the downstream side of the dam and pumping them back into either the tailing pond or to the reverse osmosis plant 2 (RO2). Process water within the TSF is recycled from the tailing pond to the mill via pumps on a floating barge located near the north abutment of the dam. An overview of the TSF and associated structures can be seen in Figure 1-1 on the following page.

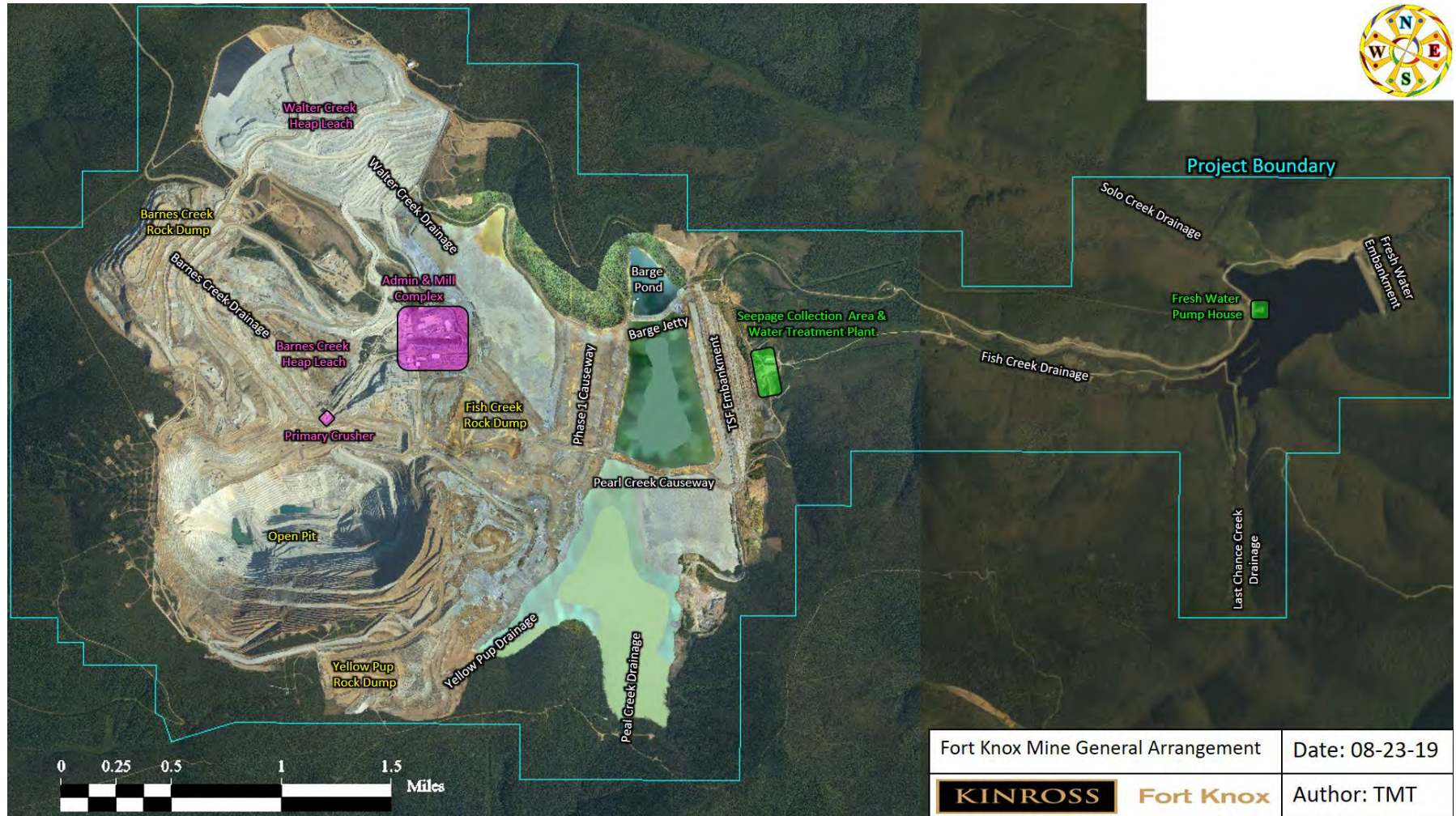
The current TSF embankment is at elevation 1560' fmsl. However, the original embankment was planned and constructed to an ultimate crest elevation of 1488.0 fmsl. As the mine continued to discover mill grade ore beyond its initial reserves, the need for additional tailings storage capacity was identified. This need triggered a tailing storage study in which a 52' modified centerline raise to the original TSF embankment was selected for proving additional tailing storage. Subsequent to the construction of the first two of three stages of the 52' raise, the design of the third stage was revised to allow for an additional 17' modified centerline raise to crest elevation 1,557 fmsl to hold water and tailing. FGMI obtained approval to raise the dam to 1560 fmsl as an operational buffer to store water only.

Construction of the modified centerline raise was predicated on the design and construction of a base working platform along the upstream face of the existing embankment, which was permitted under the Alaska Dam Safety Program and successfully completed in the fall of 2009. A general timeline of dam raising activities is below.

- 2006: Original embankment completed to elevation 1488 fmsl.
- 2009: First base working platform constructed for modified centerline design.
- 2010: Original embankment partially excavated and rebuilt on modified centerline back to 1488 fmsl.
- 2011: Modified centerline raise completed to elevation 1515 fmsl.
- 2012: Second base working platform constructed.
- 2014 - 2015: Modified centerline raise completed to elevation 1540 fmsl and third platform constructed.
- 2016 - 2017: Modified centerline raise completed to elevation 1557 fmsl.
- 2019: Modified centerline raise completed to elevation 1559.5 fmsl as a water only raise.

- 2021: The engineered zones has been constructed to 1560 fmsl to account for the 2020 survey adjustment. It is a water only dam raise.
- 2025: A modified centerline raise was completed to raise the TSF dam to 1565 fmsl. Pearl Creek Causeway Dam was raised to 1567 fsml.

Figure 1-1 – Fort Knox General Arrangement



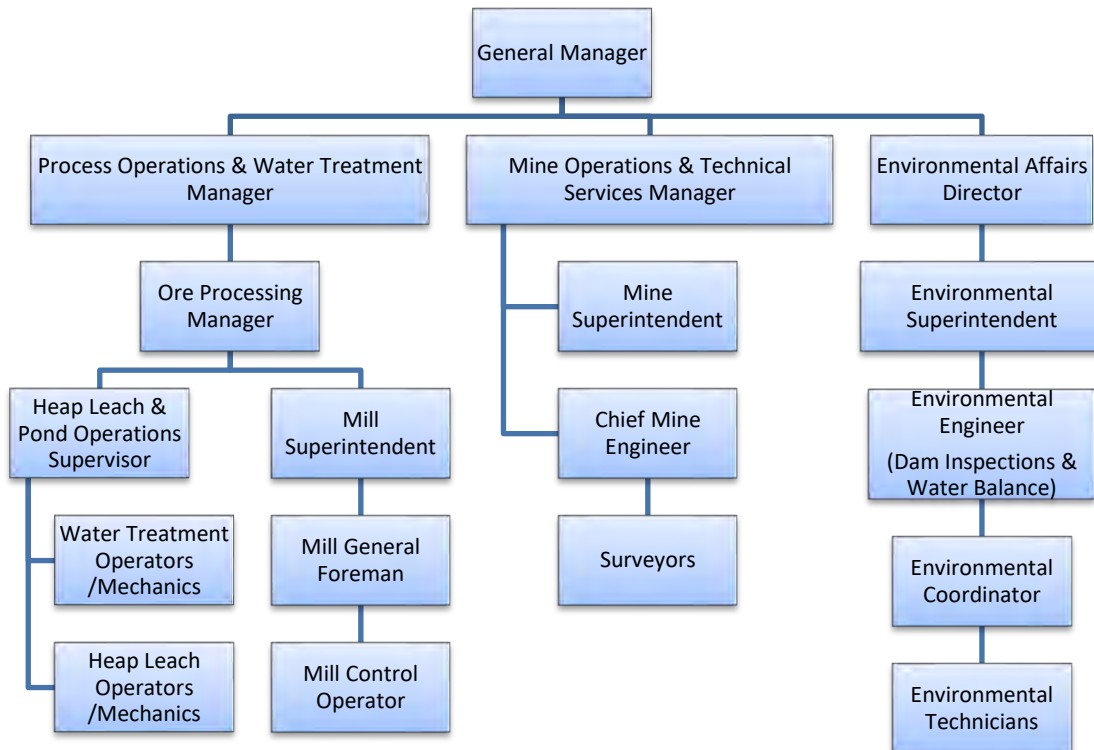
#### 1.4 Operator Training Program

An ongoing operator-training program and refresher is held annually at a minimum. The program intent is to provide the employees who are responsible for the implementation of the O&M procedures with the guidance required to perform their respective duties. New employees are trained prior to them starting any duties.

#### 1.5 Assignment of Responsibilities and Procedures

A partial organization chart outlining relationships between personnel who are involved with operation of the TSF is shown below in Figure 1-2. General responsibilities for positions are in Table 1-1 below

**Figure 1-2 – FGMI Organizational Chart**



**Table 1-1 – TSF O&M Responsibilities**

TITLE	RESPONSIBILITY
General Manager	Overall Responsibility for Project
Environmental Affairs Director Environmental Superintendent Engineers Technicians	Environmental Compliance and Permitting TSF Water Balance Modeling & Inspection Read/Record Monitoring Data & Inspection
Process Operations & W.T. Manager Operators/Mechanics Mill Control Operator	Water Inventory & Tailings Op Routine Maintenance & Inspections Real Time Operations/Alerts
Mine Operations & T.S. Manager Surveyors	Tailings Production Planning Collect Monitoring/Stability Data
FGMI and Consultants as Needed	Data Reduction/Interpretation & Inspections

Water Treatment and/or Heap Leach Operators/Mechanics are responsible for conducting daily inspections as well as general monitoring of the TSF.

The Environmental Department Technicians are responsible for collecting and filing monitoring data.

The Environmental Department Engineers will review the operator's daily inspection logs on a weekly basis.

Additionally, the environmental department will ensure that collected data and operator logs are electronically filed and maintained. Agency requests for data will be met and provided for in the fashion requested.

Emergency event detection, evaluation and mitigation are described in Section 4.

Any variances from the design basis such as higher than design water levels, signs of instability, cyanide in monitoring locations, or other items with the potential to adversely affect facility performance shall be reported daily to the Process Operations/W.T. Manger, Mine Operations/T.S. Manager, and Environmental Manager so corrective actions can be taken. Process Operations/W.T. Manger, Mine Operations/T.S. Manager, and/or Environmental Manager shall advise the General Manager of any deviations and corrective actions.

Any event that has the potential to affect overall safety, integrity, could lead to the release of solutions, or present a threat to the health and/or safety of workers and/or persons offsite shall be reported to: the General Manager and/or Environmental Manager or acting site manager. The informed manger shall initiate notifications and corrective actions. Additionally the informed manager will initiate the emergency response plan, as appropriate.

## Section 2.0 - Description

### 2.1 General

Major components of the TSF include the tailings storage embankment, tailing discharge lines, barge and pipeline, seepage collection pump and pipeline, pearl creek causeway, Phase 1 Causeway (P1C), Fish Creek East Waste Rock Dump (FCEWRD), North Basin Buttress, interceptor wells and monitoring wells. The following sections provide descriptions of these components to help understand the necessary operation and maintenance requirements.

### 2.2 Design Criteria

The below Table 2-1 shows the general TSF design criteria developed by Knight Piésold (KP) in accordance with State of Alaska Statutes and Kinross Tailings Management Standard 10.07.

**Table 2-1 – General Design Criteria**

Tailings	
Permitted average daily tailing production rate	50,000 tons
Average daily tailing productions rate	39,500 tons
Average In-situ tailing dry density	85.9 lbs/ft <sup>3</sup>
Solid content at discharge	40%
Total storage capacity	308.45 Mtons
Water Storage Volumes	
Maximum operating pond volume	Variable – must not encroach into reserved space for precipitation events
Required Storage Capacity Greater of either criteria:	<p>A: 100 yr/24 hr storm event <u>and</u> 3 feet of freeboard            Maximum 100 yr/24 hr = 944 ac-ft            3' Freeboard = 1,850 ac-ft  <b>Total Required = 2,794 ac-ft</b></p> <p>B: Probable Maximum Flood <u>and</u> 1 foot of freeboard            Maximum PMP = 3,632 ac-ft            1' Freeboard = 590 ac-ft  <b>Total Required = 4,222 ac-ft</b></p>
Required Storage Capacity for Walter Creek Heap Leach in-heap pond	See Table 2-2 Below For Storm Volume By Month 331 ac-ft ; space required in addition to above events
Earthquakes – peak horizontal acceleration	
Operational Basis Event M=6.5	0.27g (expected to occur every 1,000 years)
Maximum Credible Event M=7.5	0.63g (expected to occur every 10,000 years)
General	
Permitted raise elevation and top of seal zone	1,560 fmsl
Alaska Dam Safety Hazard Classification (designed to a Class I)	Class II

Table 2-2 – Design Precipitation Event Volumes

Parameter	Jan	Feb	Mar	Apr <sup>(5)</sup>	May	Jun	Jul	Aug	Sep <sup>(7)</sup>	Oct	Nov	Dec
	Rain-on-Snow (CN = 100) <sup>(4)</sup>				Rain (CN = 85 for 100-yr [ARCI], CN = 93 for PMP [ARCI]) <sup>(6)</sup>					Rain-on-Snow (CN = 100) <sup>(4)</sup>		
100-yr/24-hr Rainfall (in)	1.5	0.9	0.8	1.2	1.6	3.8	3.4	2.7	2.3	1.1	1.5	1.0
10-yr Snow Accumulation (SWE in)	5.8	6.2	6.3	0.0	0.0	0.0	0.0	0.0	1.6	2.2	4.1	4.6
10-yr Warm Temperature (°F)	49.9	37.2	37.6	54.8	69.2	73.9	74.0	72.2	61.5	54.9	39.9	38.1
100-yr/24-hr Snowmelt (SWE in)	1.2	0.4	0.5	0.0	0.0	0.0	0.0	0.0	1.6	1.4	0.6	0.4
100-yr/24-hr Runoff (in)	2.7	1.2	1.2	1.2	0.5	2.3	2.0	1.3	2.5	2.5	2.1	1.4
100-yr/24-hr Runoff Volume (ac-ft)	944	439	431	410	187	813	694	471	863	885	751	488
PMP/24-hr Rainfall (in)	5.1	3.2	3.3	5.5	6.4	11.2	11.2	10.5	8.8	4.7	6.6	4.3
10-yr Snow Accumulation (SWE in)	5.8	6.2	6.3	0.0	0.0	0.0	0.0	0.0	1.6	2.2	4.1	4.6
10-yr Warm Temperature (°F)	49.9	37.2	37.6	54.8	69.2	73.9	74.0	72.2	61.5	54.9	39.9	38.1
PMP/24-hr Snowmelt (SWE in)	1.6	0.5	0.6	0.0	0.0	0.0	0.0	0.0	1.6	2.0	0.9	0.5
PMP/24-hr Runoff (in)	6.7	3.7	3.8	5.5	5.6	10.3	10.3	9.7	9.6	6.7	7.6	4.8
PMP/24-hr Runoff Volume (ac-ft)	2,367	1,308	1,346	1,931	1,965	3,632	3,632	3,417	3,384	2,342	2,657	1,690

## Notes:

- 1) Based on disturbed areas received from FGMI in April 2015 and undisturbed areas estimated by Knight Piésold in June 2015.
- 2) Assumed frozen ground curve number (CN).
- 3) Antecedent Runoff Condition.
- 4) It was assumed that frozen ground conditions are present from October through April. Rain-on-snow runoff values include 100% runoff from rain and snowmelt.
- 5) April has insignificant snow accumulation values and thus, its runoff values include 100% rain only.
- 6) It was assumed that unfrozen ground conditions are present from May through September. Rain runoff values take into account infiltration losses, per the stated CNs.
- 7) September has snow accumulation values and thus, its runoff values include rain and snowmelt and take into account infiltration losses, per the stated CNs.

### 2.3 Embankment

The TSF dam is a zoned, earthfill, and rockfill embankment founded on competent fractured schist bedrock with some areas of weathered granite bedrock high on the south abutment. It contains a low permeability sloping seal zone behind the upstream face that is protected by upstream and downstream filter zones. Below elevation 1,488 fmsl, a transition zone separates the downstream filter from the downstream random fill shell; which provides structural support to the embankment. Above elevation 1,466 fmsl, a random fill Shell provides upstream support and erosion protection from tailing deposition off the embankment.

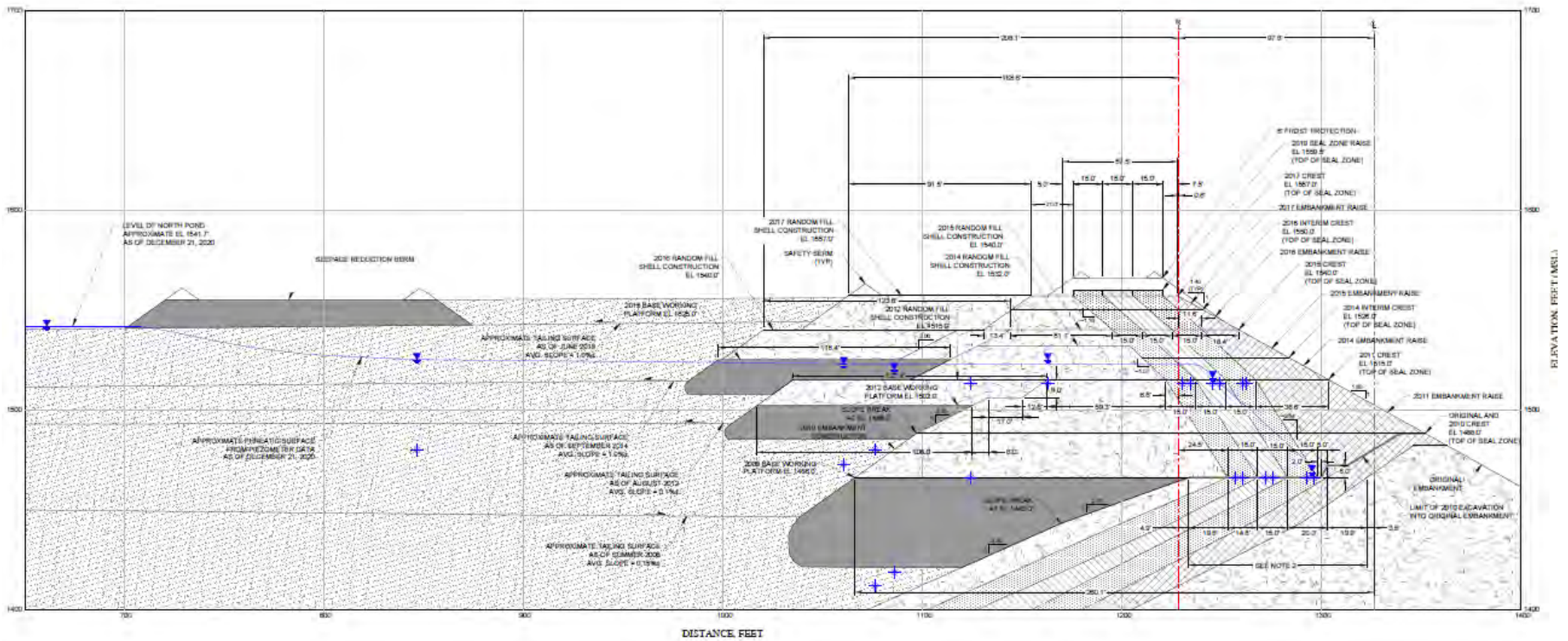
The embankment contains a relatively impervious seal zone constructed of highly weathered schist. Sand filter zones are located upstream and downstream of the seal zone, followed by a downstream transition zone constructed of weathered schist. Upstream and downstream random rock fill zones complete the embankment cross section seen in the following Figure 2-1 through Figure 2-4. The random fill comprising this is coarse enough to function as riprap for wave erosion protection. Borrow materials came from the reservoir basin and the surrounding area.

Additional features constructed with the embankment include a gravel drain incorporated into the downstream toe, a geosynthetic clay liner downstream from that drain, and seepage reclaim sump and pump system to return seepage to the tailing pond.

Dam construction initially started with a starter dam where the first seal zone was at elevation 1,323 feet. The subsequent staged raises for the original downstream constructed dam followed the timeline below.

- 1997: raised seal zone to 1,341 fmsl
- 1998: raised seal zone to 1,389 fmsl
- 2001: raised seal zone to 1,407 fmsl
- 2002: raised seal zone to 1,428 fmsl
- 2004: raised seal zone to 1,453 fmsl
- 2006: Original dam design construction completed - seal zone at 1,488 fmsl
- 2008/2009: A Base Working Platform (BWP) was constructed on tailing to elevation 1,466 fmsl
- 2010: Excavated part of the original dam to elevation 1,466 fmsl and reconstructed the zones in a modified centerline orientation back up to a seal zone elevation at 1,488 fmsl.
- 2011: Raised seal zone to 1,515 fmsl
- 2012: Second BWP constructed on tailing to elevation 1,502 fmsl. Random fill placed and compacted over the BWP to elevation 1,515 fmsl.
- 2014: Raised seal zone to 1,526 fmsl
- 2015: Third BWP constructed to 1525 fmsl and seal zone raised to 1540.
- 2016: Raised seal zone to 1,550 fmsl.
- 2017: Construction of the TSF to 1,557 fmsl with a 3' high overbuild at the maximum section of the embankment to camber the crest and 6 feet of frost protection for a top of frost protection crest elevation of 1,566' fmsl at the maximum section.
- 2019: Construction of the TSF North and South abutments extended the seal and filter zones to 1560 fmsl. The center third of the TSF engineered zones settled to elevation 1559.5 of which is the basis of calculating freeboard. This raise is designed for water storage only.
- 2021: The TSF engineered zones will be raised to elevation 1560 fmsl to resolve the elevation discrepancies identified in the On-Site Geodetic Control final project report dated September 2020. No camber is planned.
- 2025: The TSF dam was raised to 1565 fmsl to increase storage in TSF.

Figure 2-1- Embankment Section Detail



Description of Tailings Facility

Figure 2-2 - North Abutment

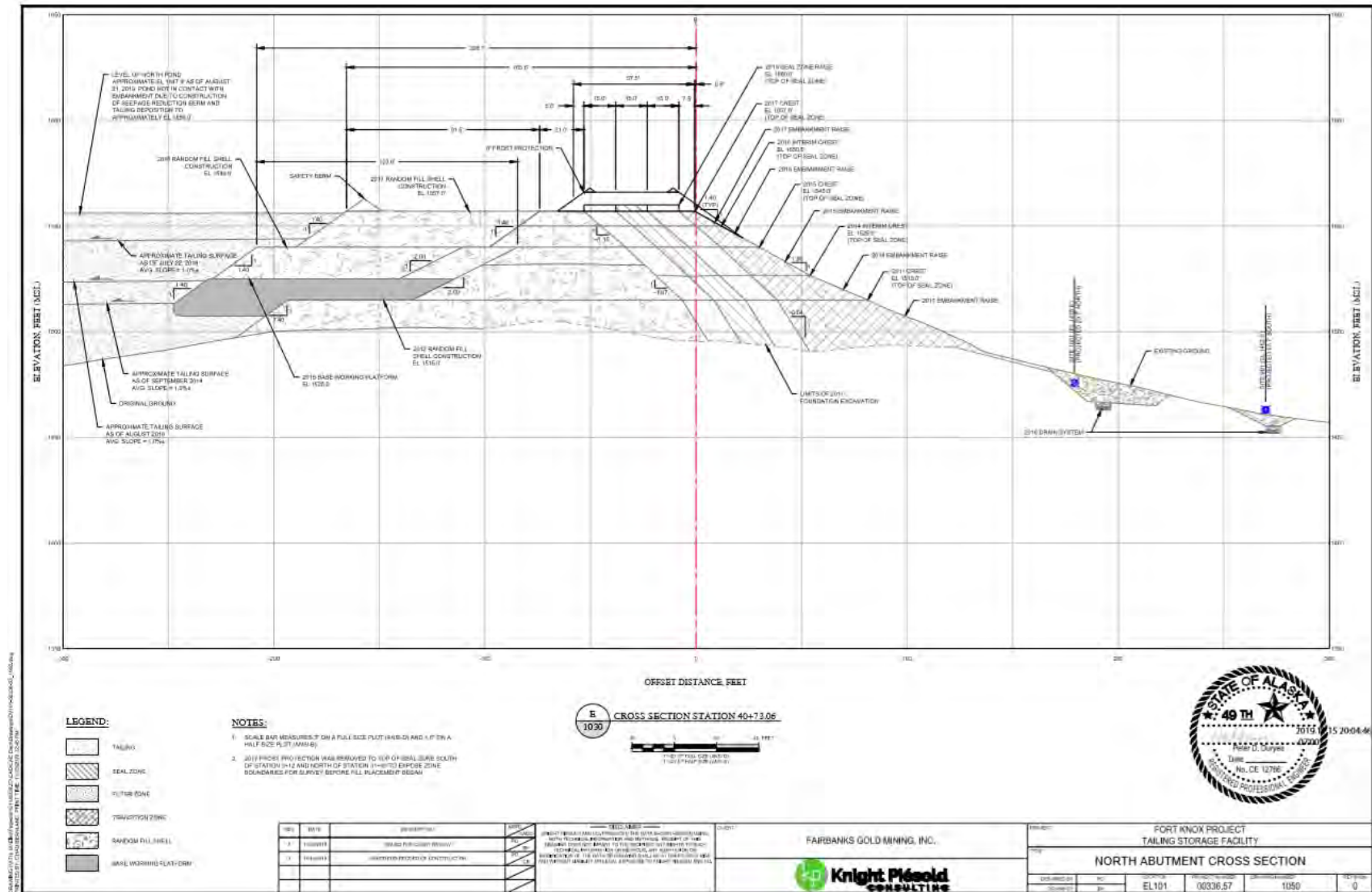
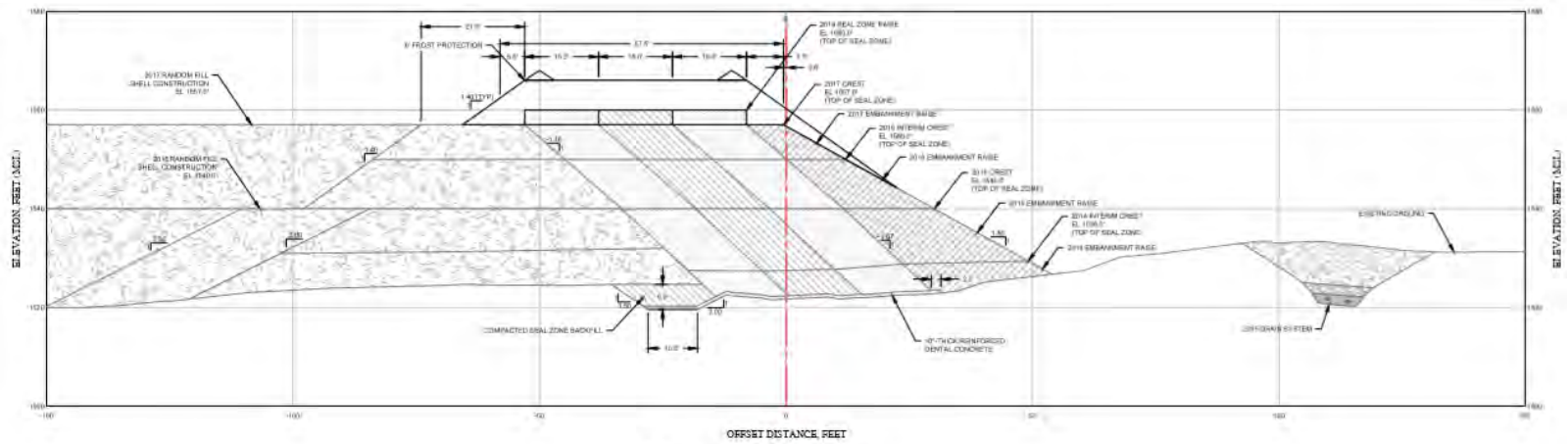


Figure 2-3 - South Abutment



D  
1000 CROSS SECTION STATION 2+00.00  
TYPICAL SLOPING CUTOFF TRENCH

- LEGEND:**
- SEAL ZONE
  - FILTER ZONE
  - TRANSITION ZONE
  - RANDOM FILL SHELL

- NOTES:**
1. SCALE BAR MEASURES 1" ON A FULL SIZE PLOT (AND 1/2" ON A HALF SIZE PLOT) (HORIZONTAL).
  2. 2017 FROST PROTECTION WAS OBSERVED TO TOP OF OVERBERM SOUTH OF STATION 3+12 AND NORTH OF STATION 2+18 TO EXPOSE ZONE BOUNDARIES FOR SURVEY BEFORE FILL PLACEMENT BEGAN.
  3. SLOPING CUTOFF TRENCH CONSTRUCTED 2018 WAS NOT EXTENDED ABOVE EL 107.0.



NO.	DATE	ISSUED BY	REVISION
1	10/24/2011	...	...
2	10/24/2011	...	...
3	10/24/2011	...	...
4	10/24/2011	...	...

**NOTES:**  
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FAIRBANKS GOLD MINING, INC.		FORT KNOX PROJECT TAILING STORAGE FACILITY	
		SOUTH ABUTMENT CROSS SECTION	
		DESIGNED BY: EL101	DATE: 06/30/17
		SCALE: 1" = 20'	PROJECT NO.: 00336.57
			1020
			0

Figure 2-4 - Typical Embankment Construction



## 2.4 Instrumentation

Instrumentation in and around the dam is designed and constructed to evaluate the performance of the dam. The instrumentation plan is found on Figure 2-5 and Figure 2-6. The P1C and the FCEWRD instrumentation descriptions are in later sections.

- Vibrating wire piezometers (VWPs) located on two vertical planes through the dam were installed on to planes during initial construction of the starter dam. See the following Figure 2-5 for the plane locations and instruments. Their purpose is to monitor pore pressures, gradients, and head losses across the Seal Zone and in the downstream Random Fill Zone. When construction transitioned to the modified centerline design, additional VWPs were installed in the Seal and Filter. The purpose of these instruments is likewise.
- VWPs are installed within the tailing under the BWPs. These instruments were initially used to monitor for the development of excess pore pressures under the BWPs during construction. After construction, these instruments allow for monitoring of piezometric head at the upstream face of the dam.
- Standpipe piezometers were installed into the foundation with transducers below the upper south side of the dam. Three of the wells are installed to the foundation contact at the base of the dam and three are installed just below the contact in the foundation. Their purpose is to investigate the region where a prominent discontinuity in the foundation is considered responsible for transmitting seepage to a point downstream of the dam, termed Seep 501. This seep has subsequently been intercepted by an extension of the foundation drain system.
- Piezometers were installed into boreholes at the south abutment. They are equipped with VWP. The piezometer leads are accessible of the crest of the dam.
- Piezometers were installed with transducers grouted in place in the Pearl Creek Causeway and the remaining two are open standpipe with transducers. Their purpose is to track head loss within the pearl creek causeway and hydraulic connectivity between the barge pond and the north abutment. In addition to the four piezometers, three legacy wells are being monitored to provide supplemental data.
- VWP were installed in tailings under the Seepage Reduction Berm (SRB). Their purpose is to measure head loss in the tailings between the SRB and the BWP.

Fort Knox is subscribed to Knight Piésolds' web-based data management system called FULCRUM. Historical instrumentation data has been loaded into this database and new readings are added by the environmental techs and/or the Environmental Engineer as the data is collected. During 2020, FGMI subscribed to sensemetrics, an automated data acquisition system, which is a cloud-based platform. The FCEWRD, Phase One Causeway and TSF embankment piezometers (with exception to P1 – P28) are currently on the platform. FULCRM is configured to receive data twice per day from the sensemetrics platform. As data is introduced to FULCRUM it is automatically populated and graphs are updated.

Figure 2-5 – TSF Instrumentation Plan View

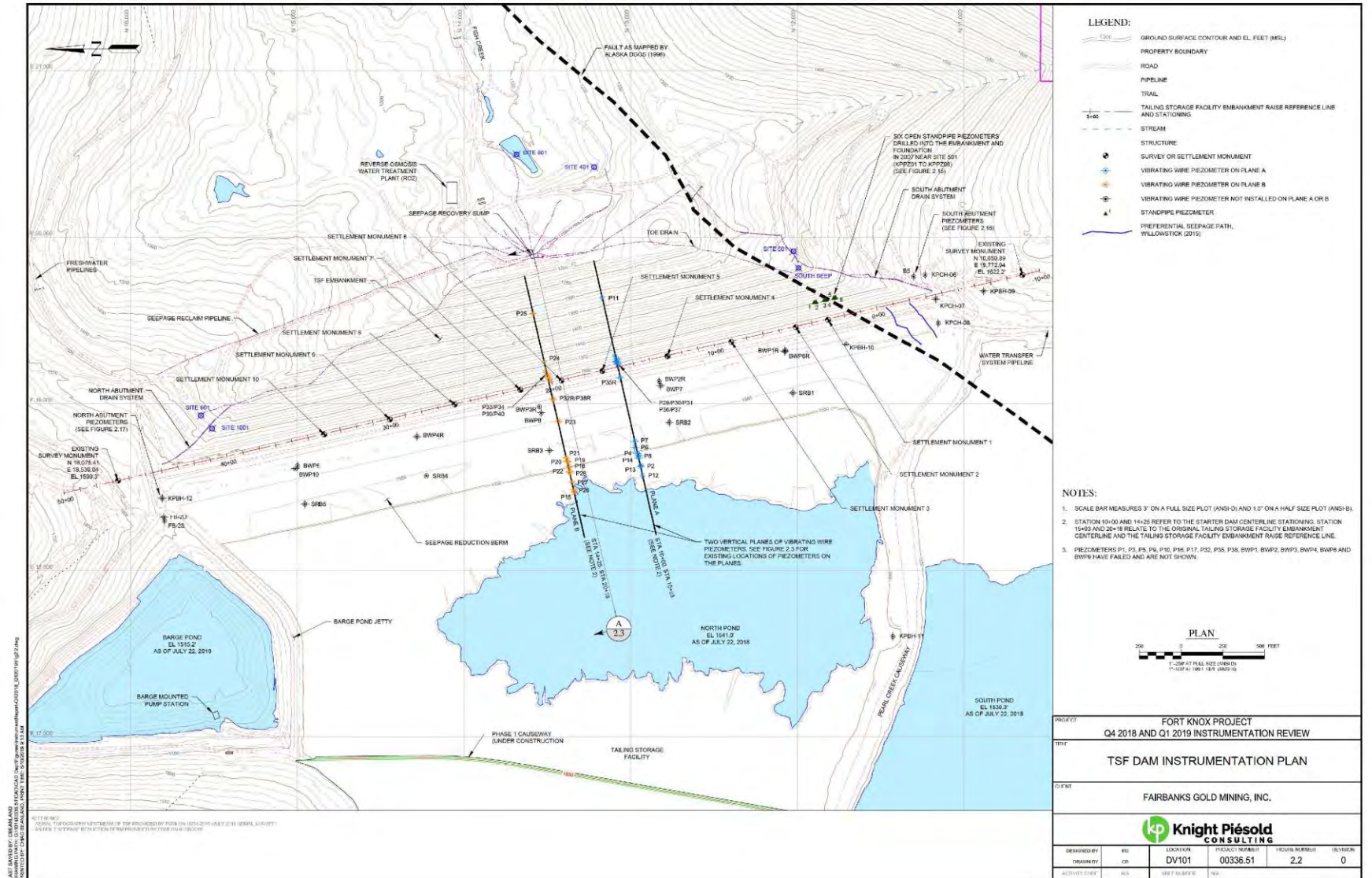
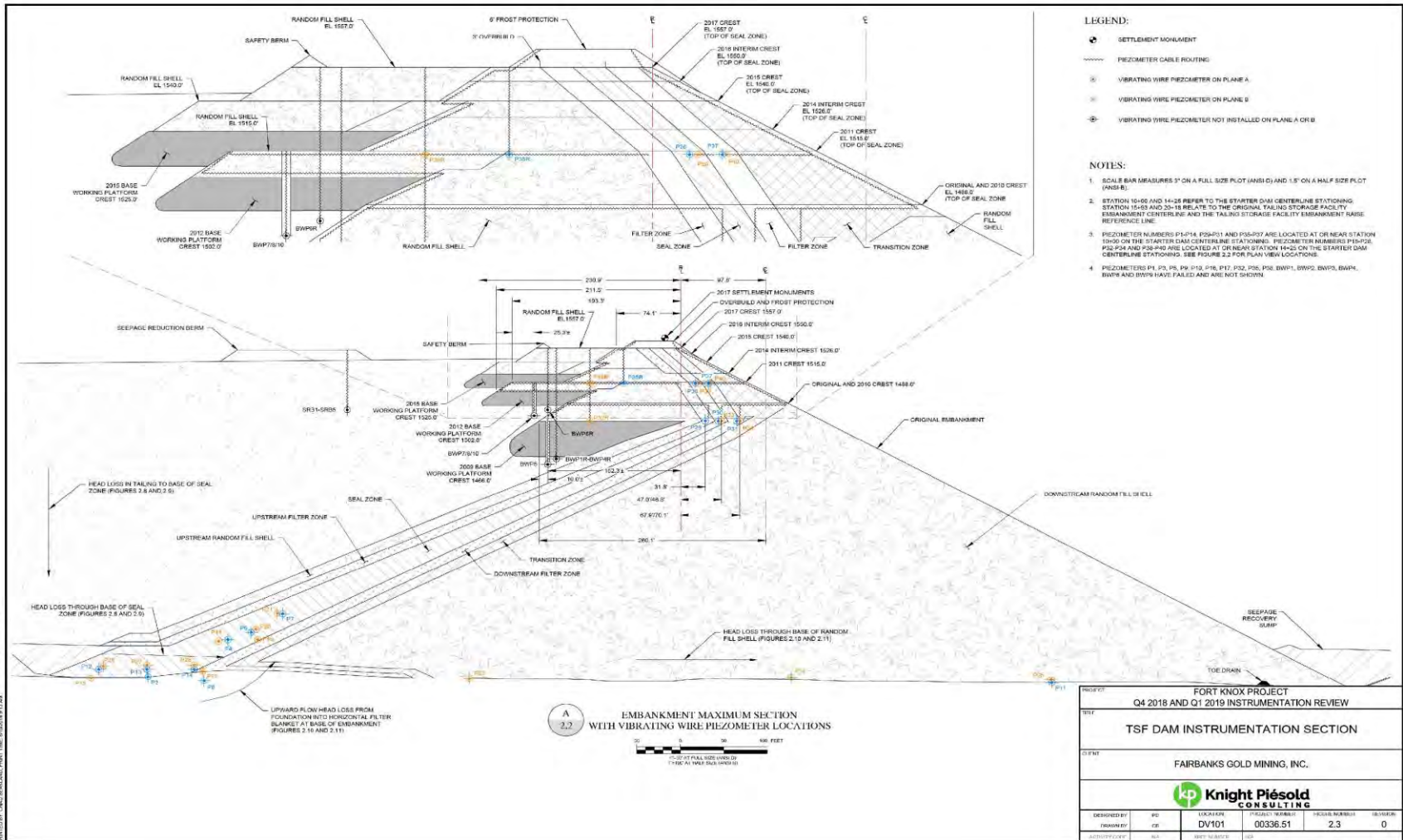


Figure 2-6 – TSF Instrumentation Cross-Section



## 2.5 Tailing Discharge Line

Three, 24-inch diameter, HDPE, tailing discharge lines, each designed to handle 50,000 tons per day of solids have been installed to carry tailing material from the mill to the impoundment. Tailing slurry from the cyanide detox building can be directed to any one of these lines, depending on maintenance requirements, season, and depositional objectives. When available the water transfer system will be utilized to keep adequate water depth at the barge.

In the event of water encroaching on the TSF freeboard FGMI has several pipelines that run along the corridor that could be used to send water from the TSF Ponds to the Pit.

The deposition of tailings to the TSF and management of the decant water changes month to month and year to year

## 2.6 Barge and Pipeline

A floating barge located in the northeast corner of the tailing pond is used to pump decant water to the mill (Figure 2-7). The barge is equipped with four 350 to 400 hp pumps with a pumping capacity of approximately 9,000 gpm. Pumping is on an as-need basis with the pumping controlled either by radio telemetry from the mill or manually by the pond operator. Additionally, the barge is equipped with a flow meter, pressure gauges, a surge anticipator. It also has deicing system that allows high-pressure water to be released through jets around the barge. The barge is a heated enclosed structure.

The decant water is pumped to the process water tank at the mill through a 24-inch HDPE pipeline. Automatic and manual drain valves allow the entire reclaim pipeline to be drained during power outages, maintenance, and barge relocations.

**Figure 2-7 Floating Barge**



## 2.7 Seepage Collection System

The original 1994 design of the toe drain and seepage sump was designed to accommodate up to 12,200 gpm of seepage. The design flow rate was based on the largest flow rate that could be expected during the start-up of the TSF. Start-up conditions were based on the initial filling of the TSF with tailings. Since no tailings were present to blanket the basin or the along the length of the upstream face of the dam a large flow rate was a result of the analysis.

During 2018 the toe drain seepage rate was evaluated for the interim closure configuration of the TSF with the embankment at crest elevation 1557.0 fmsl, and the pond separated from the embankment by the seepage reduction berm. The modelled toe drain flow is 1,493 gpm.

In 2019 the tow drain seepage rate was evaluated for an operating configuration with tailings at elevation 1556 feet, the operating pond at 1557 and the crest of the dam at elevation 1566 (to account for the frost protection). If these conditions were to exist, the analysis results predict the toe drain flow to be 2,137 gpm.

The main TSF embankment has 12-inch diameter, perforated HDPE drain pipes set horizontally in gravel along its toe to collect seepage and divert it to a collection sump. Additionally, water collected from the interceptor wells and the monitoring wells equipped with pumps, is pumped to the collection sump. Water collected in the sump is pumped back to the tailing impoundment. The seepage collection sump is located at the base of the tailings dam and consists of two 63-inch diameter by 50-feet long, perforated HDPE pipes set vertically. A vertical turbine pump is installed to return seepage back to the tailing pond from the sump. The pump is turned on and off by a water level controller. The seepage reclaim building (Figure 2-8) houses the electrical and mechanical components for the seepage collection system.

**Figure 2-8 - Seepage Reclaim Building**



## 2.8 Interceptor and Monitoring Wells

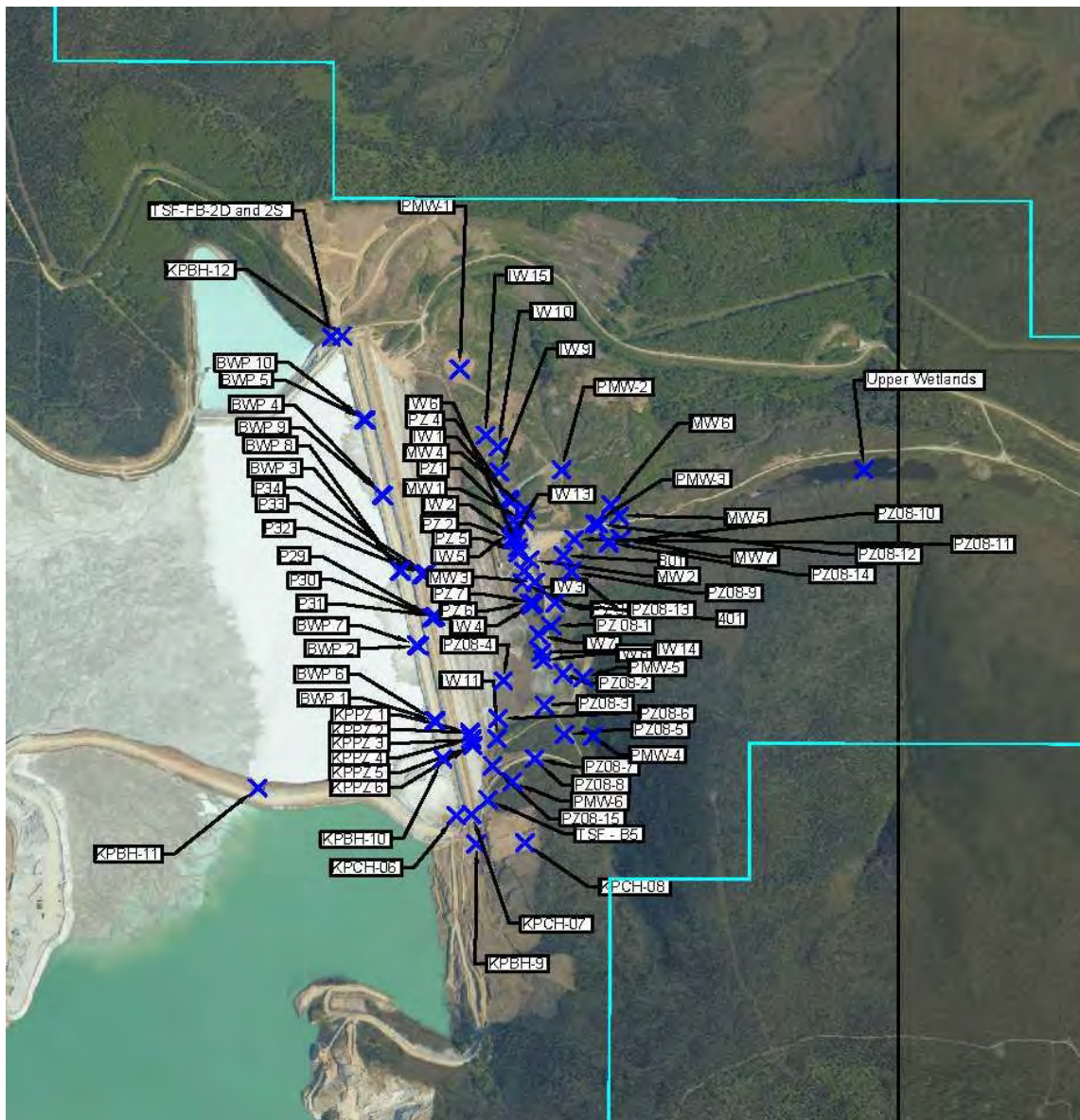
A series of wells that function as either monitoring, interception or compliance are located across the Fish Creek valley downstream from the TSF. The wells are constructed with blank and slotted casing ranging between 6 and 14 inches in diameter, the depth ranges between 120 and 480 feet.

Submersible pumps up to 30 hp are installed in the interceptor wells. The water from these wells flow and discharge into seepage collection sump. Adjustment of the valves control the ground water table drawdown to the recommended target depth to achieve containment.

Smaller submersible pumps, used for ground water sampling, are installed in the monitoring wells. Figure 2-9 includes the locations of the interceptor wells and instrumentation associated with the monitoring of the system.

An optimization study conducted in June 2016 evaluated the seepage containment efficiency. This resulted in updates to the water elevation and pumping rate for the individual interceptor wells. They are indicated on the weekly well pump log in Appendix D.

Figure 2-9 - TSF Interceptor System



## 2.9 Barge Pond Jetty

The Barge Pond jetty structure, shown in Figure 2-10, is intended to isolate the barge from areas of active tailing deposition and provide a pool of water that is deep enough to accommodate the barge mounted pumps. Decant water will enter the barge pond through the open graded mine waste rock comprising the jetty or it will be pumped to the barge pond from the south pond via the water transfer system. Should flows through the jetty not provide the 8,500 gpm of reclaim water required, a channel could be excavated at its northwest end at a point furthest from the tailing deposition points along the crest of the raised embankment. The flow path through the structure is proven to be long enough to allow adequate clarification of the decant water prior to its return to the mill.

**Figure 2-10 - Barge Pond Jetty**



## 2.10 Pearl Creek Causeway

The Pearl Creek Causeway (PCC) is a continuous bottom to top vertical rockfill structure. The PCC provides a hydraulic connection between the north and south decant ponds of the Fort Knox Tailings Storage Facility (TSF).

The PCC hydraulically connects the upstream face of the TSF dam when the pond(s) are in contact with the causeway even if the north pond is not in contact with the TSF embankment itself.

The hydraulic connection between the decant ponds and the TSF dam provide by the PCC is not a safety concern since the TSF is designed to withstand full hydraulic loading up to the crest of the embankment.

It is considered good practice to isolate the decant pond(s) from the front face of the dam and the causeway to reduce the head on the dam. This practice reduces the hydraulic gradient through the dam core thereby reducing the seepage flow rate through the TSF dam embankment.

The current tailing deposition plan prioritizes the development of beaches in these key areas to facilitate separation of the decant ponds from the TSF dam embankment.

A lower permeability rockfill has been placed along both sides of the causeway to increase the head loss upstream of the embankment when the pond(s) are in contact of the causeway.

FGMI rerouted the causeway in 2016 (Figure 2-11) such that it terminates against natural ground at the south abutment rather than the upstream face of the dam. This will have some effect by further increasing the head loss between the decant ponds and the upstream face of the embankment.

During 2018, the PCC was raised to 1555 in various locations, which is four and a half feet below the engineered zones.

In June 2024, the PCC nominal crest and overflow section elevations were raised at elevations 1559.0 fmsl and 1557.0 fmsl, respectively.

In August 2024, an additional lift raised the (PCC to a nominal crest elevation of 1563.0 fmsl, with the overflow section at 1561.0 fmsl.

This increase made the PCC higher than the existing 1560 fmsl TSF dam embankment. The PCC was reclassified by the State of Alaska as a jurisdictional dam under designation AK00311. The PCC's status as a jurisdictional dam is expected to be temporary until the main TSF raise can be completed.

Any deviations from normal operating conditions will result in immediate evaluation and corrective action to ensure stability and safety.

The PCC is designed to handle a 24-hour probable maximum precipitation (PMP) storm with 1 foot of freeboard, the section includes safety berms made of erodible material with periodic breaks.

In extreme events, these berms will erode, allowing stormwater runoff from the South TSF basin to flow into the North TSF basin, from where it will either pass through the barge pond jetty or be pumped back to the mill.

Design features include a constructed 2-foot-deep, 350-foot-wide overflow section aligned with the low point of tailings deposition in the South decant pond. The overflow section is constructed at the center of the PCC to prevent overtopping of the 1563.0 fmsl crest during extreme storm events.

The trigger point for inspecting the Pearl Creek Causeway occurs when water levels approach the overflow section elevation of 1561.0 fmsl or when unusual seepage or head loss is detected.

Increased inspections will be required if significant structural changes, such as settlement or erosion, are observed during daily routine monitoring (Appendix C: Inspection Form – Pond Route Sheet).

Earthquakes affecting the Fort Knox dams are categorized as insignificant, minor, or major. Inspections must be conducted by FGMI environmental personnel and designated operators after any seismic event with a Peak Ground Horizontal Acceleration (PGHA) exceeding 0.05g in accordance with Figure 4.1 and Table 4.2.

Figure 2-11 - Pearl Creek Causeway 2024 lift



### 2.11 Phase 1 Causeway

The Phase 1 Causeway (P1C) is a rockfill embankment structure was constructed from north to south over the north tailings basin (Figure 2-12). The P1C is approximately 40 feet high in two lifts. The first lift is constructed to elevation 1557 fmsl with an overall width of 1730 feet. The second lift is at elevation 1582 fmsl and a width of 1093 feet. It extends in an arc from the natural ridge on the north side of the TSF just west of the barge-mounted pump station to the natural ridge at the west end of the Pearl Creek causeway that is partially covered by the Yellow Pup waste rock dump (YPWRD). Construction of the P1C was completed using mine waste rock, including both general and coarse rockfill.

There were seventy-four piezometers installed to monitor the P1C. Currently there are thirty-six functional piezometers. The piezometers are installed in depth-based zones A-D

(Figure 2-13) and there are 28 settlement monuments (Figure 2-14).

During operations, tailing will be deposited from points remote from, and opposite to, the causeway such that a low point on the tailing deposit will develop against the upstream face of the P1C. Direct precipitation run-off and decant water will report to this face. By design the water will transport through the P1C via a coarse rockfill upstream face drain that extends over the entire upstream crest and the four coarse rockfill drain outlet fingers that extends from the face drain through the width of the P1C. Decant water will daylight on the downstream side.

**Figure 2-12 - Phase 1 Causeway**

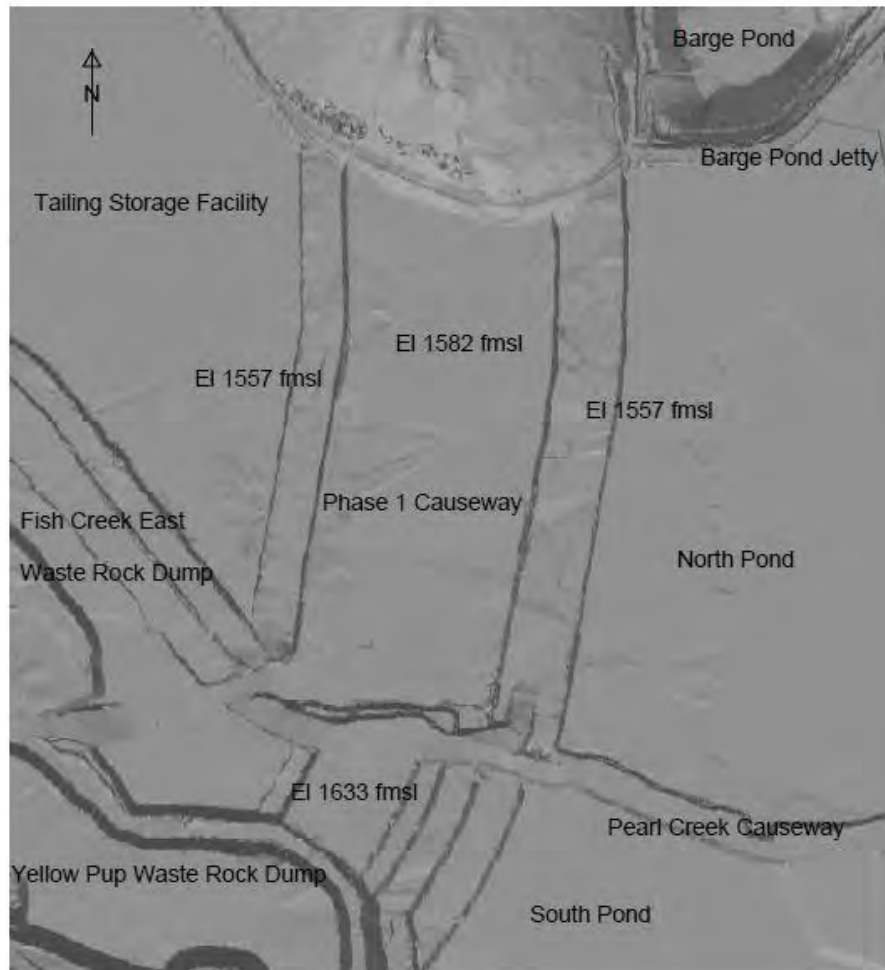


Figure 2-13 –P1C Piezometer Locations

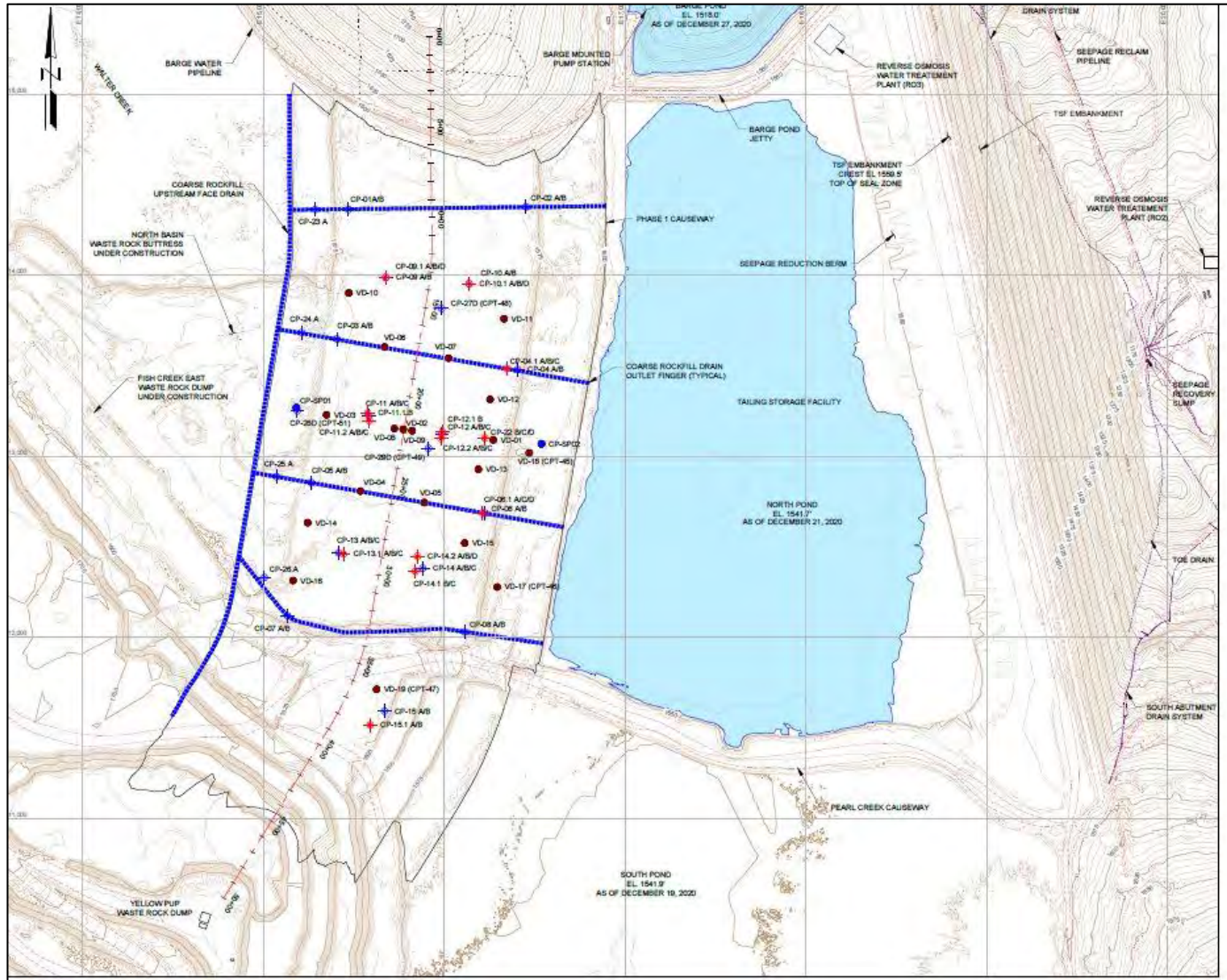
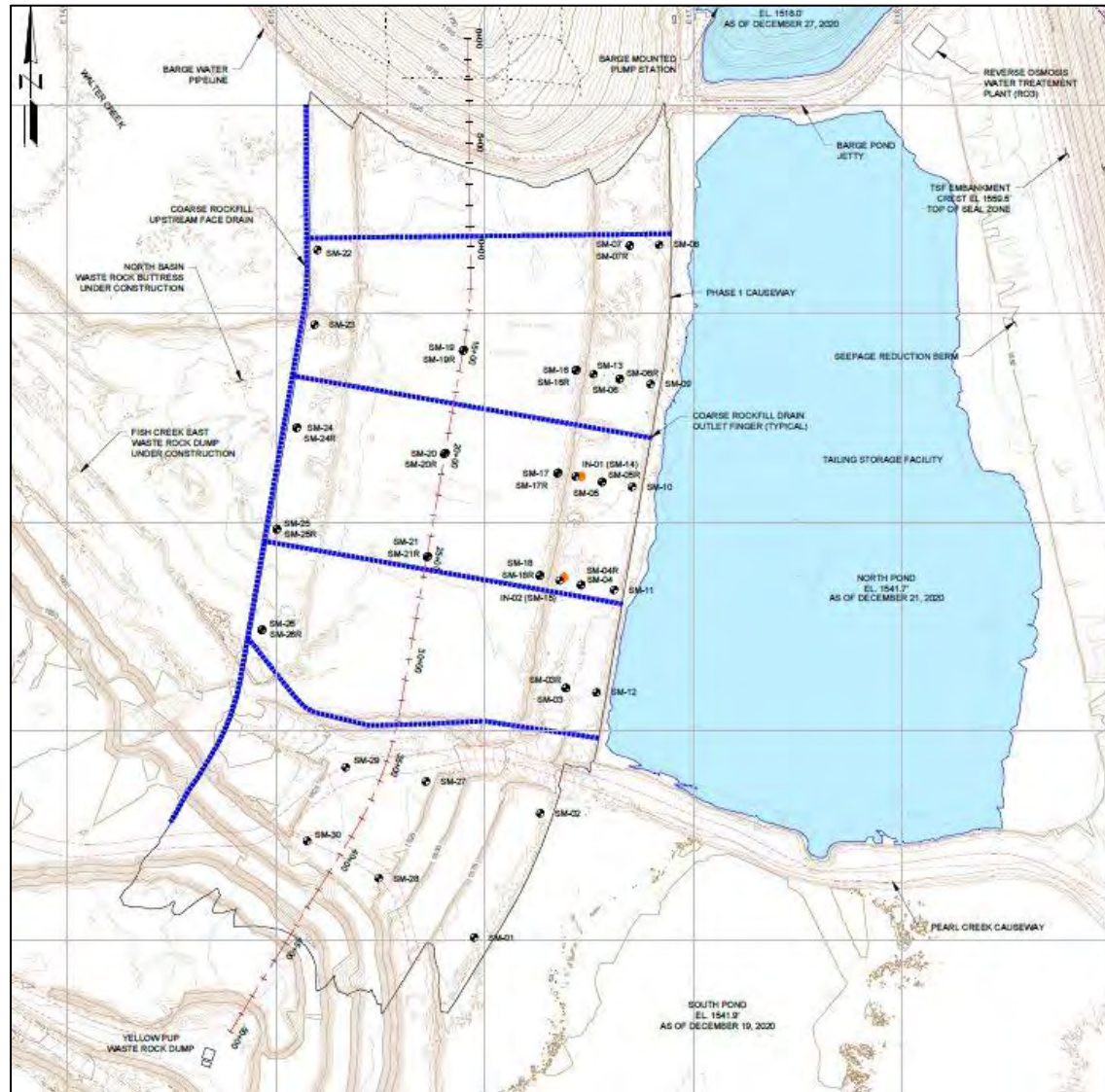


Figure 2-14 – P1C Settlement Monuments



## 2.12 Fish Creek East Waste Rock Dump

The Fish Creek Waste Rock Dump is built over native ground and expanded over tails. To maintain safety while construction advances over tails a series of VWP have been installed to evaluate the factors of safety and evaluate the performance of the dump, similar to the P1C.

There are fifteen boreholes with Thirty-four operational piezometers. Prior to constructing to the 1,900 elevation there are a total of Six piezometer that have been installed see Figure 2-15

There are six operational settlement monuments installed. Eleven additional monuments will be installed at various elevations during the construction to elevation 1,900 fmsl (Figure 2-16)

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Description of Tailings Facility

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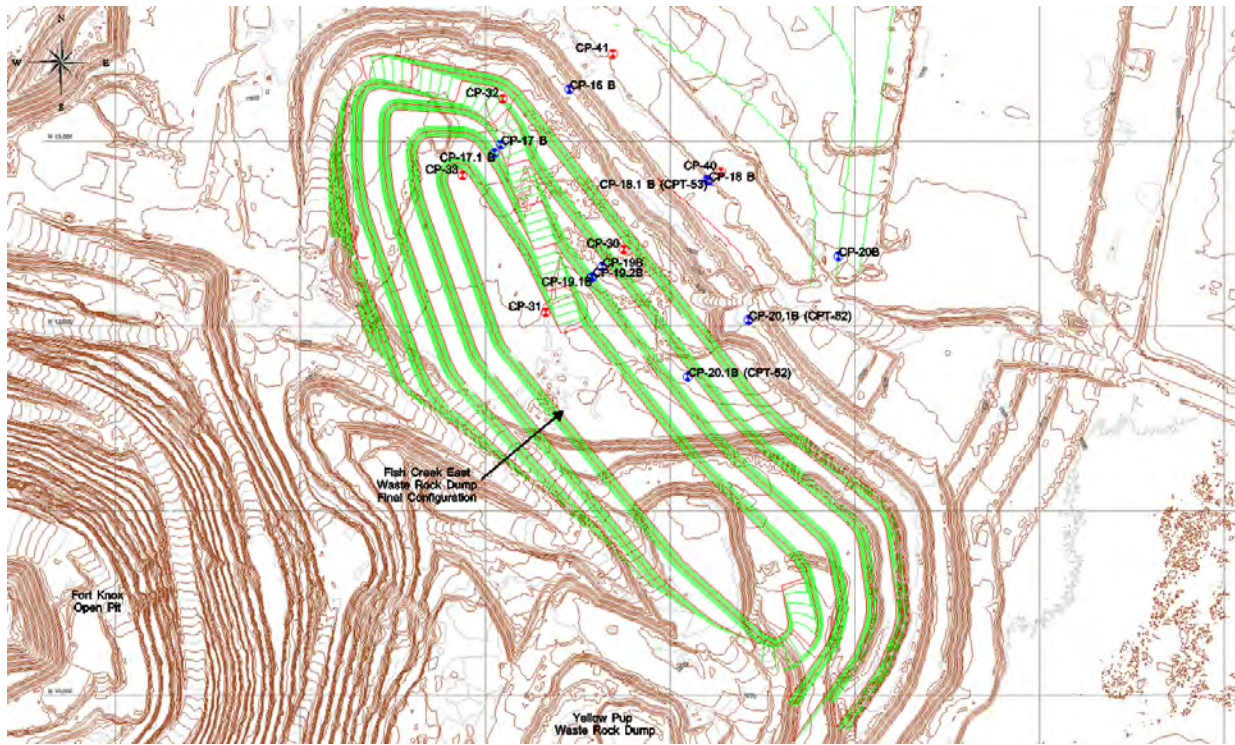
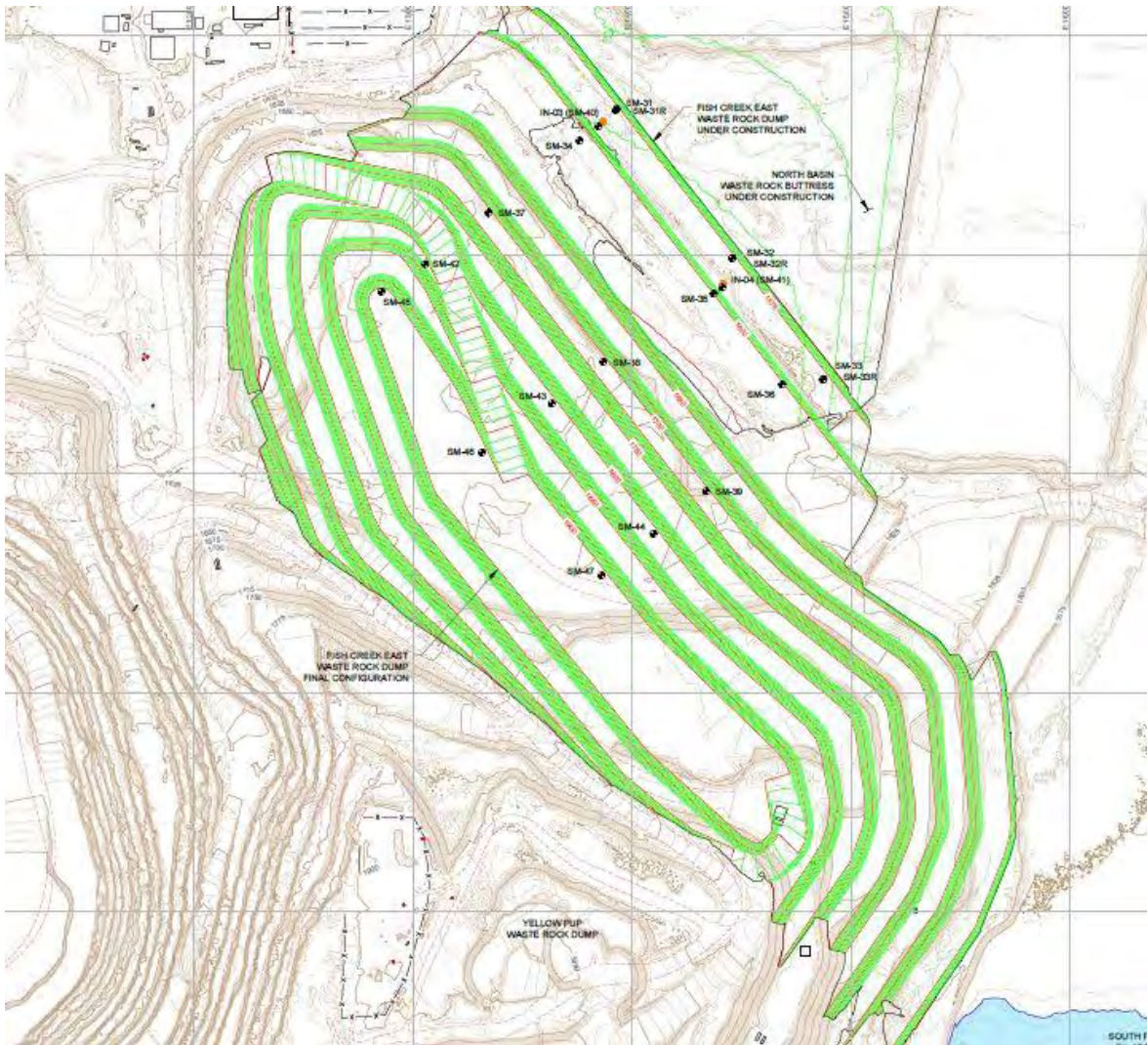


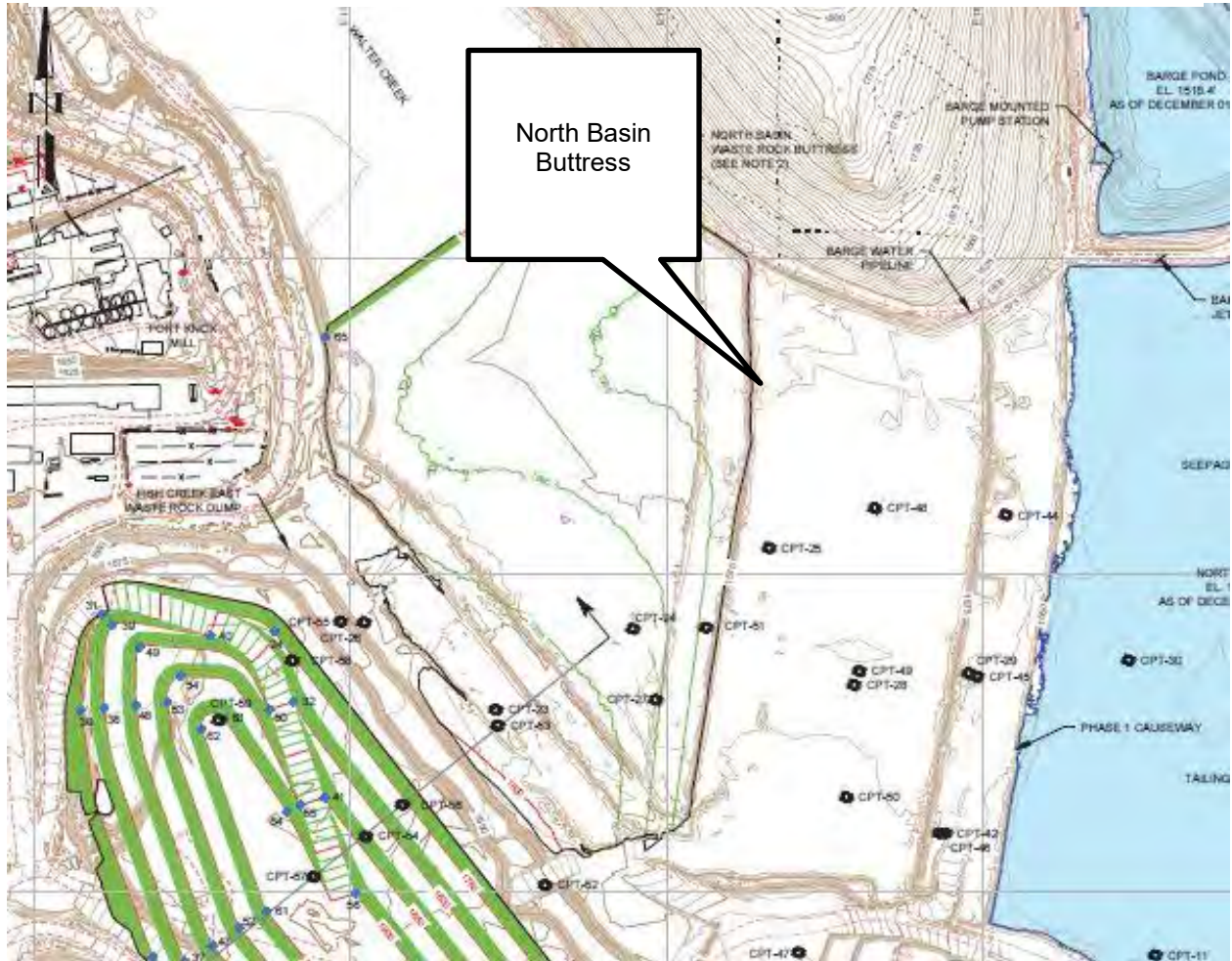
Figure 2-16 Fish Creek Settling Monument Layout



### 2.13 North Basin Buttress

The North basin buttress is constructed within the northwest tailing basin in the area between the FCEWRD and the P1C as shown on Figure 2-17. The purpose is to buttress the FCEWRD which increases the FoS.

Figure 2-17 North Basin Buttress



## Section 3.0 - OPERATION AND MAINTENANCE PROCEDURES

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### 3.1 General

The O&M program includes a description of the parameters by which the TSF is to be operated and a monitoring program to confirm that the decant pond, embankment, and related systems are performing in accordance with the design. The monitoring program will include both informal routine inspections by operations personnel and formal inspection monitoring for the ultimate operation of the TSF.

As discussed in Section 2.0, major components of the TSF consist of the tailings storage embankment, tailing discharge lines, barge and pipeline, pearl creek causeway, seepage collection pump and pipeline, interceptor wells and monitoring wells. This section outlines the operation and maintenance procedures and corresponding monitoring requirements for each of these components.

### 3.2 Embankment

#### 3.2.1 Operation and Maintenance - Embankment

An important aspect of protecting the embankment is maintaining an appropriate freeboard. A stage-storage curve has been developed showing maximum freeboard limits and the volume of containment relative to the elevation up to the top of the seal zone. (Appendix F). A maximum water surface elevation and freeboard requirements, related to the storage capacity, were developed for the dam and is incorporated into the water balance. The water balance is calculated and evaluated quarterly to (1) confirm the minimum required volume for the extreme event containment with adequate freeboard is available above the tailings and average operations pond levels; (2) model what-if scenarios based on future operational changes. The FGMI Environmental Engineer is responsible for coordination with KP that the correct inputs are used. Design criteria and climatic parameters inputs for the TSF water balance model are listed below:

- Current seal zone elevation input is 1560 fmsl
- Freeboard allowance of 3 feet above the water elevation associated with the combined average operations pond volume from the water balance, maximum volume of pregnant solution in the WCHLF in-heap pond (323 ac-ft), and the 100-year/24-hour storm water volume (960 ac-ft)
- Freeboard allowance of 1 foot above the water elevation associated with the combined average operations pond volume from the water balance, maximum volume of pregnant solution in the WCHLF in-heap pond (323 ac-ft), and the PMF (2,926 ac-ft)
- Precipitation both rain and snow
- Temperature
- Snow accumulations
- Evaporation
- Runoff
- Infiltration
- Ice
- Current mine plan

In addition to the water balance, the FGMI Environmental Engineer is also responsible for:

- Tracking and reporting total precipitation, surface water elevations for the north, south and barge pond twice per month.
- Submitting a water balance forecast twice per year. The biannual submittals are due March 31 and October 31.

The stability of the TSF embankment also depends on the effectiveness of the seal zone and filter zone limiting the development of an elevated phreatic surface within the downstream random fill shell.

The original 28 piezometers installed in the dam are to be maintained as required to keep them functional; however, since they are buried deep within the embankment, the primary maintenance item is to protect the exposed wires and the readout-panel located in the seepage reclaim pump building.

### 3.2.2 Inspections and Monitoring - Embankment

Daily embankment inspections are to be completed by the Pond Operators. This includes observations for settlements, heaving, deflections, and lateral movement, increased or decreased seepage, new seepage areas, or erosion. Inspections are to be conducted along the exposed abutment contacts, upstream and downstream faces of the dam, crest, and the toe of the dam. Observations will be reported on the form “Inspection Form – Pond Route” attached in Appendix C. Copies are to be provided to the environmental department. The environmental department ensures the forms are scanned and available electronically.

Changes in the appearance or behavior of the embankment must be reported immediately to the supervisor. The supervisor is responsible to report the observations and coordinate up the chain. An investigation will be conducted to determine the frequency of inspections, instrumentation analysis and stability monument surveys.

During normal operating conditions, weekly piezometer readings are to be taken by the Environmental Technicians. Piezometer frequencies and temperature will be recorded from a digital readout box, and entered into Fulcrum. A senior Environmental Engineer will coordinate the names of the FGMI personal who can view and/or input the data.

Survey data from the survey monuments are to be collected on a monthly basis by the survey department. Data that is obtained is uploaded to FULCRUM where it is accessible to the engineers and the environmental department. The data is compared to the original location of the monuments as well as the previous months reading. The environmental department reviews the horizontal movement and the vertical settlement data as it is uploaded. The settling monuments locations are shown on Figure 3-1.

**Figure 3-1 - TSF Survey Monuments**



### 3.3 Tailings Discharge Lines

#### 3.3.1 Operation and Maintenance – Tailings Discharge Lines

Tailing discharge lines are designed to handle 50,000 tons per day of solids, they are routed from the mill to the impoundment. Tailing slurry from the cyanide detox building can be directed to any line, depending on maintenance requirements, season, and depositional objectives. The lines may be incorporated into the water transfer system when necessary to maintain freeboard and provide adequate water depth at the barge. The tailings will be managed according to the current deposition plan (Appendix G) operational requirements, and final closure topography.

At no time is a pipeline to be left with all off-takes closed. Discharge into a closed pipe could result in sanding or high pressures that could lead to pipeline failures, especially at off-takes and valves. When discharge is redirected to a different pipeline or off-take, the off-take valves in the new area of discharge must first be opened and flow established through them before the valves to the previous active area are closed. Prior to any prolonged shutdown, a pipeline will be flushed of solids to all off-takes and then allowed to drain.

#### 3.3.2 Inspections and Monitoring – Tailings Discharge Lines

The tailing discharge line is inspected daily for leaks, erosion, and settlement. Leaks are most likely to occur at saddle off-takes, valves, fabricated bends, drop boxes, and along steep downgrades. Hence, daily visual inspections focus on these areas. Pond Operators perform operations, maintenance, inspections and record activities on a daily basis unless otherwise specified.

Visual inspection of the discharge point into the tailing pond is made daily. Items checked include excessive movement or vibration of the HDPE pipe, excessive erosion, reduction or loss of flow, etc.

The tailing discharge point is noted on the “Inspection Form – Pond Route” (Appendix C). The daily shift log kept by Mill Control provides a record of the tons of tailing discharged, percent solids in the tailing discharged, and the duration of any shutdowns.

Periodic inspections of sub-aerial and sub-aqueous deposition are performed as directed to verify the desired depositional patterns are being achieved. Sub-aerial deposition is inspected visually. Additionally, the Environmental Technicians along with the surveyors conduct a bathymetric survey to measure the sub-aqueous deposition using a depth sounder. This is done a minimum twice per year and generally corresponds to the yearly aerial survey and prior to freeze up. The water balance is calibrated with the new bathymetry data and the deposition plan is checked to verify predicted vs actual calculations.

### 3.4 Barge and Pipeline

#### 3.4.1 Operation and Maintenance – Barge and Pipeline

The reclaim water system, including the barge and pipeline, are critical to operation of the mill. Since the barge is a floating vessel, any listing or change in its waterline should be reported to superiors immediately. Such changes will trigger more frequent inspections and a complete investigation to identify and rectify the cause.

Each flotation and ballast compartment on the barge has been fitted with a 2-inch diameter discharge pipe and a 1-inch diameter air inlet fitting so that water can be expelled when necessary. It is critical to limit air pressure to less than 2 psi on these compartments. (Consider that on the 8-foot by 8-foot side of each compartment every 1 psi exerts 9,216 lbs of force pushing the side outwards. This total force must be contained by the compartment bracing and the corner welds. Too much pressure will cause the compartment to bulge and possibly rupture.)

If any welding is done on a compartment, the compartment shall be pressure tested to make certain no pinholes or leaks exist. Pressure testing is conducted with an accurate pressure gauge (one that reads 0 to 5 psi) and is attached to piping on the compartment prior to applying the 2 psi air pressure. The pressure is observed for 12 to 24 hours. If no pressure drop is observed, then the compartment is sound. Otherwise, it is necessary to investigate further.

When the process water pipeline is empty, it takes almost one hour for water to reach the process water tank after the barge pumps start. Consequently, good planning and coordination with the Pond Operators is required when starting up after a prolonged shutdown.

The barge is anchored in place at each corner. Each day The Pond Operators will check and adjust the tension in the mooring cables. A walkway from the shore is connected to the barge that also carries a 24-inch, flexible pipeline and electrical cables. Each day these are checked and propped or adjusted as necessary. As the water elevation in the pond rises, the barge must be relocated. The Pond Operators will keep their supervisors advised of an upcoming need to relocate the barge, well in advance of the need for relocation. This is especially important during breakup, significant storm events and the winter months when the jetty may not be transferring enough water due to icing conditions.

Pump lubrication, alignment checks, impeller adjustments, seal replacements, etc. will be scheduled by the mill maintenance planners according to manufacturers' recommendations and operator experience Mill maintenance mechanics normally perform this service however; the Pond Operators should be mindful of items that may have been overlooked or may need more frequent attention than anticipated.

### 3.4.2 Inspections and Monitoring – Barge and Pipeline

The barge and process water pipeline are inspected daily by the Pond Operators. The Pond Operators will inspect for any unusual noises from the pumps, excessive snow loads on the barge, etc. Fire extinguishers, life preservers, and other safety equipment are inspected regularly and serviced or replaced as required Other critical items include indications or signs of leaks or excessive movement, particularly at the connection between the barge and the shore. If any adverse conditions are observed, the Pond Operator will take appropriate corrective action.

Observations and measurements such as the depth of water under the barge, pontoon condition, deicing system performance, condition of the valves, total barge pump time, instantaneous flows for each pump, and monthly totalizer flow, are recorded on the "Inspection Form – Pond Route" (Appendix C) and the "Daily Pond Operators Log" (Appendix D).

During inspection the Pond Operator will look and document any signs of corrosion, grounding problems, and general wear and tear at the barge.

## 3.5 Seepage Collection System

### 3.5.1 Operation and Maintenance – Seepage Collection System

The Mill Control Operator will control the operation of the seepage reclaim pump remotely. The automatic level controller activates a pump when the water rises within 20 feet below the floor grate; the pump deactivates when the water level drops to 35 feet below the grate. The elevation of the floor grate is 1175 fmsl During periods of automatic control, operators must verify that the pumps are starting and stopping when they should. During periods when the automatic level controller is not functioning properly, the Pond Operator must control the pump manually. To insure prompt response to water level changes, an electronic data recorder measures the depth-to-water in the sump every two seconds and immediately transmits the measurement to the Mill Data Collection System where it is monitored on a continuous basis. An associated automatic alarm alerts Mill Control when the sump rises above or below the target pumping depth.

The seepage pump arrangement has been modified to accommodate the operations of the Reverse Osmosis Plant 2 (RO 2).The pump located in the north well casing is replaced with pumps that report to RO-2 . The south pump remains installed with the capacity to pump 2,600 gpm. In the event the south pump is down and the RO2 plant is offline the brine pump valve to the TSF must be opened to accommodate the flow.

When the pumps are shutdown, the pipeline will slowly drain back into the sump. The surge anticipator should be operated regularly to be certain it is functioning properly.

Pump lubrication, alignment checks, impeller adjustments, seal replacements, etc. are scheduled by the mill maintenance planners according to manufacturers' recommendations and experience. Mill Maintenance normally perform this service however; the Pond Operators should be mindful of items that may have been overlooked or may need more frequent attention than anticipated.

### 3.5.2 Inspections and Monitoring – Seepage Collection System

The Environmental Engineer will review the electronic seepage sump depth and total seepage flow data transmitted to the Mill Data Collection System on a weekly. This system also collects and records totalizer, run hour, and instantaneous flow rate for the seepage collection sump these data are maintained on the mill server.

## 3.6 Interceptor and Monitoring Wells

### 3.6.1 Operation and Maintenance – Interceptor and Monitoring Wells

Seepage that bypasses the seepage collection sump located in the embankment foundation is collected by a series of ground water interceptor wells, one surface pond (801), one shallow ground well (401) and the 501 seep drain all are located downstream from the embankment. Routine operation of the deep interceptor wells will include observing that each of the wells is producing water and adjusting the flow rate as needed to maintain the desired drawdown in each well. The mill will coordinate cleaning of interceptor wells as needed. A Environmental Engineer will coordinate cleaning of the monitoring wells as needed.

The Pond Operators will wrap the wellheads with a heating blanket and turn on the heat trace to prevent wellhead and lines freezing during cold weather. If the well freezes, the supervisor will coordinate thawing activities.

Pond Operators will maintain pond 801 water level as to not allow it to overflow.

### 3.6.2 Inspections and Monitoring – Interceptor and Monitoring Wells

The Pond Operators will perform daily inspections of the interceptor and monitoring wells. The site survey will verify the integrity of the pipelines from all wells to the seepage collection sump.

The Pond Operators will perform a weekly inspection recording totalizer, instantaneous flow rate and water depth readings for each well included on the "Well Pump Log Sheet - Weekly form. (Appendix D). The form will be turned into the Environmental Engineer. The Environmental Engineer will ensure the forms are archived electronically in the environmental department files. This data is monitored weekly by a Environmental Engineer.

The Environmental Technicians will collect water quality samples on a quarterly basis and ensure the data is archived electronically.

## 3.7 Phase 1 Causeway

### 3.7.1 Inspections and Monitoring P1C

Monitoring of the causeway's performance will be conducted visually through field observations and analytically through review of collected instrument data. The goal is to allow for adequate data collection and inspection of the facility to alert the operation of potential problems or unexpected behavior.

FGMI will notify Knight Piésold if at any point inspections and or observations show concerning and/or unexpected behavior of the structure. KP will instruct FGMI as needed on any necessary remedial actions necessary for the safety of people and the dam. Planed deposition is complete behind the P1C.

Piezometers installed in the B-horizon are located in the shallower tailing at 1500 fmsl (approximately 40 to 45 feet below the surface of the tailing). The pore pressures reported by these piezometers are critical to the stability of the P1C. The modeled elevation of 1590 fmsl is based on substantial geotechnical data gathered over the years. The functioning "B" piezometers as of 4/15/2021 are:

- P1CW-CP-04.1B-CONF
- P1CW-CP05B
- P1CW-CP-09B
- P1CW-CP-09.1B
- P1CW-CP-10.1B
- P1CW-CP13B

- P1CW-CP-14.2B
- P1CW-CP-15.1B
- P1CW-CP-22B

The listed piezometers have alarms associated with them in sensemetrics. If any of them goes above 1590 an email is automatically generated and sent to those listed in Table 1-1.

Piezometers installed in the D-horizon are located in the intermediate tailing near elevation 1470 fmsl (approximately 70 to 75 feet below the surface of the tailing).

The pore pressures reported by these piezometers are critical to the stability of the P1C. The modeled elevation of 1596 fmsl is based on substantial geotechnical data gathered over the years. The functioning "D" piezometers as of 4/15/2021 are:

- P1CW-CP-14.2D
- P1CW-CP22D

The listed piezometers have alarms associated with them in sensemetrics. If any of them goes above 1590 an email is automatically generated and sent to those listed in Table 1-1.

Per the Certificate of Approval to Operate FY2020-12-AK00212 the P1C must be maintained at nominal crest elevation 1582 feet (site datum) and no water may be intentionally impounded. A mitigation plan will be developed if either of these conditions exist.

### 3.8 Fish Creek East Waste Rock Dump

#### 3.8.1 Inspections and Monitoring FCWRD

Monitoring of the FCEWRD performance will be conducted visually through field observations and analytically through review of collected instrument data. The goal is to allow for adequate data collection and inspection of the facility to alert the operation to any signs of potential problems or unexpected behavior.

FGMI will notify Knight Piésold if at any point inspections and or observations show concerning and/or unexpected behavior of the structure. KP will instruct FGMI as needed on any necessary remedial actions beyond those already specified in the above.

Piezometers installed in the B-horizon are located in the intermediate tailing near elevation 1510 fmsl

The pore pressures reported by these piezometers are critical to the stability of the FCEWD. The modeled elevation of 1596 fmsl is based on substantial geotechnical data gathered over the years. The functioning "B" piezometers are:

- FCEWRD-CP18B
- FCEWRD-CP-18.1B (CPT 53)

The listed piezometers have alarms associated with them in sensemetrics. If any of them goes above 1790 an email is automatically generated and sent to those listed in Table 1-1

Piezometers installed in the C-horizon are located in the deeper tailing near elevation 1465 fmsl.

The pore pressures reported by these piezometers are critical to the stability of the P1C. The modeled elevation of 1596 fmsl is based on substantial geotechnical data gathered over the years. The functioning "C" piezometers are

- FCEWRD-CP-20C
- FCEWRD-CP-20.1C (CPT52)
- FCEWRD-CP-21C

The listed piezometers have alarms associated with them in sensemetrics. If any of them goes above 1596 an email is automatically generated and sent to those listed in Table 1-1

During future construction of FCEWRD, Survey will take readings of the settlement monuments on a daily basis as conditions allow. The Environmental Technicians will ensure the VWP piezometers data collected from the automated data collection, sensemetrics, are transmitting to the cloud platform. Either the environmental technicians or the environmental engineer will ensure the sensemetrics is communicating with FULCRUM.

### 3.9 North Basin Buttress

#### 3.9.1 Inspection and Monitoring North Basin Buttress

Monitoring of the buttress will be conducted visually through field observations to alert the operation to any signs of potential problems or unexpected behavior.

### 3.10 TSF Inspection Program

As discussed in the previous sections, inspections are conducted on the TSF associated structures. The Table 3.1 summarizes the TSF inspection schedule.

In addition to the TSF Inspection Program, water quality monitoring is conducted at various locations below the tailings impoundment by the Environmental Technicians. The current seepage monitoring program is summarized in Table 3.2.

**Table 3-1: Inspection Schedule for the TSF**

<b>TSF Associated Structure</b>	<b>Inspection Activity</b>	<b>Document</b>	<b>Schedule</b>	<b>Responsible Person / Group</b>
<b>Embankment</b>	Tailings Dam Inspection Form	Appendix C	Daily	Pond Operator
	Update Water Balance	GoldSim Model	Quarterly and as needed	Environmental Engineer
	Piezometer Monitoring	1.1 Monitoring Data (Internal Server M:\Enviromental)	Weekly	Environmental Technician
	Stability Monuments	Survey Slope spreadsheet	Monthly	Surveyors
<b>Tailing Discharge Lines</b>	Barge Inspection Form	Appendix C	Daily	Pond Operator
	Shift Log	Mill Control System	Daily	Mill Control
	Deposition	Spot survey according to deposition plan	Quarterly (minimum)	Surveyors
	Sub-Aqueous Deposition	Bathymetric Survey	Twice a year	Environmental Technicians and Surveyors
<b>Barge and Pipeline</b>	Barge Inspection Form	Appendix C	Daily	Pond Operator
	Pond Operators Daily Report	Appendix C	Daily	Pond Operator
<b>Seepage Collection System</b>	Seepage Monitoring	Appendix C	Weekly	Pond Operator
<b>Interceptor and Monitoring Wells</b>	Seepage Monitoring	Appendix C	Weekly	Pond Operator
<b>Periodic Safety Inspection</b>	Annual Inspection	Report on Annual Inspection	Annual	Engineer of Record
	Safety Inspection	Appendix G	Every Three Years	Engineer of Record

Table 3-2: Seepage Monitoring Locations

Location	Sample and Analysis	Schedule
Site 501	Full Profile (Appendix B)	Quarterly
Site 801		
Upper Wetlands		
Lower Wetlands		
Pond C		
Pond D		
TSF Decant		
Tailings Filtrate		
Tailings Solids		
TSF Seepage		
Fresh Water Reservoir		
Fresh Water Dam Seepage		
IW – 1, 2, 3, 6, 7, 8, 11, 13, 14,16		
MW – 1, 2,3, 4, 5, 6, 7		
PMW – 1, 2, 3S, 3D, 4, 5,6		

### 3.11 Photographs

Taking photographs of conditions needing repair and of the repairs are encouraged to provide a visual record of the conditions and the repair. This is especially important when design of the repair may involve personnel who are offsite. It also provides a visual record of areas that are taking more than routine maintenance that could reduce the maintenance costs by revising the design. The photographic record is many times a real value in showing the designer the problem to be addressed.

### 3.12 Data Interpretation

This manual provides the guidelines for a consistent method for monitoring and inspecting the facilities including trigger cases that initiates actions based on the results of the monitoring and inspection. Any unexpected change in data is reported to management, KP and the appropriate personnel of the specific area effected.

The data collected and reviewed by the environmental department. KP analyzes and prepares a quarterly geotechnical and instrumentation report to confirm the TSF, P1C, and the FCEWRD are performing to design standards. The report includes an executive summary, recommendations and graphical representations of the data on a time basis. This includes piezometric elevations, water elevations, flow rates and stability movements.

### 3.13 Internal and External Reviews

Knight Piésold conducts an annual inspection of the TSF. Knight Piésold conducts a PSI every 3 years in accordance with the Class II ranking of the TSF dam under the Alaska Dam Safety Program. The next PSI is scheduled for 2024. The TSF is included in the State required third-party environmental audit, required in 2023.

## Section 4.0 - Event Detection

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This section is a tool to identify potential situations before they become critical events. The majority of this material is taken from the Fort Knox Emergency Action Plan is coordinated with the Fort Knox Emergency Response Plan. Refer to those plans for additional information.

### 4.1 Event Detection

This step describes the detection of an unusual or emergency event and provides information to assist the Dam Operator in determining the appropriate emergency level for the event. Unusual or emergency events may be detected by:

- Observations by FGMI personnel or contractors
- Observations at or near the dam by government personnel (Local, State, or Federal), landowners, visitors to the dam, or the public
- Evaluation of instrumentation data
- Earthquakes felt or reported in the vicinity of the dam
- Forewarning of conditions that may cause an unusual event or emergency event at the dam (for example, a severe weather or flash flood forecast)

#### 4.1.1 Level 1 Non-Failure

A non-failure emergency is an unusual condition. They are conditions or situations that differ from the normal or expected condition of the dam and impoundment. These unusual conditions may indicate problems needing investigation or corrective measures.

#### 4.1.2 Level 2 Potential Failure

A potential failure emergency level indicates that conditions are developing at the dam and could lead to a failure. A potential failure should convey that time is available for analyses, decisions and actions prior to a failure. A failure may occur but predetermined response action may moderate or alleviate the failure. This also includes water at the WCHL spillway invert and a release to the tailings storage in imminent.

#### 4.1.3 Level 3 Imminent Failure

The imminent failure emergency level indicates that time has run out, and the dam, is failing or about to fail

**Table 4-1 Event Detection**

Event	Situation	Emergency Level Notification
Spillway flow	Water Supply Reservoir water is obstructed Walter Creek Heap Leach any amount is reportable to DEC	1
	Water Supply Reservoir water surface elevation at 1027.5 ( 2.5 feet above spillway crest) Spillway flow could contribute to downstream flooding if the reservoir level continues to rise	2
	Water Supply Reservoir water surface elevation at 1033 ( 8 feet above spillway) flow could continue to contribute to flooding downstream	3
Embankment overtopping	Water level is encroaching on the freeboard TSF 1555. amsl (5 feet below seal zone) WCHL 1648 amsl (5 feet below dam crest) WSRD 1030 amsl; (5 feet above spillway)	1
	TSF Mitigation efforts for Level 1 are not working or water elevation is at or above 1557 (3 feet below seal zone) WCHL 1650.5 Water is at the spillway invert and a release to the tailings is imminent WSRD 1033 amsl; (8 feet above spillway)	2
	TSF, WCHL, WSRD Water level has exceeded the freeboard and water is flowing over the dam failure is imminent.	3
Seepage	New seepage areas in or near the dam	1
	Increase in new or existing seepage rates. New or existing seepage have a cloudy discharge or increasing flow rate.	2
	Is the new or existing seepage cloudy and the discharge flow rate is rapidly increasing. Surface cracks are developing. Notable and unusual conditions are occurring.	3
Earthquake	Minor Earthquake as defined in Figure 4.1 and Tables 4.2 and 4.3	1
	Major Earthquake as defined in Figure 4.1 and Tables 4.2 and 4.3	2
	Earthquake resulting in uncontrolled release of water from the dam	3
Embankment cracking	New cracks in the embankment less than ¼-inch wide without seepage	1
	New cracks in the embankment greater than ¼-inch wide without seepage	2
	Cracks in the embankment with seepage	3
Embankment movement	Small movement detectable by instruments	1
	Slightly larger movements/slippage that are visually observable	2
	Sudden or rapidly proceeding slides of the embankment slopes	3
Instruments	Increase in instrument readings	1

Event	Situation	Emergency Level Notification
	Instrumentation readings beyond predetermined values Instrument readings that continue to increase from the expected norm	2
	Elevated instrument readings in conjunction with other elevated event detection situations	3
Boils and Sinkholes	Observation of new sinkhole in reservoir area or on embankment. Observation of a boil down stream of the toe	1
	A boil is noticed with the formation of a silty soil cone around the outlet of the boil Enlarging sinkhole	2
	Rapidly enlarging sinkhole with a whirlpool on the lake surface with or without a drop in water elevation	3
Security threat	Vague or unverified bomb threat	1
	Verified bomb threat that, if carried out, could result in damage to the dam	2
	Detonated bomb that has resulted in damage to the dam or appurtenances	3
Sabotage/ vandalism	Damage to dam or appurtenance with no impacts to the functioning of the dam	1
	Modification to the dam or appurtenances that could adversely impact the functioning of the dam	2
	Damage to dam or appurtenances that has resulted in a dam safety issue	3

## 4.2 Conditions and Evaluation

The potential emergency conditions or unusual occurrences are reviewed in this section. Measures to mitigate the effects of the emergency condition are in Section 4.3.

### 4.2.1 Extreme Runoff from Rainfall or Snowmelt

On a heavy rain warning from the National Weather Service, the water level in the impoundment and reservoir will be monitored closely and facilities will be maintained as necessary during the event.

After any major storm or thaw runoff event, a thorough inspection of all ditches, culverts, ponds, and other water-related facilities will be completed. Necessary repairs will be completed as soon as is reasonably possible to reduce the chance of additional damage during subsequent storm events.

### 4.2.2 Increase in Seepage

Observations of water levels and flow rates on the piezometers, seepage reclaim sump, and interceptor and monitoring wells should be evaluated to determine if there are any significant changes in seepage rates associated with any of the dams. If an increase in seepage is detected, the flow will be examined to see if it is cloudy or clear and a determination of the reason for the increase in seepage will be made. Water quality analyses must also be performed to help determine the source of the water.

The identification of unanticipated seepage from the abutments or toe will be investigated, monitored, evaluated, and steps taken to control it. Monitoring will be conducted daily and will include visual inspection to determine if the water is clear or cloudy. Quantity measurements and water quality samples will be taken as required provided conditions are not prohibitive.

The engineer of record will be advised of new seeps, significant or sudden increases in seepage rates, changes in seepage color or cloudiness, or identification of new surface seeps.

Measures to control the seepage will be based on planned investigations and studies. Investigations will be carefully designed to provide information that can be used to analyze and evaluate the nature of the seepage.

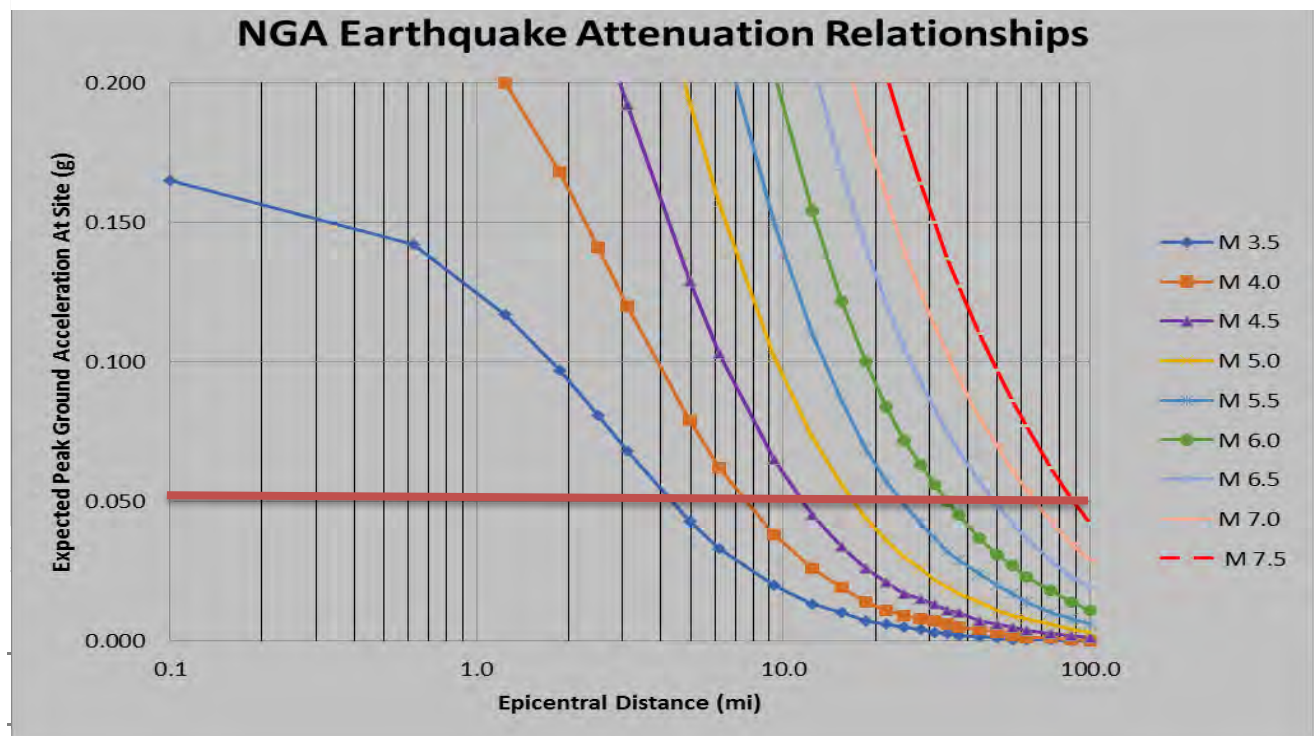
#### 4.2.3 Earthquakes

Fairbanks Gold Mining is currently using QuakeFeed mobile application to monitor any earthquake event. The QuakeFeed provides the magnitude of the earthquake and the epicentral distance. Using QuakeFeed data into the Earthquake attenuation plot (Figure 4 1), with epicentral distance and magnitude FGMI determines the Peak Ground Horizontal Acceleration (PGHA) value.

Earthquakes are classified as insignificant, minor, or major, with regard to the Fort Knox dams. An inspection of the dams should be conducted by FGMI environmental and designated operators following any seismic event that produces a Peak Ground Horizontal Acceleration (PGHA) greater than 0.05g. Reference Figure 4.1 and Table 4.2 All geotechnical instruments will be read or surveyed. The Engineer of Record will be contacted and made aware of the occurrence and brought out to site if the situation is warranted. Instrumentation data will be entered into FULCRUM (web based instrumentation data collection program). Heightened attention should be given the normal daily inspection. Any necessary repairs will be completed as soon as practical.

Fort Knox is also working with University of Alaska Fairbanks Geophysical Institute on installing two accelerometers to monitor peak ground acceleration the TSF Dam continuously. One of the instruments will be located directly in the center of the Dam and the second one will be about 30 feet north of the north abutment. The system should have a web interface and will send out email notifications to those listed in Figure 2-1 . Once the data from the instruments is continuously recorded and sent through the FGMI network to a computer and data storage on-site. In case of major events (PGHA  $\geq$  0.05g) FGMI designated team and EOR are immediately notified via email and above mentioned inspection will be performed. The data can also be downloaded manually then taken back to the office and analyzed. Until this system is fully automated with email notifications. Figure 4.1 Earthquake Attenuation Plot and Table 4.3 will continue to be used as the basis for inspections. Once the data from the accelerometer has been manually downloaded or and analyzed the inspections may change in accordance with resulting PGHA.

Figure 4-1 - Earthquake Attenuation Plot and Table



**Event Detection**

Epicentral Distance	Miles	0.1	0.6	1.2	1.9	2.5	3.1	4.1	5.0	6.2	7.8	9.3	10.2	12.4	15.5	10.8
<b>Peak Horizontal Ground Acceleration (PHGA) Expected at Mine Site (g)</b>																
<b>Earthquake Magnitude</b>	<b>M 3.5</b>	0.165	0.142	0.117	0.097	0.081	0.068	0.050	0.043	0.033		0.020		0.013	0.010	
	<b>M 4.0</b>	0.275	0.239	0.200	0.168	0.141	0.120		0.079	0.062	0.050	0.038		0.026	0.019	
	<b>M 4.5</b>	0.411	0.361	0.307	0.260	0.223	0.192		0.129	0.103		0.065	0.050	0.045	0.034	
	<b>M 5.0</b>	0.555	0.494	0.426	0.368	0.318	0.278		0.193	0.157		0.102		0.073	0.056	0.050
	<b>M 5.5</b>	0.698	0.630	0.552	0.483	0.424	0.375		0.269	0.222		0.150		0.110	0.086	
	<b>M 6.0</b>	0.811	0.740	0.658	0.584	0.520	0.465		0.345	0.291		0.204		0.154	0.122	
	<b>M 6.5</b>	0.922	0.851	0.768	0.691	0.623	0.565		0.432	0.370		0.269		0.208	0.169	
	<b>M 7.0</b>	0.969	0.905	0.827	0.754	0.689	0.631		0.498	0.434		0.327		0.260	0.215	
<b>M 7.5</b>	0.993	0.935	0.866	0.799	0.739	0.685		0.557	0.494		0.384		0.314	0.266		
<b>Peak Horizontal Ground Acceleration (PHGA) Expected at Mine Site (g)</b>																
<b>Earthquake Magnitude</b>	<b>M 3.5</b>	0.007	0.006	0.005	0.004	0.003	0.003	0.002	0.002	0.001	0.001	0.000		0.000	0.000	0.000
	<b>M 4.0</b>	0.014	0.011	0.009	0.008	0.007	0.006	0.005	0.004	0.003	0.002	0.001		0.001	0.000	0.000
	<b>M 4.5</b>	0.026	0.021	0.017	0.015	0.013	0.011	0.010	0.007	0.006	0.005	0.004		0.003	0.002	0.001
	<b>M 5.0</b>	0.044	0.036	0.030	0.026	0.022	0.019	0.017	0.014	0.011	0.009	0.008		0.006	0.004	0.003
	<b>M 5.5</b>	0.069	0.057	0.049	0.042	0.037	0.032	0.029	0.024	0.020	0.017	0.014		0.010	0.008	0.006
	<b>M 6.0</b>	0.100	0.084	0.072	0.063	0.056	0.050	0.045	0.037	0.031	0.027	0.023		0.018	0.014	0.011
	<b>M 6.5</b>	0.141	0.121	0.105	0.093	0.083	0.075	0.068	0.057	0.049	0.042	0.037		0.029	0.023	0.019
	<b>M 7.0</b>	0.183	0.159	0.140	0.125	0.113	0.103	0.094	0.080	0.070	0.061	0.054	0.050	0.043	0.035	0.029
<b>M 7.5</b>	0.230	0.203	0.182	0.164	0.150	0.137	0.127	0.110	0.097	0.086	0.077		0.062	0.051	0.042	
		No extra inspections required														

**Table 4-2 Required Inspection Based on Peak Ground Accelerations Greater than 0.05g**

<b>Insignificant</b>	Action	They require no special actions or inspections. Continue daily inspections and report any deformation or movement (cracking, slump, seep, etc.).
<b>Minor Earthquakes</b> Magnitude producing less than a 0.05g peak horizontal ground acceleration. Reference Figure 5.1 if the accelerometer is not functioning	Action	They require no special actions or inspections. Continue daily inspections and report any deformation or movement (cracking, slump, seep, etc.).

<p><b>Major Earthquakes</b></p> <p>Magnitude producing greater than 0.05g peak horizontal ground acceleration Reference Figure 5.1 if the accelerometer is not functioning</p>	<p>Action</p>	<p>Immediately stop the pumping of reclaim water and all process solutions if problems are discovered during the inspections.</p> <p>If safe to do so, immediately inspect the main embankments (Heap Leach, Freshwater Reservoir and TSF), for obvious deformation or movement (cracking, slump, seep, etc.).</p> <p>If safe to do so, immediately inspect all pipelines and the pump barge for rupture, leakage, or other obvious damage.</p> <p>For a two-week period after an earthquake classified as major, the piezometers should be read daily by an Environmental Technician or Engineer. After data reduction, water levels should be graphically displayed on a summary graph to track any unusual changes piezometer readings.</p> <p>Check the interceptor and monitoring wells for any indication of changes in ground water elevations.</p> <p><b>Arrange for an immediate inspection by the Engineer of Record</b></p>
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#### 4.2.4 Slumping of the Embankment

Any slumping or abnormal deformation of the embankment or areas adjacent too at any time is to be reported to the ore processing manager and the environmental manager. The location, extent, and size of the slump are to be reported, as well as the pond level and any flow or seepage associated with the slump. The Engineer of Record must also be contacted.

#### 4.2.5 Unusual Instrument Readings

Initial instrument readings from piezometers and survey monuments must be compared with design limits to see any variation. Instrument readings when obtained will be compared with previous readings of the same instrument, as well as design limits. If the current readings differ significantly from previous readings taken under similar circumstances and conditions an additional reading to verify the results will be taken as soon as possible.

#### 4.2.6 Avalanche or Debris Slide

No indications exist that natural avalanches or debris slides are of concern within the TSF, HLP or Fresh water reservoir. However, operating personnel will always be alert to indications of slide movement such as the development of tension cracks or scarp faces on slopes, downhill movement of roads, pipelines, or other constructed elements, and the development of seepage at the base of slopes. In addition to debris slides, be alert of the potential sliding of the overliner on the LLDPE primary geomembrane of the heap leach.

### 4.3 Mitigation measures

The following actions describe some of the steps that could be taken at the dam to prevent or delay failure after an emergency is first discovered. These actions should be performed with consultation from of the Dam Safety Office, or other qualified engineers. It will be necessary to stop tailings deposition if any of the emergency events listed below were to occur.

#### 4.3.1 Overtopping by Flood Waters

- Reduce the volume of water stored in the impoundment, if possible

- Run critical events pipeline.
- Provide erosion-resistant protection to the downstream slope by placing plastic sheets or other materials over eroding areas
- Divert flood waters around the reservoir basin if possible
- Provide emergency siphons or pumps

#### 4.3.2 Reduction in Freeboard and/or Loss of Dam Crest Width

- Place additional rip rap or sandbags in damaged areas to prevent further embankment erosion
- Lower the water level to an elevation below the damaged area
- Restore freeboard with sandbags or earth and rock fill
- Continue close inspection of the damaged area until the storm is over
- Provide emergency siphons or pumps

#### 4.3.3 Slide on the Upstream or Downstream Slope of the Embankment

- Lower the water level at a rate, and to an elevation, that is considered safe given the slide condition. If the barge pumps are damaged or blocked, pumping, siphoning, or a controlled breach may be required
- Restore lost freeboard if required by placing sandbags or filling in the top of the slide.
- Stabilize slides on the downstream slope by weighting the toe area with additional soil, rock, or gravel
- Provide emergency siphons or pumps

#### 4.3.4 Erosional Seepage or Leakage (Piping)

- Plug the flow with whatever material is available (hay bales, bentonite, or plastic sheeting if the entrance to the leak is in the reservoir)
- Lower the water level until the flow decreases to a non-erosive velocity or until it stops.
- Place a reverse filter directly against the soil from which the leakage is exiting.
- Deposit tailings in a manner that moves the operating pool in the impoundment away from the embankment area where the seepage and/or piping is occurring
- Provide emergency siphons or pumps

#### 4.3.5 Failure of an Appurtenant Structure such as Inlet or Outlet Piping

- Discontinue pumping
- Identify cause of leak (pipe penetration, landslide, etc.)
- Repair damaged pipe and attended areas
- Provide emergency siphons or pumps

#### 4.3.6 Mass Movement of the Dam on its Foundation

- Immediately lower the water level until excessive movement stops
- Continue lowering the water level until a safe level is reached
- Continue operation at a reduced level until repairs are made
- Place fill at the base of the movement

- Provide emergency siphons or pumps

4.3.7 Excessive Seepage and High Level Saturation of the Embankment

- Lower the water to a safe level
- Continue frequent monitoring for signs of slides, cracking, or concentrated seepage
- Continue operations at a reduced level until repairs are made

4.3.8 Excessive Settlement of the Embankment

- Lower the water level by releasing it by pumping, or siphoning
- If necessary, restore freeboard, preferably by placing sandbags
- Lower water to a safe level
- Continue operating at a reduced level until repairs can be made

## Section 5.0 - REFERENCES

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- [1] Fort Knox Project, Design of Tailing Storage Facility and Water Reservoir, Design Report, August 1993.
- [2] Fairbanks Gold Mining, Inc., Fort Knox Project Tailing Storage Facility Technical Specifications, August 1993.
- [3] Surface and Groundwater Hydrology for the Fort Knox Project, J. C. Halepaska and Associates, December 1992.
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- [5] Fort Knox Mine Monitoring Plan, Fairbanks Gold Mining, Inc., Jan, 2011.
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- [7] Fairbanks Gold Mining Inc, Fort Knox Mine, Tailings Storage Facility Expansion, Geotechnical and Hydrological Evaluation Report, November 13, 2009, Knights Piésold and Co. Denver, Colorado.
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- [10] Fort Knox Mine Reclamation Plan, Fairbanks Gold Mining, Inc., November 2013 Rev 2
- [11] Knight Piésold and Co., 2016, Fort Knox Project Tailing Storage Facility Expansion Report on Design of Embankment Raise to Crest Elevation 1557 Rev 1
- [12] Knight Piésold and Co., 2016, Fort Knox Project Tailing Storage Facility Expansion 2016 Construction Completion Report Rev 1
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- [14] Knight Piésold and Co., 2016, Fort Knox Project Report through Q4 2017 on Geotechnical and Hydraulic Instrumentation Records for the Tailing Storage Facility, Water Supply Reservoir and Walter Creek Heap Leach Facility
- [15] Knight Piésold and Co., 2017, Fort Knox Project Tailing Storage Facility Expansion 2017 Construction Completion Report Rev 0
- [16] Knight Piésold and Co., 2017, Fort Knox Project Tailing Storage Facility Report on Annual Inspection for 2017 Rev 0
- [17] Fort Knox Gold Mining, Inc. 2017 Emergency Action Plan Rev 7 Fairbanks Gold Mining, Inc., January 2017
- [18] Knight Piésold and Co., 2018, Fort Knox Project Tailing Storage Facility Report on 2018 Periodic Safety Inspection, Rev A.
- [19] Knight Piésold and Co., 2019, Fort Knox Project Tailing Storage Facility Seal Zone Raise to Elevation 1560.0 FMSL Construction Completion Report, Rev 0

## Section 6.0 - LIST OF REVISIONS

This revision log is included to provide the manual user with a description of the revisions made to the manual. The manual should be reviewed on at least an annual basis. If updates are necessary, they should be made and a revised manual issued.

<b>REVISION LOG</b>	
<b>REVISION NUMBER AND DATE</b>	<b>DESCRIPTION OF REVISIONS</b>
Revision - April 2011	Updated to reflect the 2010 construction
Revision 1 – March 2012	Updated to reflect 2011 Construction: Section 2.3 Embankment Section 2.4 and 3.3 – Tailings discharge line Fig 4.1 Emergency Notification – Updated names and numbers Table 3.2 – Updated monitoring locations Appendix A – Updated freeboard added graphical representation of freeboard
Revision 2 – December 2013	Updates incorporated from the 2012 PSI report Dated May 2013
Revision 5 March 2016	Updated to reflect 2016 Embankment Construction and instrumentation. Updated seepage system to account for 2015 and 2016 studies and new 2017 regional wells downstream of the TSF Added pearl creek causeway information Added TSF Steering Committee and TSF Quarterly Scorecard information. Updated Section 4 to Event Detection Updated operating parameters and 2016 Deposition Plan
Revision 6 – March 2017	Updated to reflect 2017 Embankment Construction and instrumentation. Updated seepage system to account for new 2017 regional wells downstream of the TSF and updated toe drain seepage. Incorporated applicable 2017 Annual inspection recommendations
Revision 7 – November 2018	Incorporated 2018 Periodic Safety Inspection recommendations
Revision 8 - August 2019	Deleted superfluous information in all sections Added Phase 1 Causeway
Revision 9 – November 2019	General formatting and text updates included information from the 1560 CCR
Revision 10 – April 2020	Added trigger piezometric elevation for the P1C and FCEWRD Updated with recommendations from the 2020 annual inspection report

	<p>Included North Basin Buttress</p> <p>Updated freeboard operating limits</p> <p>Updated filling curve</p>
Revision11– December 2021	Update include construction of engineered zones to 1560 fmsl and installation of 6 piezometers installed on Fish Creek
Revision 12- August 2024	Update on the earthquake monitoring system. Added new inspection form in Appendix C Pond Route Sheet.
Revision 13- November 2024	1563 fmsl PCC raise included. Updated the tailings deposition plan.

## Section 7.0 - Acronyms and Abbreviations

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ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
BWP	Base Working Platform
COE	Corps of Engineers
DCS	Data Collection System
EOR	Engineer of Record
FCEWrD	Fish Creek East Waste Rock Dump
FGMI	Fairbanks Gold Mining, Inc.
fmsl	Feet mean sea level
FWD	Fresh Water Reservoir Dam (Water Supply Reservoir Dam)
INCO	company name-patented cyanide destruction process
KP	Knight Piésold
P1C	Phase 1 Causeway
QA/QC	Quality Assurance/Quality Control
TSF	Tailings Storage Facility
WAD CN	Weak Acid Dissociable Cyanide
YPWRD	Yellow Pup Waste Rock Dump

## **Appendix A**

### **Project Data Sheet**

**ALASKA DAM SAFETY PROGRAM  
PROJECT DATA SHEET**

NID No. AK 00212

**A. GENERAL**

Dam Name Fort Knox Tailing Storage Facility Dam  
 NID Number AK00212  
 Hazard Potential Class II with Class I design criteria  
 Purpose water and tailing storage  
 Year Built starter embankment: 1995  
 Year Modified staged raises; intermittent through 2017  
 Location Latitude 65°00'N Longitude 147°18'W lat/long (GPS)  
 Reservoir Name Tailing Storage Facility Basin  
 River or Creek Name Fish Creek  
 Owner Fairbanks Gold Mining, Inc. (FGMI)  
 Contact Name Ms. Bartly Kleven  
 Address #1 Fort Knox Road (P.O. Box 73726)  
 City, State, Zip Fairbanks, Alaska 99707-3726  
 Phone 907 490 2207  
 Email bartly.kleven@kinross.com

**B. DAM**

Type earth and rock fill embankment  
 Primary Seepage Control low permeability seal zone  
 Crest Length approximately 4,800 feet  
 Crest Width at top of seal zone: 165.0 feet  
 Crest Elevation 1,557.0 feet at top of seal zone and 1,566.0 feet with overbuild and frost protection  
 Crest Height (from d/s toe) to top of seal zone: 383.0 feet  
 Hydraulic Height at Normal Pool as of June 17, 2018: 361.5 feet to elevation of north pond

**C. PRIMARY SPILLWAY**

Type N/A (not applicable) - none present  
 Location \_\_\_\_\_  
 Spillway Invert Elevation \_\_\_\_\_ feet  
 Top Width \_\_\_\_\_ feet  
 Bottom Width \_\_\_\_\_ feet  
 Length \_\_\_\_\_ feet  
 Discharge Capacity at Dam Crest \_\_\_\_\_  
 Elevation or Maximum Flood Pool \_\_\_\_\_ cubic feet/second (cfs)

**D. EMERGENCY SPILLWAY**

Type N/A - none present  
 Location \_\_\_\_\_  
 Spillway Invert Elevation \_\_\_\_\_ feet  
 Top Width \_\_\_\_\_ feet  
 Bottom Width \_\_\_\_\_ feet  
 Length \_\_\_\_\_ feet  
 Discharge Capacity at Dam Crest \_\_\_\_\_  
 Elevation or Maximum Flood Pool \_\_\_\_\_ cfs

**ALASKA DAM SAFETY PROGRAM  
PROJECT DATA SHEET**

NID No. AK 00212

(continued)

**E. OUTLET WORKS**

Type	<u>N/A - none present</u>	
Location	_____	
Inlet Invert Elevation	_____	feet
Outlet Invert Elevation	_____	feet
Diameter	_____	inches
Length	_____	feet
Outlet Type	_____	
Discharge Capacity at Dam Crest Elevation or Maximum Flood Pool	_____	cfs

**F. RESERVOIR**

Normal Storage Capacity at Spillway Invert Elevation	<u>N/A - none present</u>	acre-feet
Surface Area at Spillway Invert Elevation	<u>N/A - none present</u>	acres
Maximum Storage Capacity at Dam Crest or Maximum Flood Pool	<u>at top of seal zone: 27,324</u>	acre-feet as of June 15, 2018
Maximum Surface Area at Dam Crest or Maximum Flood Pool	<u>at top of seal zone: 1,042</u>	acres as of June 15, 2018

**G. HYDROLOGY**

Drainage Basin Area	<u>5,006 acres - 7.8</u>	sq. miles including open pit
Average Annual Precipitation	<u>17.3</u>	inches
100 Year/24 Hour Precipitation	<u>rain: 3.8 inches (June) - runoff: 2.7</u>	inches (January rain-on-snow)
100 Year Flood	<u>1,119 acre-feet (no discharge)</u>	cfs
Probable Maximum Precipitation	<u>rain: 11.2 inches (June or July) - runoff: 10.3</u>	inches (June or July)
Probable Maximum Flood	<u>4,304 acre-feet (no discharge)</u>	cfs
Flood of Record	<u>unknown</u>	cfs
Inflow Design Flood	<u>100 yr/24 hr plus WCHLF pond with 3.0 feet freeboard 24 hr PMP plus WCHLF pond with 1.0 foot freeboard</u>	cfs

**H. DATA REFERENCES**

(use endnotes)

## **Appendix B**

### **Analytical Profile Chemistry**

### *Analytical Profile I – Surface Water Inorganic Parameters*

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<b>Major Ion Chemistry</b>	<b>Minor Ion Chemistry</b>	<b>Trace Ion Chemistry</b>
Lab pH	*Arsenic	*Antimony
Lab Conductivity	Cyanide	*Barium
Temperature (field)	Total	*Bismuth
Turbidity	WAD	*Cadmium
Settleable Solids	Fluoride	*Chromium
Total Suspended Solids	*Iron	*Copper
Total Dissolved Solids	*Manganese	*Lead
*Calcium	Nitrogen, Ammonia	*Mercury
*Magnesium	Nitrate as Nitrogen	*Nickel
*Potassium	Nitrite as Nitrogen	*Selenium
*Silicon	Total Phosphorus	*Silver
*Sodium	TPH	*Zinc
Chloride		
Sulfate		
Alkalinity (as CaCO <sub>3</sub> )		
Bicarbonate		
Total Hardness		

---

\* Dissolved

### *Analytical Profile II - Groundwater Inorganic Parameters*

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<b>Major Ion Chemistry</b>	<b>Minor Ion Chemistry</b>	<b>Trace Ion Chemistry</b>
Lab pH	*Arsenic	*Antimony
Lab Conductivity	Cyanide	*Barium
Temperature (field)	Total	*Bismuth
Turbidity	WAD	*Cadmium
Total Suspended Solids	Fluoride	*Chromium
Total Dissolved Solids	*Iron	*Copper
*Calcium	*Manganese	*Lead

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*Magnesium	Nitrogen, Ammonia	*Mercury
*Potassium	Nitrate as Nitrogen	*Nickel
*Silicon	Nitrite as Nitrogen	*Selenium
*Sodium	Total Phosphorus	*Silver
Chloride	Sulfide	*Zinc
Sulfate	TPH	
Alkalinity (as CaCO <sub>3</sub> )		
Bicarbonate		
Total Hardness		
Calcium Hardness		
Magnesium Hardness		

---

\* Dissolved

## **Appendix C**

### **Inspection Form – Pond Route Sheet**

## DAILY CHECKS:

### Tailings Barge / Reclaim Pumps:

Barge Access?	Yes
Water Depth:	77
GPM:	3231
Totalizer:	13519764
Line PSI:	125
Temp °F:	40

### PUMP 30-pp-055

Running?	No
----------	----

### PUMP 30-pp-056

Running?	Yes
Amps 1:	43
Amps 2:	41
Amps 3:	41
Hours M:	48077

### PUMP 30-pp-057

Running?	No
----------	----

### PUMP 30-pp-058

Running?	No
----------	----

### Corners

RF:	1.5
RR:	0.11
LR:	1.3
LF:	1

### Ballast Readings

L1:	8.1
L2:	0
L3:	0
L4:	4.7
R1:	8.3
R2:	0

R3:	-2
R4:	5.6
De-icing Agitators On?	YES

**TSF Dam Inspection:**

Upstream Slope	Pass
Downstream Slope	Pass
Dam Crest	Pass
Downstream Toe	Pass

**Pearl Creek Causeway Inspection:**

North Slope	Pass
South Slope	Pass
Causeway Crest	Pass

**Tails Discharge:**

TSF Disch Point:	Pit Bottom
Dilution/Rinse Water:	No longer visible

**Seepage Area:**

Seepage Sump Level:	25.92
PUMP 30-pp-063	

Running?	Yes
801 Pond Status	On
Comments:	still running two pumps one to seepage one to brine tank in RO Plant

**Fresh Water**

Fresh H2O Dam Inspection

Upstream Slope	Pass
Downstream Slope	Pass
Dam Crest	Pass
Downstream Toe	Pass
Below Dam Area	
Piezo Hut	Pass
Spillway	Flowing
Weir	Pass

## **Appendix D**

### **Well Pump Log Sheet – Weekly**

Weekly Well Pump Log Report					Date:	Name:				
Well ID	Well Depth (FT)	Pump Depth (ft)	Target Range (ft)	Depth to Water (FT)	In Range (Y/N)	Flow Rate (gpm)	Valve Position (% Open)	Totalizer	Comments	
PZ-1	420									
PZ-2	450									
PZ-3	445									
PZ-4	550									
PZ-5	450									
PZ-6	150									
PZ-7	200									
IW-1	320	252	140-200							
IW-2	329	252	210-230							
IW-3	310	283	250-260							
IW-5	380	320								
IW-6	380	237	220-240							
IW-7	160	147	130-140							
IW-8	184	171	130-150							
IW-9	197									
IW-10	260									
IW-11	296	294	180-200							
IW-13	480	440	400-420							
IW-14	400	337	90-120							
IW-15	380									
IW-16	342	296	240-260							
MW-1	305									
MW-2	279									
MW-3	296	253								
MW-4	288	231								
MW-5	120									
MW-6	150									
MW-7	135									
401										
501										
801										
Signature					Notes:					

## **Appendix E**

### **TSF Annual Inspection Form**



**ALASKA DAM SAFETY PROGRAM  
VISUAL INSPECTION CHECKLIST**

NID ID# AK00212  
SHEET 1 OF 9

**GENERAL INFORMATION**

NAME OF DAM: Fort Knox TSF Dam NATIONAL INVENTORY OF DAMS ID#: AK00212 OWNER: Fairbanks Gold Mining Inc. HAZARD POTENTIAL CLASSIFICATION: II SIZE CLASSIFICATION: Mine Tailings Dam PURPOSE OF DAM: Tailings storage O & M MANUAL REVIEWED: Yes EMERGENCY ACTION PLAN REVIEWED: Yes	POOL ELEVATION: 1515 fmsl TAILWATER ELEVATION: Water level in seepage pumpback sump is between 1,132 and 1,140 fmsl. CURRENT WEATHER: Dry, Clean, Sunny PREVIOUS WEATHER: Dry, Clean, Sunny INSPECTED BY: Thomas Kerr, P.E. (Alaska) INSPECTION FIRM: Knight Piésold and Co. DATE OF INSPECTION: July 22, 2015
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ITEM	YES	NO	REMARKS
<b>RESERVOIR</b>			
1. Any upstream development?	✓		Mine, Mill, HLP
2. Any upstream impoundments?	✓		HLP
3. Shoreline slide potential?		✓	
4. Significant sedimentation?		✓	Tailing in impoundment
5. Any trash boom?		✓	
6. Any ice boom?		✓	
7. Operating procedure changes?	✓		Priority deposition is spigot discharges from dam in summer and single point discharges from both sides of the causeway and Fish Creek stockpile to control seepage.

<b>DOWNSTREAM CHANNEL</b>			
1. Channel			
a. Eroding or Backcutting		✓	
b. Sloughing?		✓	
c. Obstructions?		✓	
2. Downstream Floodplain			
a. Occupied housing?		✓	
b. Roads or bridges?	✓		Access to Water Reservoir Dam
c. Businesses, mining, utilities?	✓		Water Reservoir Dam
d. Recreation Area?		✓	
e. Rural land?		✓	
f. New development?		✓	

<b>EMERGENCY ACTION PLAN</b>			
1. Class I or Class II Dam?	✓		Class II
2. Emergency Action Plan Available?	✓		
3. Emergency Action Plan current?	✓		June 2015. New dam break study upcoming to replace most recent in 2010.
4. Recent emergency action plan exercise?	✓		Completed in Q2 2014

<b>INSTRUMENTATION</b>			
1. Are there			
a. Piezometers?	✓		
b. Weirs?		✓	
c. Observation wells?	✓		



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d. Settlement Monuments?		✓	New monuments to be installed at 1540 fmsl.
e. Horizontal Alignment Monuments?		✓	New monuments to be installed at 1540 fmsl.
f. Thermistors?	✓		With piezometers
2. Are readings			
a. Available?	✓		
b. Plotted?	✓		
c. Taken periodically?	✓		



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**SAFETY**

ITEM	YES	NO	REMARKS
<b>SAFETY</b>			
<b>1. ACCESS</b>			<b>TYPE:</b>
a. Road access?	✓		
b. Trail access?		✓	
c. Boat access?	✓		In surface water pond.
d. Air access?		✓	
e. Access safe?	✓		
f. Security gates and fences?	✓		
g. Restricted access signs?	✓		
<b>2. PERSONNEL SAFETY</b>			
a. Safe access to maintenance and operation areas?	✓		
b. Necessary handrails and ladders available?	✓		Reclaim Pump Barge
c. All ladders and handrails in safe condition?	✓		Reclaim Pump Barge
d. Life rings or poles available?	✓		Reclaim Pump Barge
e. Limited access and warning signs in place?	✓		Reclaim Pump Barge
f. Safe walking surfaces?	✓		Reclaim Pump Barge
<b>3. DAM EMERGENCY WARNING DEVICES</b>			
a. Emergency Action Plan required?	✓		
b. Emergency warning devices required by EAP?	✓		<b>TYPE(S):</b> Piezometers
c. Emergency warning devices available?	✓		
d. Emergency warning devices operable?	✓		
e. Emergency warning devices tested?	✓		
f. Emergency warning devices tested by owner?	✓		<b>WHEN:</b> At times of readings
g. Emergency procedures available at dam?	✓		
h. Dam operating staff familiar with EAP?	✓		
<b>4. OPERATION AND MAINTENANCE MANUAL</b>			
a. O & M Manual reviewed?	✓		
b. O & M Manual current?	✓		<b>DATE:</b> June 2015
c. Contains routine inspection schedule?	✓		
c. Contains routine inspection checklist?	✓		



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**EMBANKMENT DAMS**

ITEM	YES	NO	REMARKS
<b>EMBANKMENT DAMS</b>			<b>TYPE:</b>
<b>1. CREST</b>			
a. Any settlement?		✓	
b. Any misalignment?		✓	
c. Any cracking?		✓	
d. Adequate freeboard?	✓		
<b>2. UPSTREAM SLOPE</b>			
a. Adequate slope protection?	✓		Coarse rockfill
b. Any erosion or beaching?	✓		Good tailing beach established over most of length, no erosion.
c. Trees or brush growing on slope?		✓	
d. Deteriorating slope protection?		✓	
e. Visual settlement?		✓	
f. Any sinkholes?		✓	
<b>3. DOWNSTREAM SLOPE</b>			<b>TYPE:</b>
a. Adequate slope protection?	✓		Coarse rockfill
b. Any erosion?		✓	
c. Trees or brush growing on slope?	✓		Minor, no stability issues but should clear a path along toe of dam.
d. Animal burrows?		✓	
e. Sinkholes?		✓	
f. Visual settlement?		✓	
g. Surface seepage?	✓		3 new, small seeps just downstream of dam, expanded drainage systems being implemented.
h. Toe drains dry?		✓	Drains collecting seepage.
i. Relief wells flowing?	✓		Pumped seepage recovery system
j. Slides or slumps?		✓	
<b>4. ABUTMENT CONTACTS</b>			
a. Any erosion?		✓	
b. Seepage present?	✓		Seepage being collected by drains and wells.
c. Boils or springs downstream?	✓		3 new, small seeps just downstream of dam, expanded drainage systems being implemented.
<b>5. FOUNDATION</b>			<b>TYPE: Fractured rock</b>
a. If dam is founded on permafrost		✓	
(1) Is fill frozen?			N/A
(2) Are internal temperatures monitored?			N/A
b. If dam is founded on bedrock	✓		<b>TYPE: Fairbanks Schist</b>
(1) Is bedrock adversely bedded?		✓	
(2) Does rock contain gypsum?		✓	
(3) Weak strength beds?		✓	
c. If dam founded on overburden			<b>TYPE: Dam not on O/B</b>
(1) Pipeable?			N/A
(2) Compressive?			N/A
(3) Low shear strength?			N/A



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**TIMBER DAMS**

ITEM	YES	NO	REMARKS
<b>TIMBER DAMS</b>			TYPE: Not a timber dam
<b>1. CREST</b>			N/A
a. Any settlement?			N/A
b. Any misalignment?			N/A
c. Adequate freeboard?			N/A
d. Deck timbers sound?			N/A
<b>2. ABUTMENT AND FOUNDATION CONTACTS</b>			N/A
a. Any erosion?			N/A
b. Seepage present?			N/A
c. Boils or springs downstream?			N/A
d. Exposed bedrock?			N/A
e. Is bedrock deteriorating?			N/A
f. Visible displacements?			N/A
<b>3. STRUCTURAL AND CRIB TIMBERS</b>			TYPE: Not a timber dam
a. Any deterioration?			N/A
b. Are ends broomed or checked?			N/A
c. Are timbers preservation treated?			N/A
d. Are timbers pinned or bolted?			N/A
<b>4. CRIBS</b>			
a. Are cribs filled with rock fill?			N/A
b. Is rock fill sound rock?			N/A



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**SPILLWAYS**

ITEM	YES	NO	REMARKS
<b>SPILLWAYS</b>			TYPE(S): No Spillways
<b>1. CREST</b>			TYPE(S):
a. Any settlement?			N/A
b. Any misalignment?			N/A
c. Any cracking?			N/A
d. Any deterioration?			N/A
e. Exposed reinforcement?			N/A
f. Erosion?			N/A
g. Silt deposits upstream?			N/A
<b>2. CONTROL STRUCTURES</b>			
a. Mechanical equipment operable?			N/A
b. Are gates maintained?			N/A
c. Will flashboards trip automatically?			N/A
d. Are stanchions trippable?			N/A
e. Are gates remotely controlled?			N/A
<b>3. CHUTE</b>			
a. Any cracking?			N/A
b. Any deterioration?			N/A
c. Erosion?			N/A
d. Seepage at lines or joints?			N/A
<b>4. ENERGY DISSIPATERS</b>			
a. Any deterioration?			N/A
b. Erosion?			N/A
c. Exposed reinforcement?			N/A
<b>5. METAL APPURTENANCES</b>			
a. Corrosion?			N/A
b. Breakage?			N/A
c. Secure anchorages?			N/A
<b>6. EMERGENCY SPILLWAY</b>			
a. Adequate grass cover?			N/A
b. Clear approach channel?			N/A
c. Erodible downstream channel?			N/A
d. Erodible fuse plug?			N/A
e. Stable side slopes?			N/A
f. Beaver dams present?			N/A



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**LOW LEVEL OUTLET**

ITEM	YES	NO	REMARKS
<b>LOW LEVEL OUTLET</b>			TYPE: No low level outlet
<b>1. GATES</b>			
a. Mechanical equipment operable?			N/A
b. Are gates remotely operated?			N/A
c. Are gates maintained?			N/A
<b>2. CONCRETE CONDUITS</b>			
a. Any cracking?			N/A
b. Any deterioration?			N/A
c. Erosion?			N/A
d. Exposed reinforcement?			N/A
e. Are joints displayed?			N/A
f. Are joints leaking?			N/A
<b>3. METAL CONDUITS</b>			
a. Is metal corroded?			N/A
b. Is conduit cracked?			N/A
c. Are joints displaced?			N/A
d. Are joints leaking?			N/A
<b>4. ENERGY DISSIPATERS</b>			
a. Any deterioration?			N/A
b. Exposed reinforcement?			N/A
<b>5. METAL APPURTENANCES</b>			
a. Corrosion?			N/A
b. Breakage?			N/A
c. Secure anchorages?			N/A



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**INTAKES**

ITEM	YES	NO	REMARKS
<b>INTAKES</b>			No Intakes
<b>1. EQUIPMENT</b>			
a. Trash racks			N/A
b. Trash rake?			N/A
c. Mechanical equipment operable?			N/A
d. Intake gates?			N/A
e. Are racks and gates operable?			N/A
f. Are gate operators operable?			N/A
<b>2. CONCRETE SURFACES</b>			
a. Any cracking?			N/A
b. Any deterioration?			N/A
c. Erosion?			N/A
d. Exposed reinforcement?			N/A
e. Are joints displaced?			N/A
f. Are joints leaking?			N/A
<b>3. CONCRETE CONDUITS</b>			
a. Any cracking?			N/A
b. Any deterioration?			N/A
c. Erosion?			N/A
d. Exposed reinforcement?			N/A
e. Are joints displaced?			N/A
f. Are joints leaking?			N/A
<b>4. METAL CONDUITS</b>			
a. Is metal corroded?			N/A
b. Is conduit damaged?			N/A
c. Are joints displaced?			N/A
d. Are joints leaking?			N/A
<b>5. METAL APPURTENANCES</b>			
a. Corrosion?			N/A
b. Breakage?			N/A
c. Secure anchorages?			N/A
<b>6. PENSTOCKS</b>			TYPE MATERIAL: No Penstocks
a. Material deterioration?			N/A
b. Joints leaking?			N/A
c. Supports adequate?			N/A
d. Anchor blocks stable?			N/A



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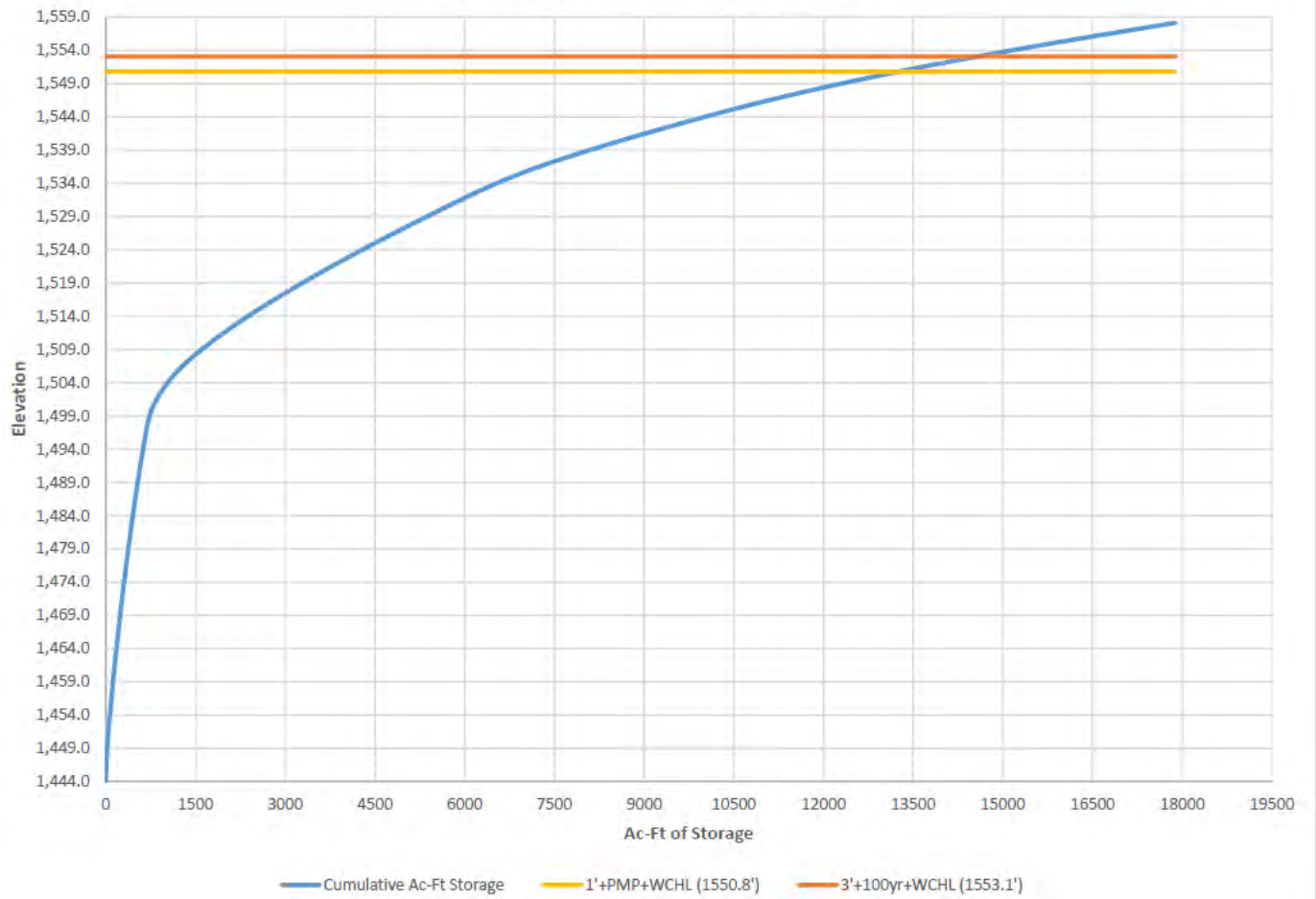
**CONCRETE DAMS**

ITEM	YES	NO	REMARKS
<b>CONCRETE DAMS</b>			TYPE OF DAM: Not a concrete dam
<b>1. CREST</b>			
a. Any settlement?			N/A
b. Any misalignment?			N/A
c. Any cracking?			N/A
d. Any deterioration?			N/A
e. Exposed reinforcement?			N/A
d. Adequate freeboard?			N/A
<b>2. UPSTREAM FACE</b>			
a. Spalling?			N/A
b. Cracking?			N/A
c. Erosion?			N/A
d. Deterioration?			N/A
e. Exposed reinforcement?			N/A
f. Displacement?			N/A
g. Loss of joint fillers?			N/A
h. Damage to membranes?			N/A
i. Silt deposits upstream?			N/A
<b>3. DOWNSTREAM FACE</b>			TYPE: Not Concrete
a. Spalling?			N/A
b. Cracking?			N/A
c. Erosion?			N/A
d. Deterioration?			N/A
e. Exposed reinforcement?			N/A
f. Inspection gallery?			N/A
g. Foundation drains?			N/A
h. Foundation drains clear and flowing?			N/A
i. Seepage from joints?			N/A
j. Seepage from lift lines?			N/A
<b>4. ABUTMENT &amp; FOUNDATION CONTACTS</b>			
a. Exposed bedrock?			N/A
b. Erosion?			N/A
c. Visible displacement?			N/A
d. Seepage from contact?			N/A
e. Boils or springs downstream?			N/A

## **Appendix F**

### **Tailing Facility Stage Storage Curve**

TSF Stage Storage - 1558.16 Seal Zone



# **Appendix G**

## **Deposition Plan**

