

KINROSS

Fort Knox

**WALTER CREEK VALLEY FILL
HEAP LEACH PAD
OPERATIONS & MAINTENANCE MANUAL
REVISION 15**

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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

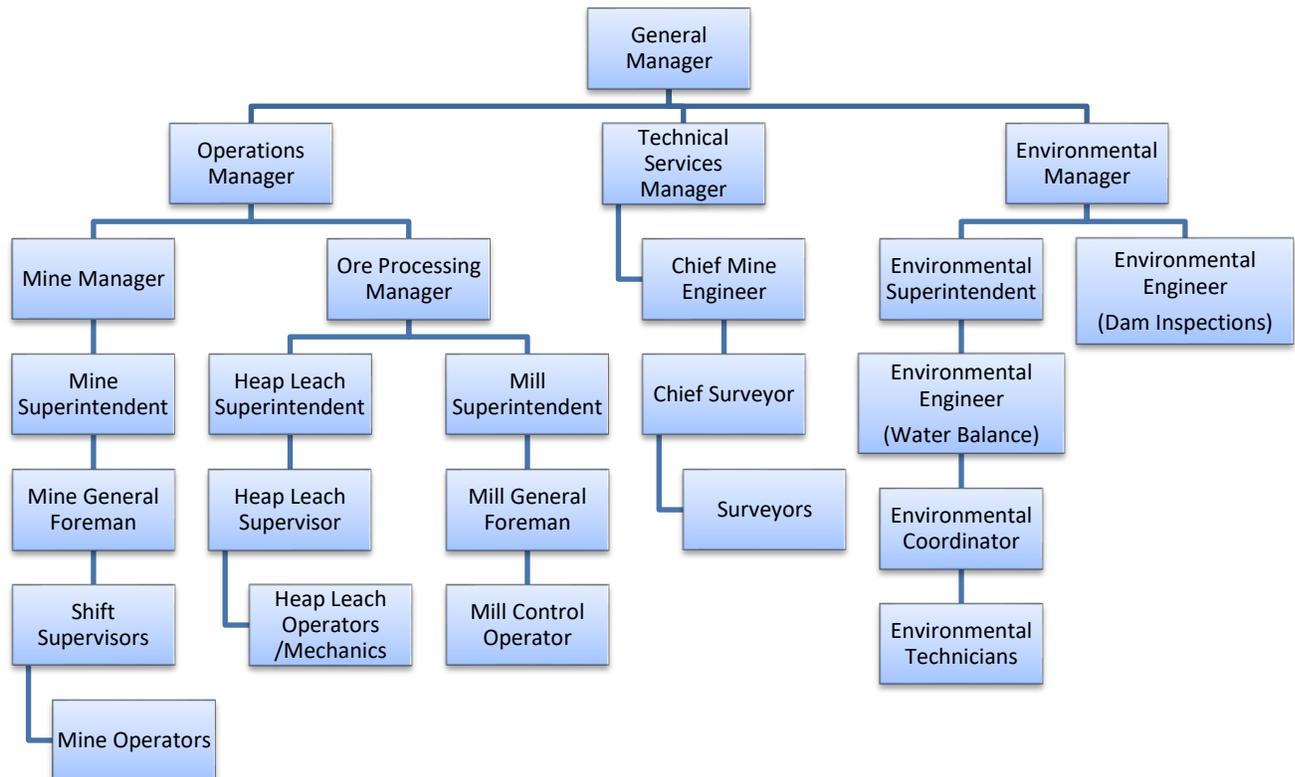


Table 1-1 – WCHL O&M Responsibilities

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
Ore Processing 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 manager 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.

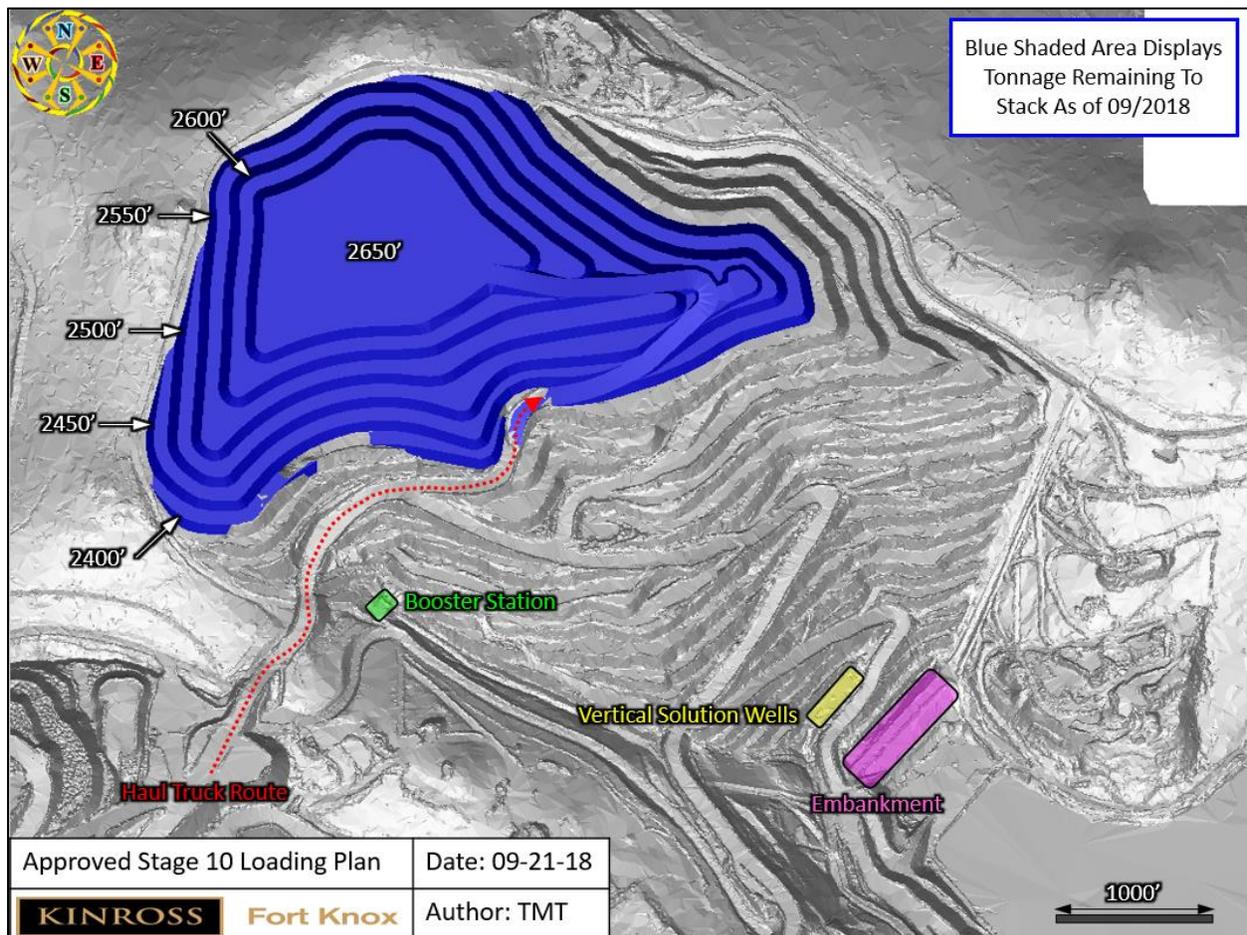
2.2 Ore Heap

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

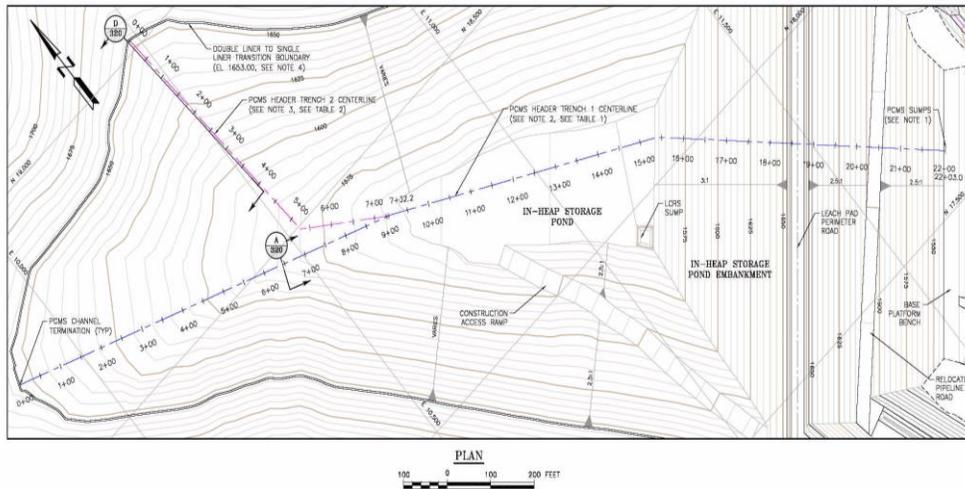
The in-heap storage pond embankment has been designed to provide containment of process solution and any precipitation amounts up to a 100-year/24-hour design storm event.

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



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

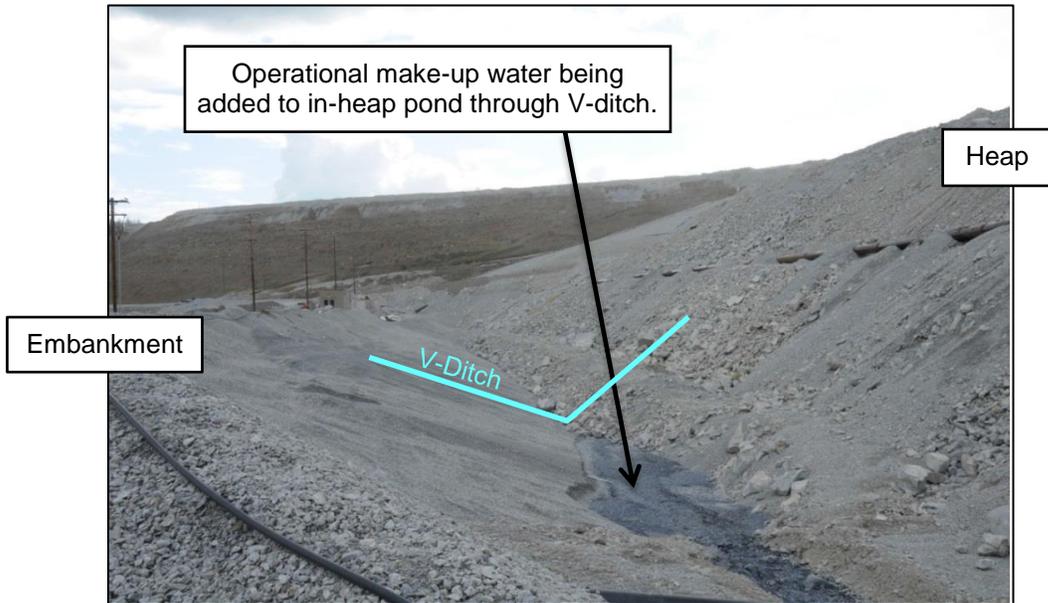


Figure 2-7 – V Ditch Looking North



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.

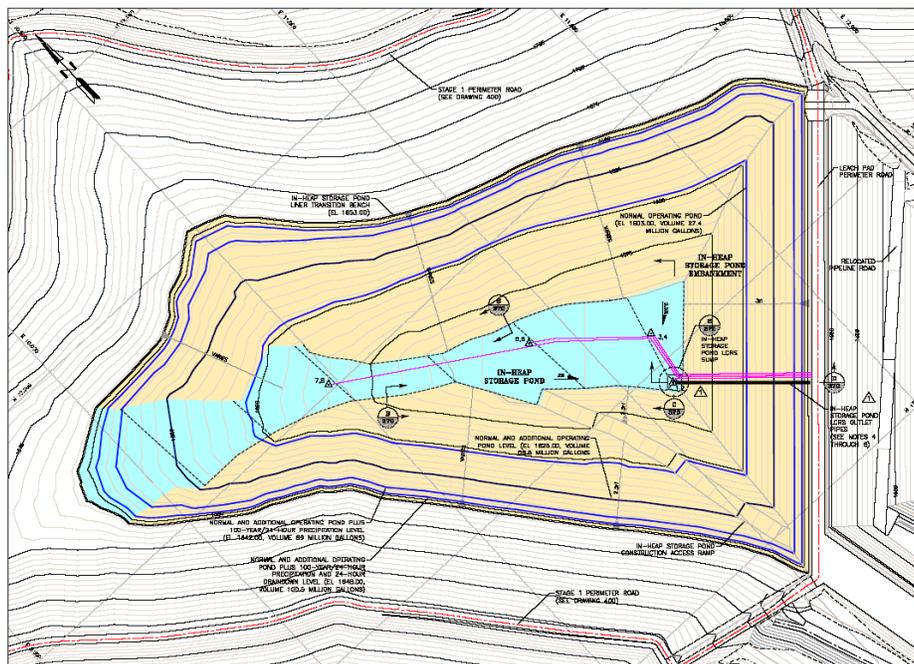
Heap leach operations using drip emitters was initiated in early 2010 at the rate of 8,000 gpm. Following the completed installation of two new vertical extraction wells in 2012, the application rate was doubled to 16,000 gpm. In 2018, FGMI secured a new permit, which allowed for an increased solution 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:

- A. Maximum normal operating level
- B. 24-hour draindown volume
- C. The 100-year/24-hour storm event potential contribution
- D. 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 3-29).

- 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 19th 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 18th the operating level of the pond was at elevation 1609. Based on the aforementioned factors, the pond elevation peaked at elevation 1631'. On August 20th 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

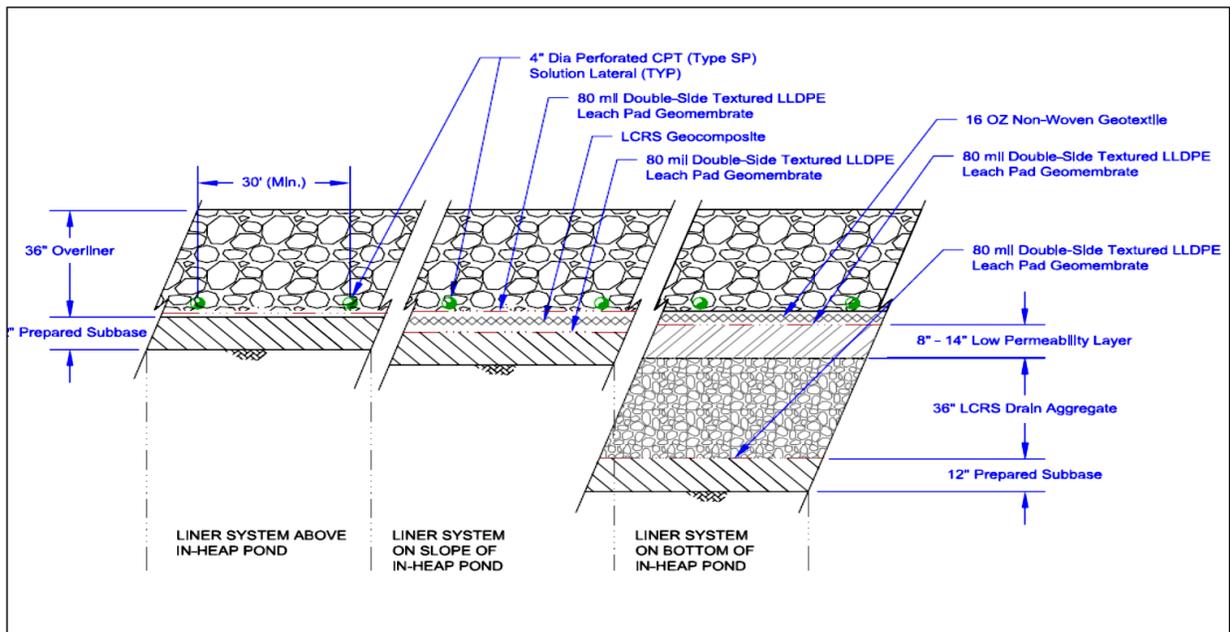
- 1) 12-inch-thick low permeability prepared sub base
- 2) 80-mil double-side textured Linear Low Density Polyethylene (LLDPE) geomembrane liner, this is a secondary containment layer
- 3) A leachate collection recovery system (LCRS) which is composed of either:
 - a. geocomposite drain, used along valley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



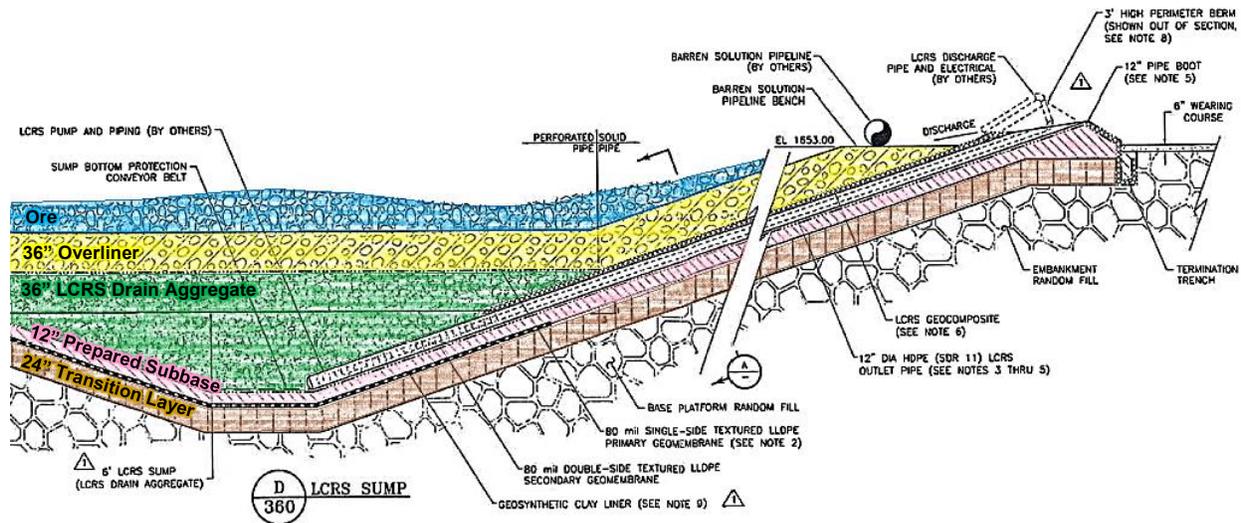
2.5.1 Leachate Collection and Recovery System (LCRS) Detail

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 through 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-feet by 6-feet-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.

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.

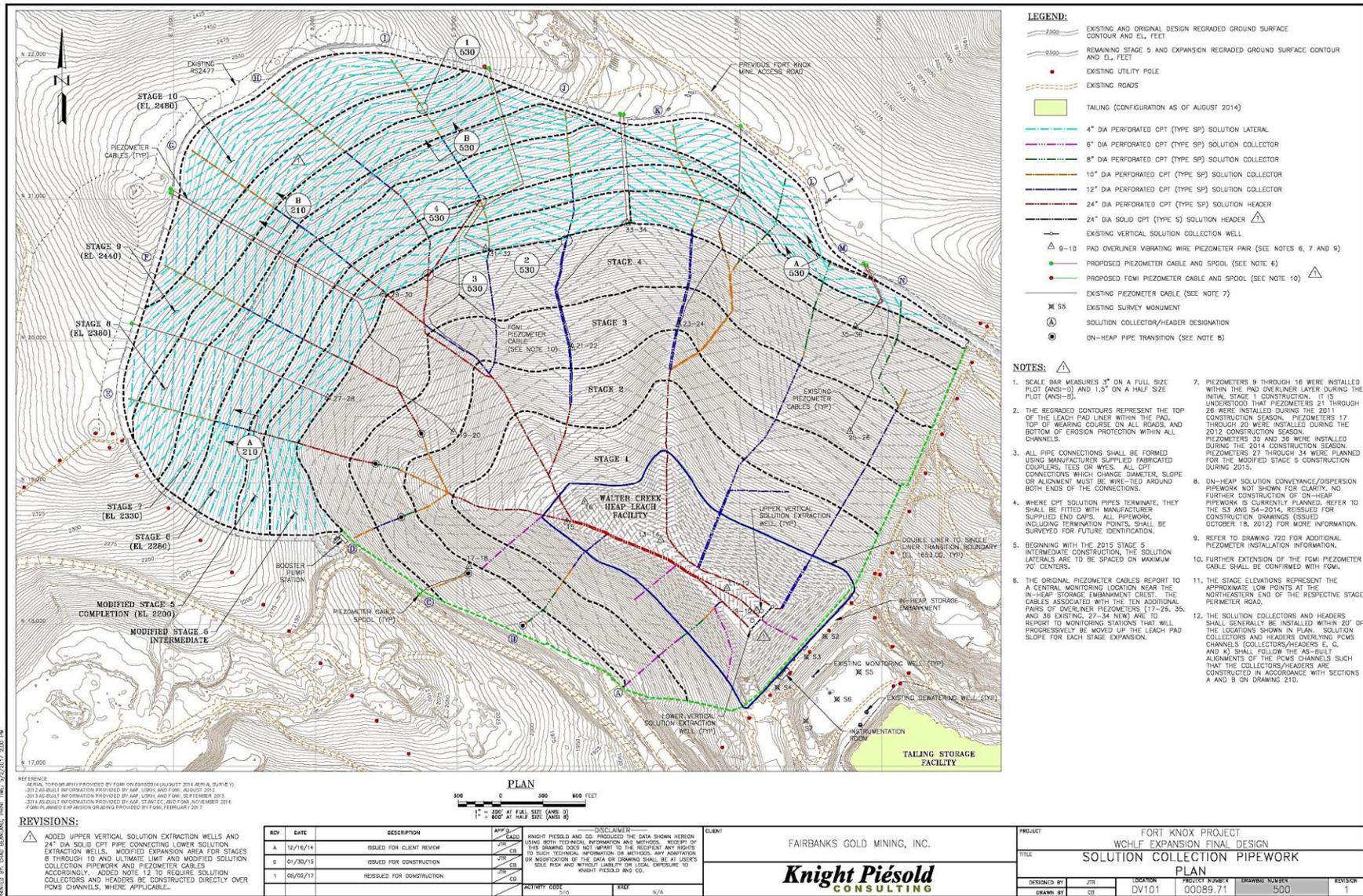
In 2017, another assessment was performed on a potential solution application rate of 20,000 gpm. The methodology followed the same logic seen in the WCHL Expansion final design report and considered the points below:

- 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 assessable. 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.

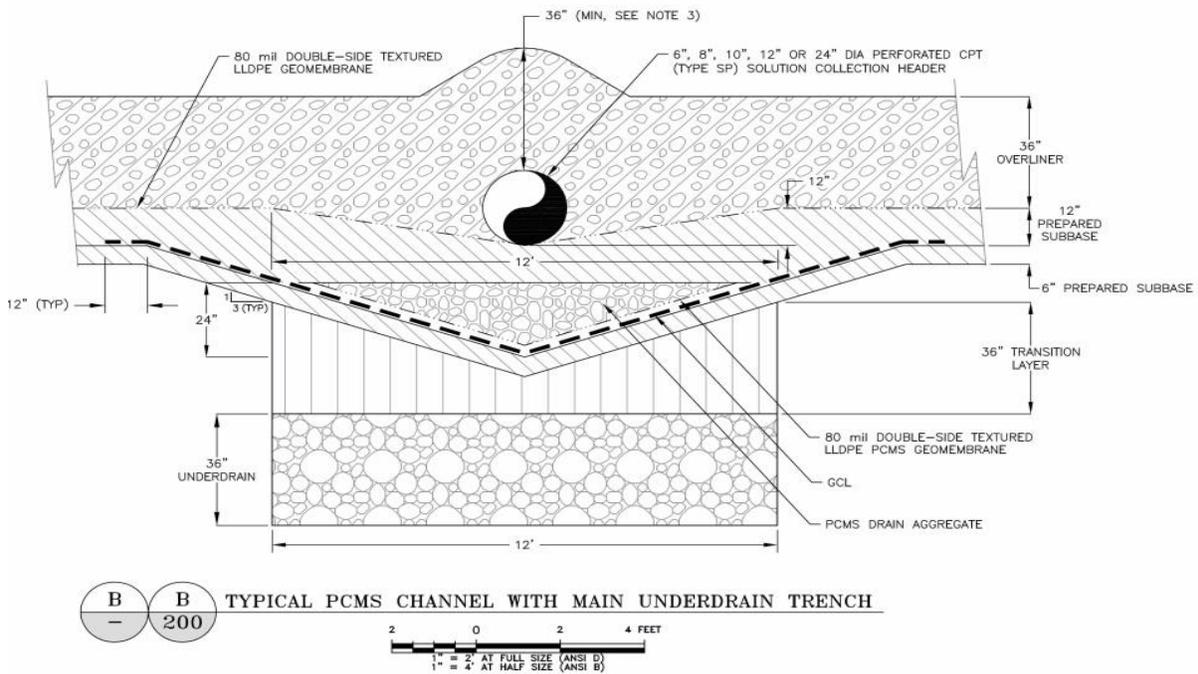
2.6 Process Component Monitoring System (PCMS)

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.

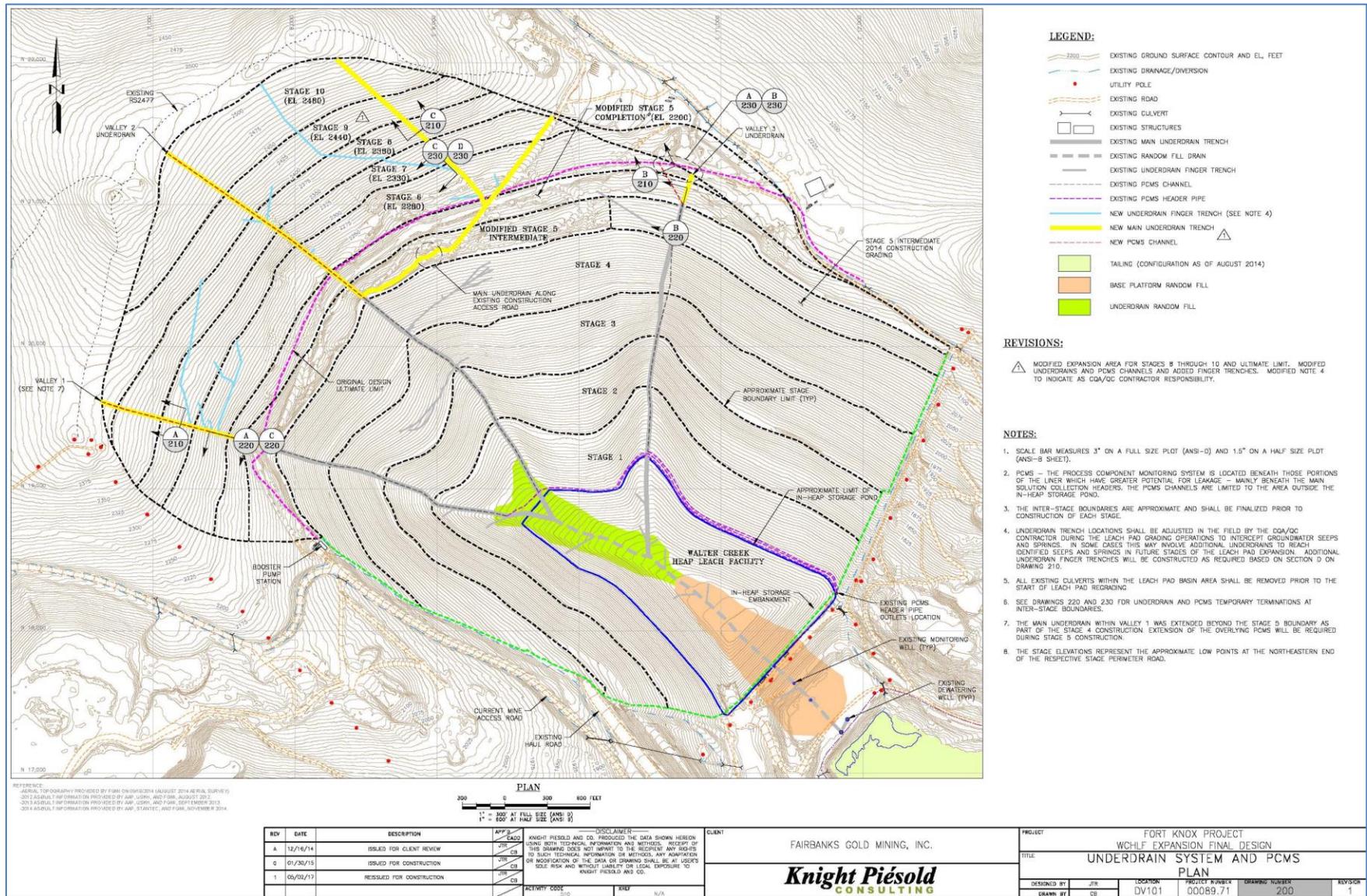
In the three drainages, the PCMS consists of a lined “V” channel filled with pervious PCMS drain aggregate. The design width of the top of the PCMS channel is 12 feet, and the depth is 2 feet. The composite liner for the channel includes a geosynthetic clay liner (GCL) overlain by an 80-mil double-side 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 constricted 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. In theory, when operating they will effectively reduce pressures from developing at the underside of the in-heap storage pond liner system. Per design, the pumps need to be operating when the TSF pond water elevation reaches 1540' or higher. Water elevations are such that continuous pumping is now required.

Due to the high transmissivity properties of the random fill used to construct the TSF/HL interface, water from the north pond and rejected Reverse Osmosis (RO) water easily recharges this area, reducing the effectiveness of the pumping efforts. As of February 2018, tailings deposition at the interface was at 1556' in the southwest corner and 1553' at the northeast corner. Knight Piésold is currently evaluating increases to tailings capacity in which they will study and account for any effects on the interface.

Increased water levels in the wells does not pose a geotechnical stability issue for the WCHL facility or dam. Potential uplift on the LCRS liner is undesirable for a number of reasons, but mainly due to the potential for infiltration of groundwater into the LCRS. Review of the LCRS water quality data and pumping volumes indicate there is currently no infiltration of decant water or groundwater into the LCRS.

A permanent pump is installed in Dewatering Well 1. The water elevation in DW 1 is typically 5 feet lower than DW 2.

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

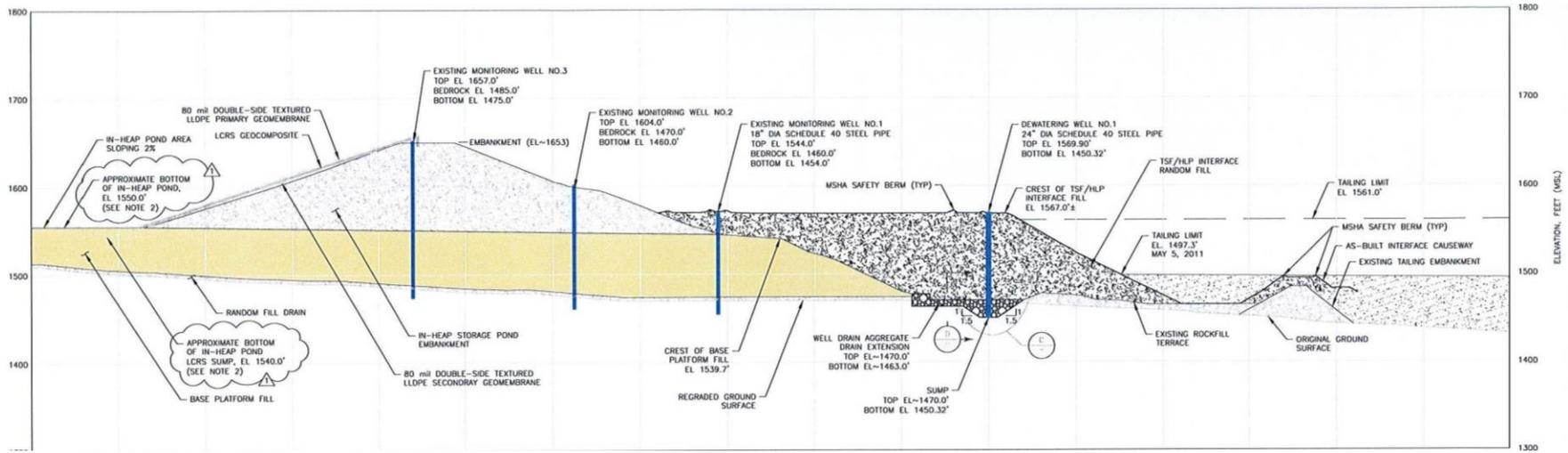
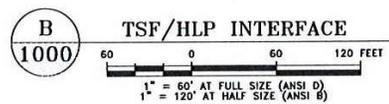
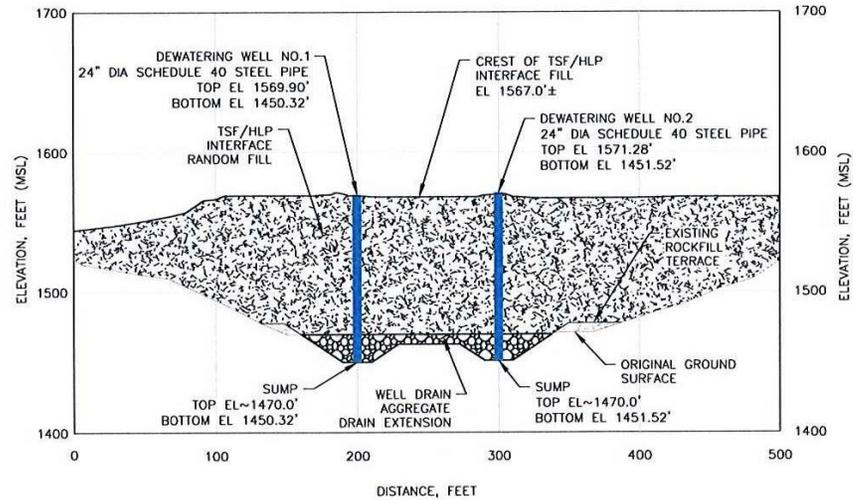


Figure 2-15 – TSF/HPL Interface Dewatering Well General Description



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

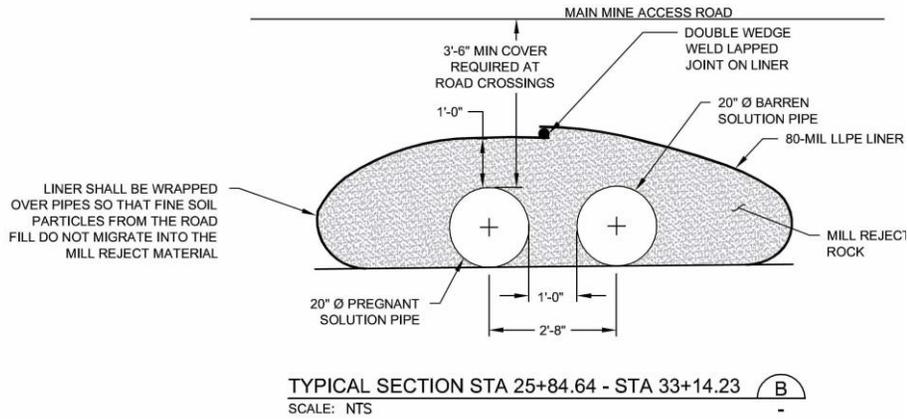


Figure 2-18 – Pipeline Corridor Detail 3

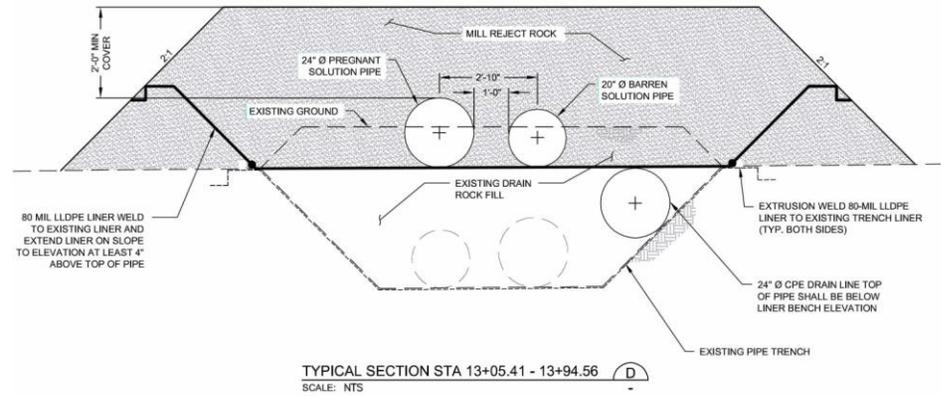


Figure 2-17 – Pipeline Corridor Detail 2

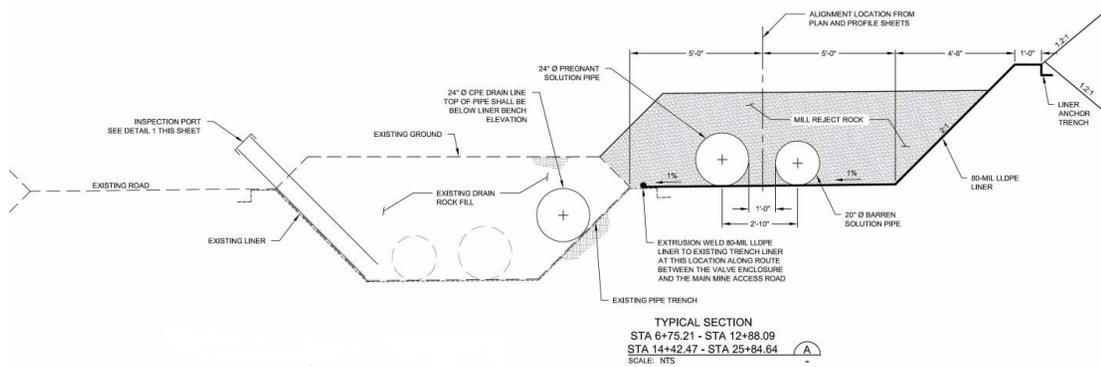
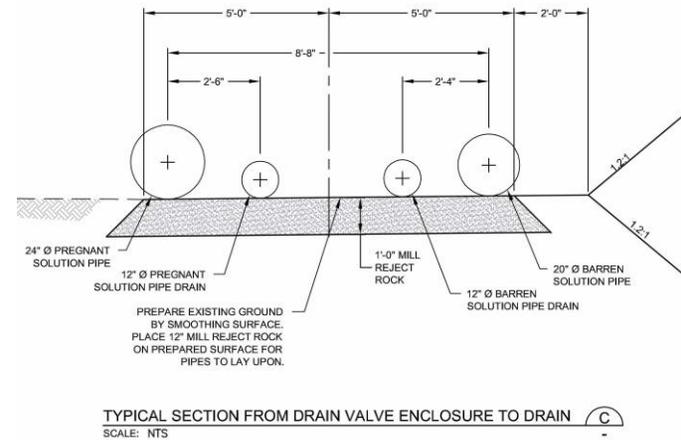


Figure 2-19 – Pipeline Corridor Detail 4



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. There are several slope stability monitoring prisms located along the length of the steel pipelines. These prisms are automatically monitored twice a day by a robotic survey instrument. In the event of movement, the system will send out alerts and prompt follow-up field inspection.

2.10 Automatic Stability Monitoring

Fort Knox started automatic stability monitoring of the WCHL heap on September 2nd 2017. Movement monitoring data is collected by a Trimble S6 robotic total station which shoots prisms placed on the pad. Data analysis, monitoring, and alert notification is managed through the Trimble 4D Control system (T4D). The T4D system allows for visualization and tracking for any occurrence of displacement and quantifies speed, direction and magnitude of an event.

2.11 Perimeter Roads and Surface Water Diversions

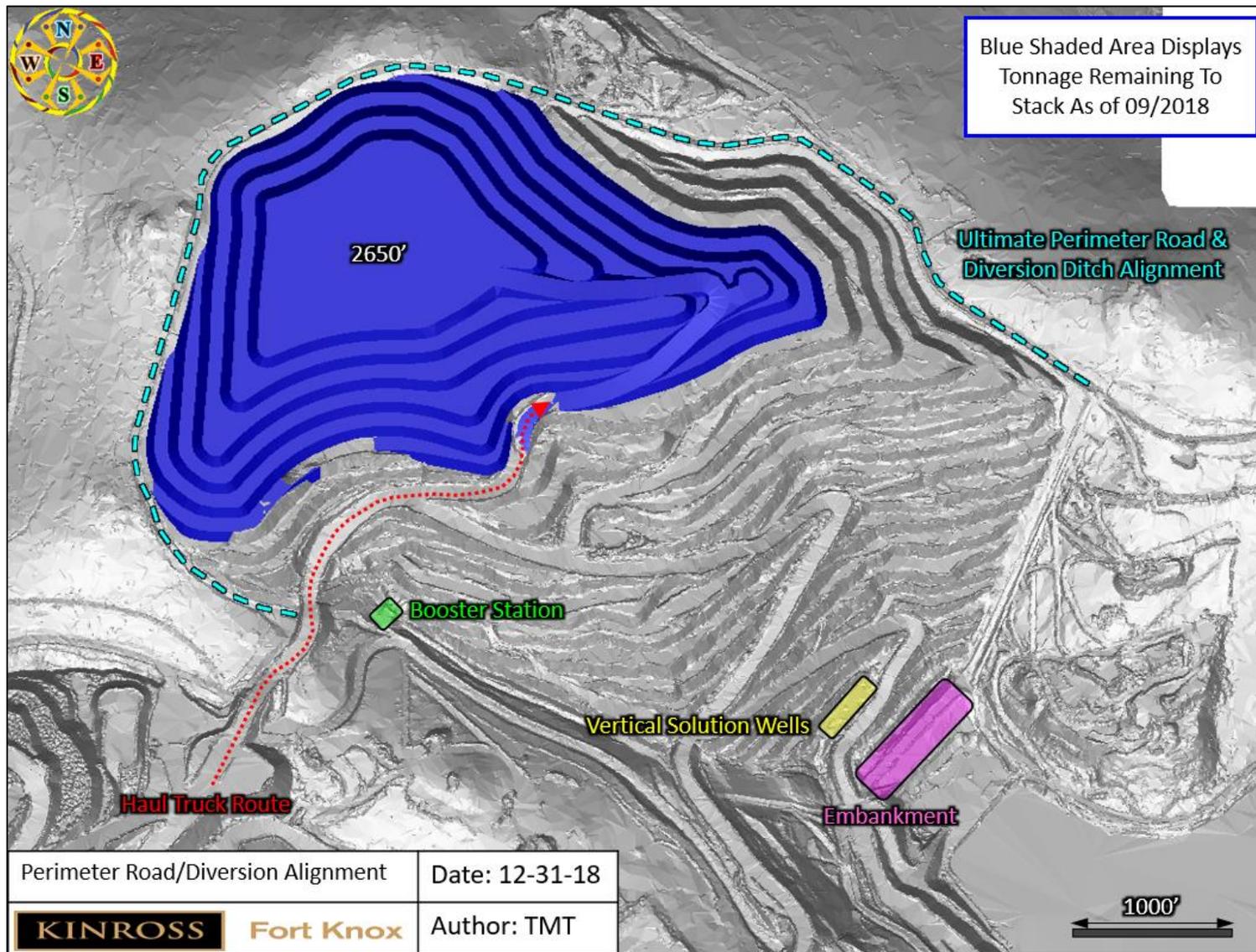
The WCHL perimeter road will typically run along exterior perimeter of the ultimate WCHL footprint. The ultimate perimeter road will start above the booster pump station on the southwestern side of the pad and run up and around the entire exterior perimeter of the ultimate (Stage 10) pad area and then cross 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 has been designed with a 16-ft running width to provide construction and maintenance access. A diversion channel will run adjacent to the ultimate perimeter road to convey runoff around the facility from the upstream catchments. Because the ultimate perimeter road and diversion channel will typically be 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

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:

- The Chief Surveyor or 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
 - 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.

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

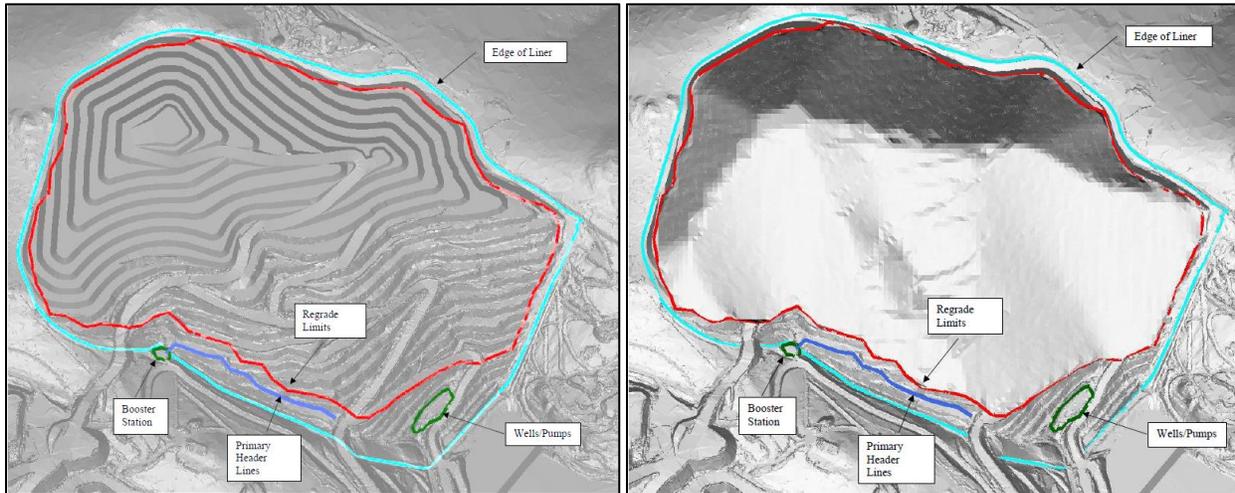
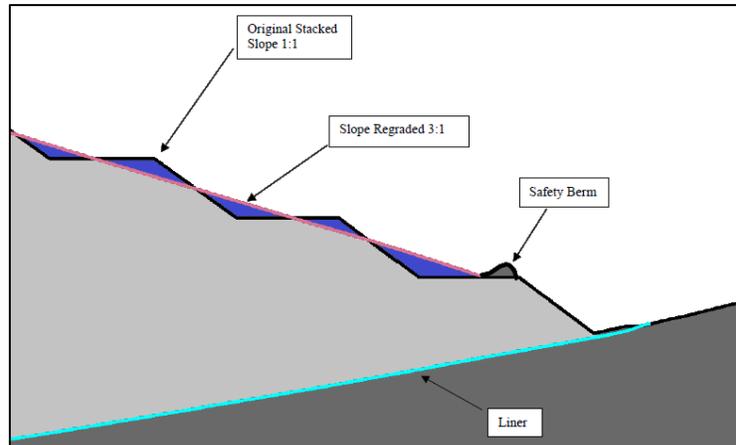


Figure 3-2 – Regraded Slope Section

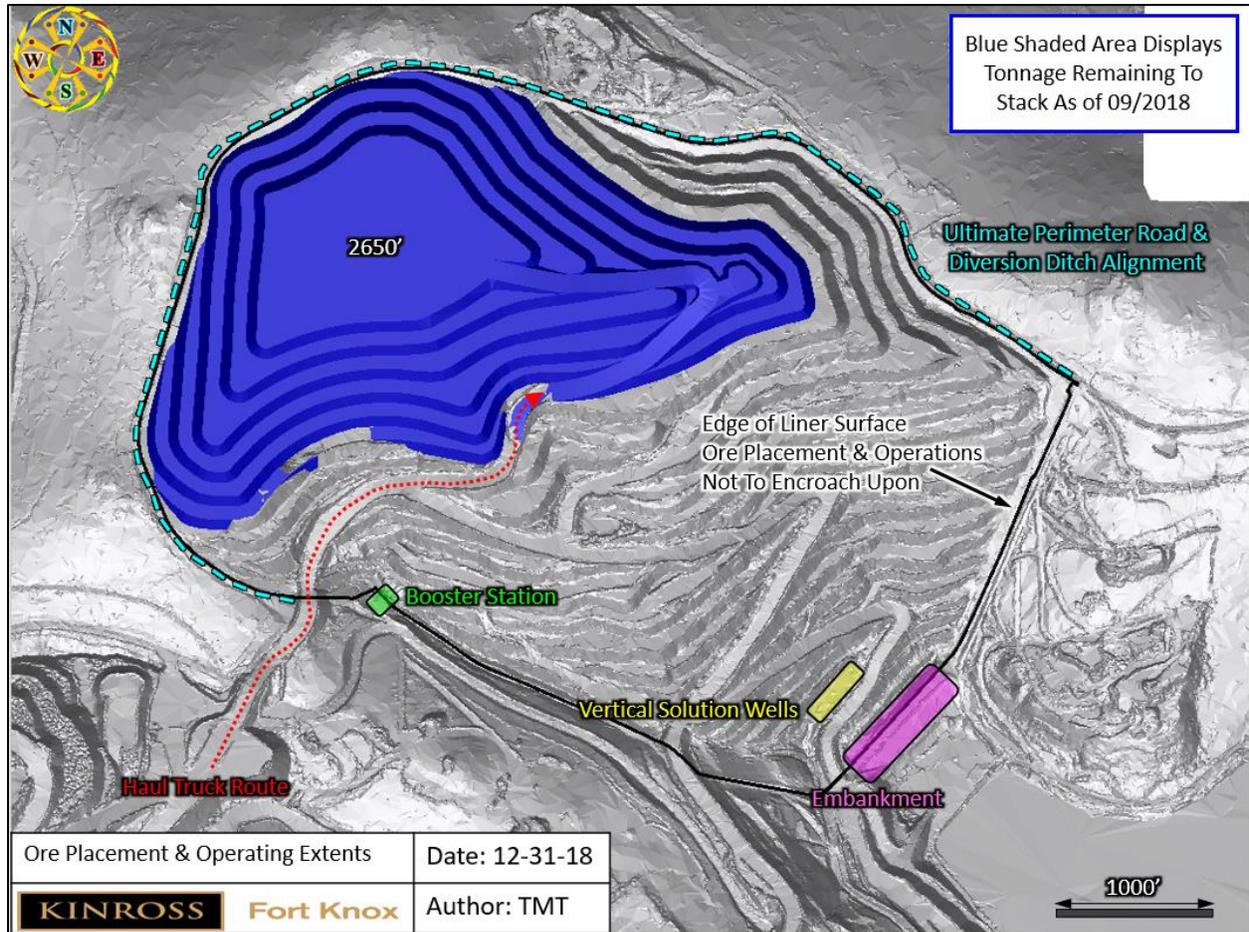


Ore is placed under leach at a rate of up to 20,000 gpm or up to a unit rate of 0.005 gpm/ft². At any one time there can be up to 4.0M ft² of ore being leached at the prescribed unit rate. Under the direction of the Chief Metallurgist or their delegate, FGMI may choose to increase the amount of area under leach through the lowering of the application rate to less than 0.005 gpm/ft². 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 that new ore is not placed on snow with accumulations of greater than 6 inches in thickness
- 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

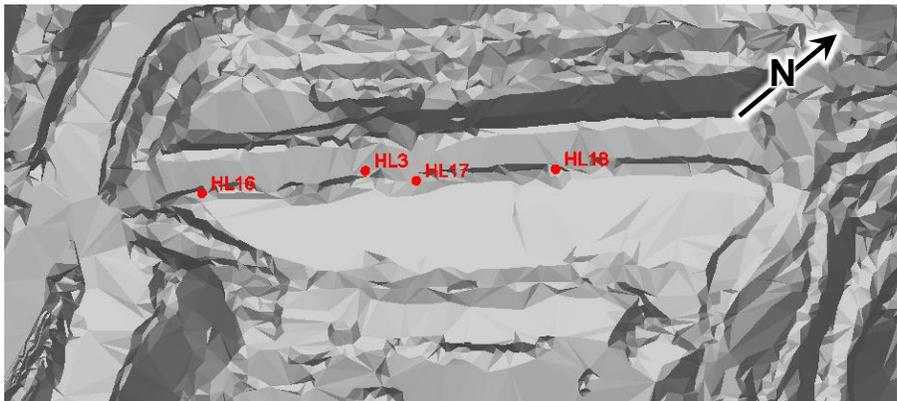
Spillway & Downstream Channel – Must be inspected if a rainfall event of 0.5” over 24 hrs occurs

- 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 8 or lower – 1616.1' Maximum Normal Operating Pond Level
- Ore Stacking on Stage 9 or lower – 1614.5' Maximum Normal Operating Pond Level
- 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 Stacking on Stage 8 or lower – 1606.5' Maximum Normal Operating Pond Level
- Ore Stacking on Stage 9 or lower – 1604.5' Maximum Normal Operating Pond Level
- 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 – Stage Storage Components @ 20,000gpm



Ms. Bartly Kleven and Messrs. Craig Natrop and Jose Pedro Bolanos Arias
Fairbanks Gold Mining, Inc.

August 29, 2017

Table 5
In-Heap Pond Storage Component Summary considering Recirculation and No Recirculation, and considering 20,000 gpm Total Solution Flow

Stage	4		5 Intermediate		5 Completion		6		7		8		9		10	
2-Dimensional Pad Area ⁽¹⁾	10.54 M sf		11.99 M sf		13.04 M sf		14.39 M sf		15.26 M sf		16.59 M sf		17.44 M sf		18.43 M sf	
Component	Elev (fmsl)	Storage (M gal)	Elev (fmsl)	Storage (M gal)	Elev (fmsl)	Storage (M gal)	Elev (fmsl)	Storage (M gal)	Elev (fmsl)	Storage (M gal)	Elev (fmsl)	Storage (M gal)	Elev (fmsl)	Storage (M gal)	Elev (fmsl)	Storage (M gal)
Maximum Normal Operating Level ^(2,3,4) (8,000gpm recirc)	1626.5	57.7	1624.2	54.1	1622.4	51.5	1620.1	48.1	1618.5	46.0	1616.1	42.7	1614.5	40.6	1612.5	38.1
100-yr/24-hr Storm Event ^(3,4) (8,000 gpm recirc)	1626.5 to 1641	26.2	1624.2 to 1641	29.7	1622.4 to 1641	32.4	1620.1 to 1641	35.7	1618.5 to 1641	37.9	1616.1 to 1641	41.2	1614.5 to 1641	43.3	1612.5 to 1641	45.7
24-hr Emergency Draindown ⁽⁴⁾ (8,000 gpm recirc)	1641 to 1648	17.3	1641 to 1648	17.3	1641 to 1648	17.3	1641 to 1648	17.3	1641 to 1648	17.3	1641 to 1648	17.3	1641 to 1648	17.3	1641 to 1648	17.3
Maximum Normal Operating Level ^(2,3,4) (no recirculation)	1618.7	46.2	1616.0	42.6	1614.0	40.0	1611.3	36.6	1609.4	34.5	1606.5	31.2	1604.5	29.1	1602.1	26.6
100-yr/24-hr Storm Event ^(3,4) (no recirculation)	1618.7 to 1635.2	26.2	1616 to 1635.2	29.7	1614 to 1635.2	32.4	1611.3 to 1635.2	35.7	1609.4 to 1635.2	37.9	1606.5 to 1635.2	41.2	1604.5 to 1635.2	43.3	1602.1 to 1635.2	45.7
24-hr Emergency Draindown ⁽⁴⁾ (no recirculation)	1635.2 to 1648	28.8	1635.2 to 1648	28.8	1635.2 to 1648	28.8	1635.2 to 1648	28.8	1635.2 to 1648	28.8	1635.2 to 1648	28.8	1635.2 to 1648	28.8	1635.2 to 1648	28.8
Freeboard Allowance (to spillway invert) ⁽⁵⁾	1648 to 1650.5	7.6	1648 to 1650.5	7.6	1648 to 1650.5	7.6	1648 to 1650.5	7.6	1648 to 1650.5	7.6	1648 to 1650.5	7.6	1648 to 1650.5	7.6	1648 to 1650.5	7.6
Freeboard Allowance (above spillway invert)	1650.5 to 1653	8.1	1650.5 to 1653	8.1	1650.5 to 1653	8.1	1650.5 to 1653	8.1	1650.5 to 1653	8.1	1650.5 to 1653	8.1	1650.5 to 1653	8.1	1650.5 to 1653	8.1
Total		116.8		116.8		116.8		116.8		116.8		116.8		116.8		116.8

Notes: 1. The pad areas shown represent the cumulative 2-dimensional areas through the remaining staged development (Stages 4 through 10) of the WCHLF.

2. The Maximum Normal Operating Level represents the maximum elevation the pond should be operated at any stage of the leach pad 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 1550 fmsl) to the elevations shown.

3. 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.

4. 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. Although FGMI has equipped the WCHLF with sufficient back-up power and redundant pumps such that 8,000 gpm would continue to be extracted from the in-heap pond and recirculated to the top of the ore heap, the 24-hr emergency draindown component was assessed based solution draindown rates of 12,000 gpm (i.e. considering 8,000 gpm recirculation) and 20,000 gpm (i.e. no recirculation). Due to the layering of the pond storage components, as presented, the components below the 24-hr Emergency Draindown are dependent on its storage requirement and elevation range.

5. During extreme conditions, flow will begin to pass through the spillway when water levels within the pond rise above this elevation. This could be from the design storm event acting on frozen ground conditions, or it could be due to extreme storm events above those established for the in-heap pond design criteria (i.e. greater than the 100-yr/24-hr storm event).

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

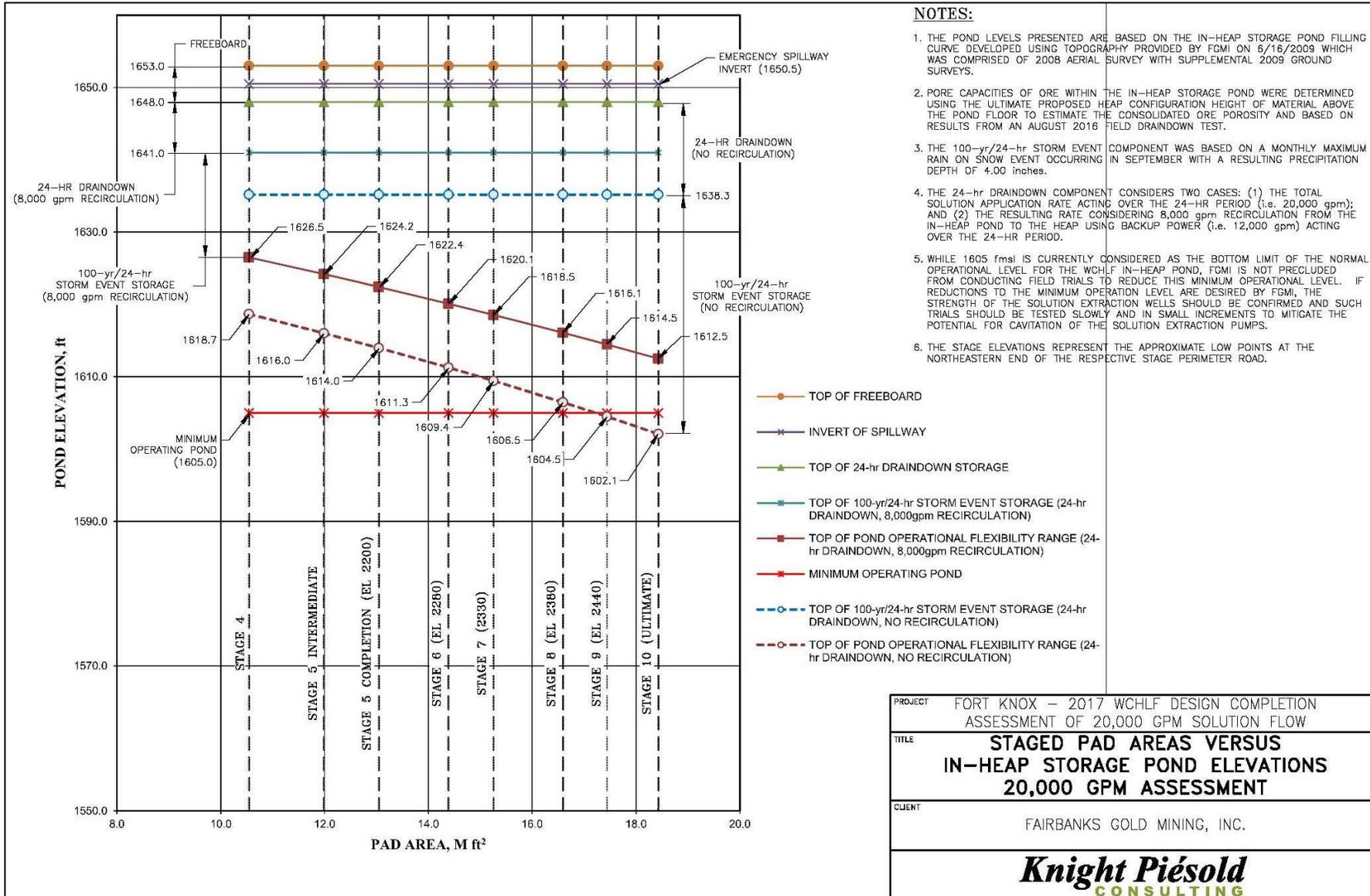
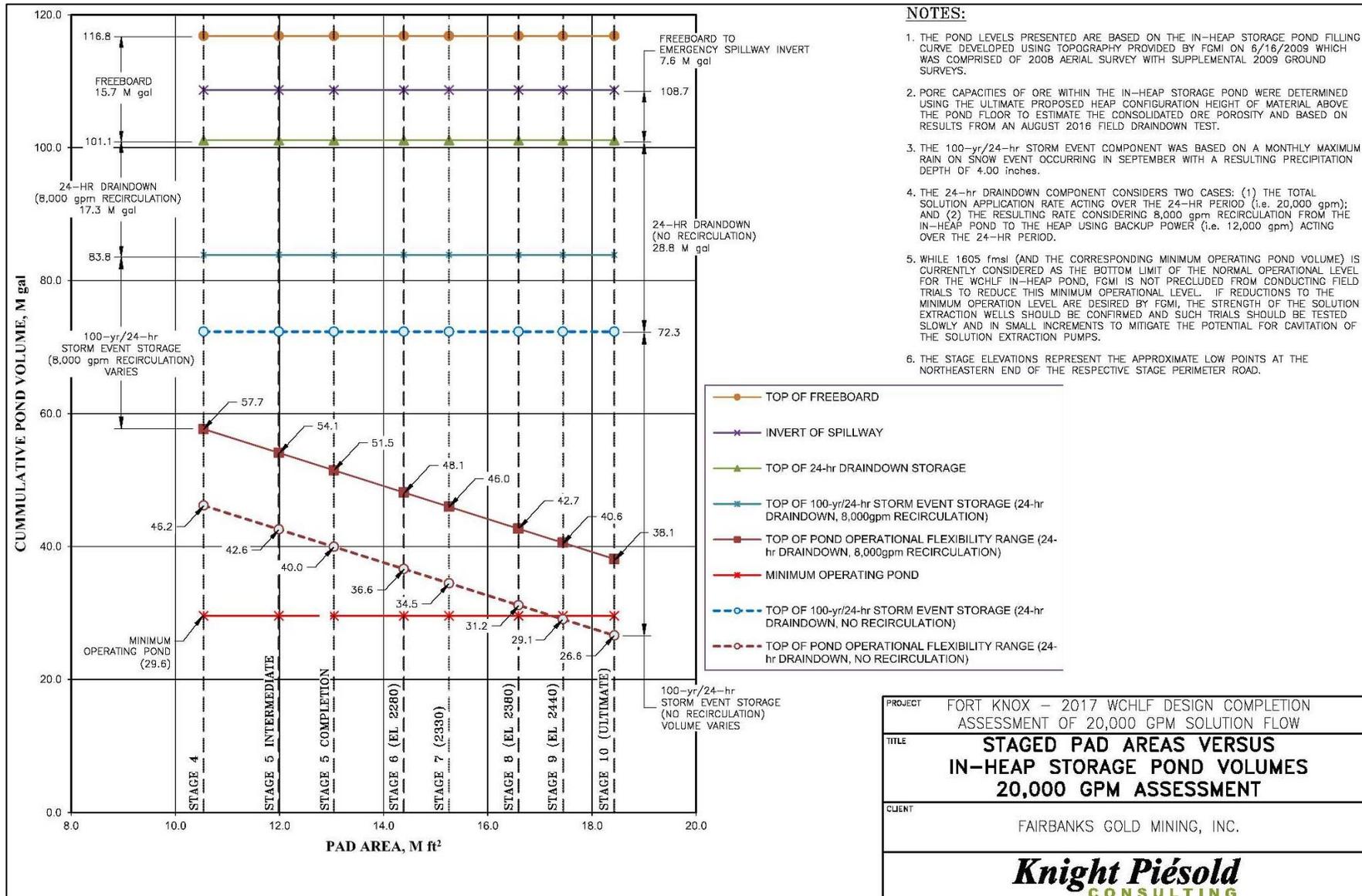
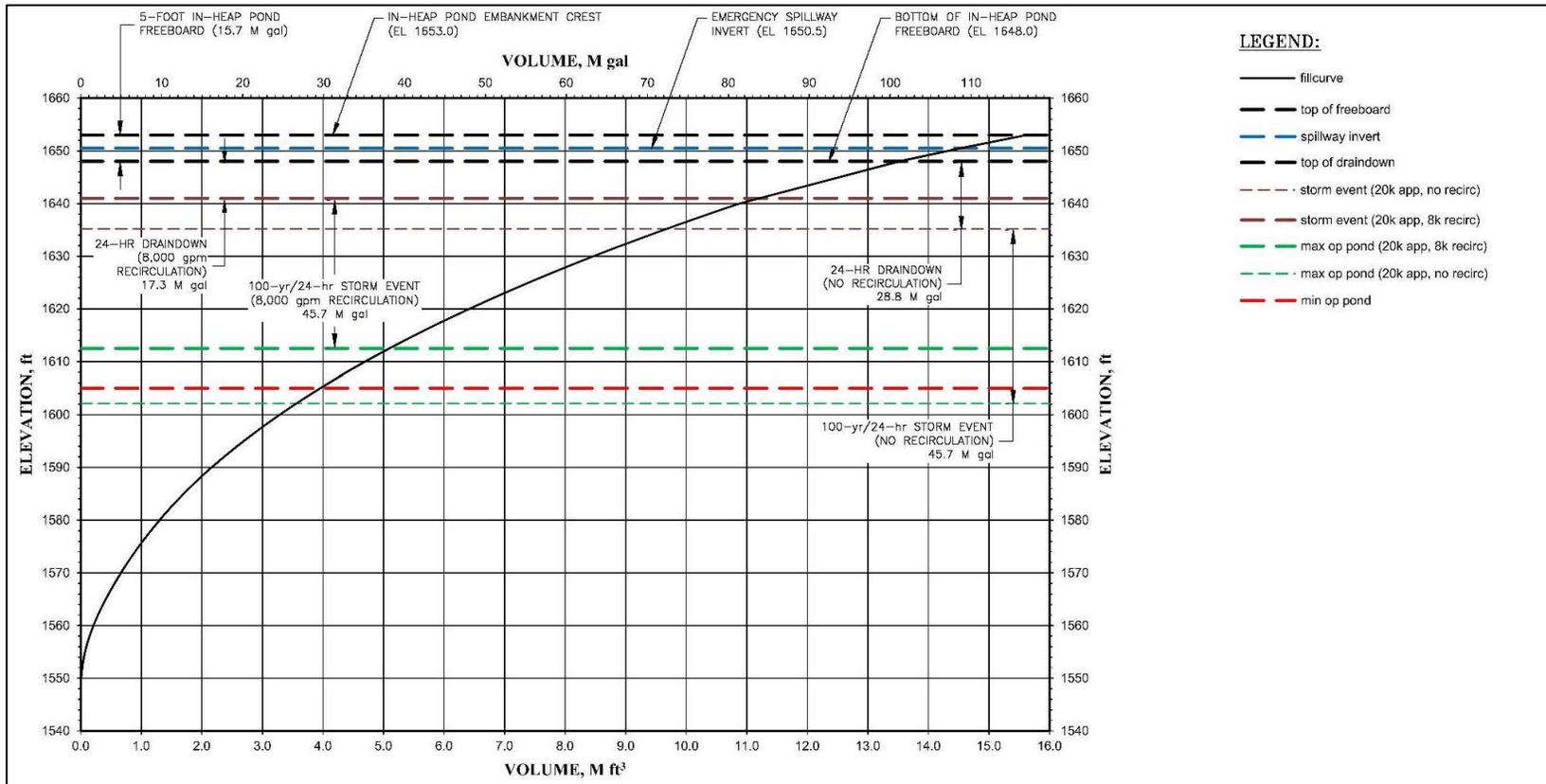


Figure 3-6 – Stage Pad Areas vs. Pond Volumes @ 20,000gpm



PROJECT	FORT KNOX – 2017 WCHLF DESIGN COMPLETION ASSESSMENT OF 20,000 GPM SOLUTION FLOW
TITLE	STAGED PAD AREAS VERSUS IN-HEAP STORAGE POND VOLUMES 20,000 GPM ASSESSMENT
CLIENT	FAIRBANKS GOLD MINING, INC.
<i>Knight Piésold</i> CONSULTING	

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



- LEGEND:**
- fill curve
 - - - top of freeboard
 - spillway invert
 - - - top of draindown
 - - - storm event (20k app, no recirc)
 - storm event (20k app, 8k recirc)
 - max op pond (20k app, 8k recirc)
 - - - max op pond (20k app, no recirc)
 - min op pond

NOTES:

1. THE POND LEVELS PRESENTED ARE BASED ON THE IN-HEAP STORAGE POND FILLING CURVE DEVELOPED USING TOPOGRAPHY PROVIDED BY FGMI ON 6/16/2009 WHICH WAS COMPRISED OF 2008 AERIAL SURVEY WITH SUPPLEMENTAL 2009 GROUND SURVEYS.
2. PORE CAPACITIES OF ORE WITHIN THE IN-HEAP STORAGE POND WERE DETERMINED USING THE ULTIMATE PROPOSED HEAP CONFIGURATION HEIGHT OF MATERIAL ABOVE THE POND FLOOR TO ESTIMATE THE CONSOLIDATED ORE POROSITY AND BASED ON RESULTS FROM AN AUGUST 2016 FIELD DRAINDOWN TEST.
3. THE 100-yr/24-hr STORM EVENT COMPONENT WAS BASED ON A MONTHLY MAXIMUM RAIN ON SNOW EVENT OCCURRING IN SEPTEMBER WITH A RESULTING PRECIPITATION DEPTH OF 4.00 inches.
4. THE 24-hr DRAINDOWN COMPONENT CONSIDERS TWO CASES: (1) THE TOTAL SOLUTION APPLICATION RATE ACTING OVER THE 24-hr PERIOD (i.e. 20,000 gpm); AND (2) THE RESULTING RATE CONSIDERING 8,000 gpm RECIRCULATION FROM THE IN-HEAP POND TO THE HEAP USING BACKUP POWER (i.e. 12,000 gpm) ACTING OVER THE 24-hr PERIOD.
5. WHILE 1605 fmsl IS CURRENTLY CONSIDERED AS THE BOTTOM LIMIT OF THE NORMAL OPERATIONAL LEVEL FOR THE WCHLF IN-HEAP POND, FGMI IS NOT PRECLUDED FROM CONDUCTING FIELD TRIALS TO REDUCE THIS MINIMUM OPERATIONAL LEVEL. IF REDUCTIONS TO THE MINIMUM OPERATION LEVEL ARE DESIRED BY FGMI, THE STRENGTH OF THE SOLUTION EXTRACTION WELLS SHOULD BE CONFIRMED AND SUCH TRIALS SHOULD BE TESTED SLOWLY AND IN SMALL INCREMENTS TO MITIGATE THE POTENTIAL FOR CAVITATION OF THE SOLUTION EXTRACTION PUMPS.

PROJECT	FORT KNOX – 2017 WCHLF DESIGN COMPLETION ASSESSMENT OF 20,000 GPM SOLUTION FLOW
TITLE	IN-HEAP STORAGE POND FILLING CURVE AND STAGE 10 STORAGE COMPONENTS 20,000 GPM ASSESSMENT
CLIENT	FAIRBANKS GOLD MINING, INC.
Knight Piésold CONSULTING	

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

Operations @ 16,000 GPM						
Stage	8		9		10	
2-Dimensional Pad Area ⁽¹⁾	16.59 M sf		17.44 M sf		18.43 M sf	
Component	Elev (fmsl)	Storage (M gal)	Elev (fmsl)	Storage (M gal)	Elev (fmsl)	Storage (M gal)
Maximum Normal Operating Level ^(2, 3, 4) (8,000gpm recirc)	1620.3	48.4	1618.8	46.3	1617.0	43.9
100-yr/24-hr Storm Event ^(3, 4) (8,000 gpm recirc)	1620.3 to 1643.3	41.2	1618.8 to 1643.3	43.3	1617 to 1643.3	45.7
24-hr Emergency Draindown ⁽⁴⁾ (8,000 gpm recirc)	1643.3 to 1648	11.5	1643.3 to 1648	11.5	1643.3 to 1648	11.5
Maximum Normal Operating Level ^(2, 3, 4) (no recirculation)	1611.5	36.9	1609.7	34.8	1607.6	32.4
100-yr/24-hr Storm Event ^(3, 4) (no recirculation)	1611.5 to 1638.3	41.2	1609.7 to 1638.3	43.3	1607.6 to 1638.3	45.7
24-hr Emergency Draindown ⁽⁴⁾ (no recirculation)	1638.3 to 1648	23.0	1638.3 to 1648	23.0	1638.3 to 1648	23.0
Freeboard Allowance (to spillway invert) ⁽⁵⁾	1648 to 1650.5	7.6	1648 to 1650.5	7.6	1648 to 1650.5	7.6
Freeboard Allowance (above spillway invert)	1650.5 to 1653	8.1	1650.5 to 1653	8.1	1650.5 to 1653	8.1
Total		116.8		116.8		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

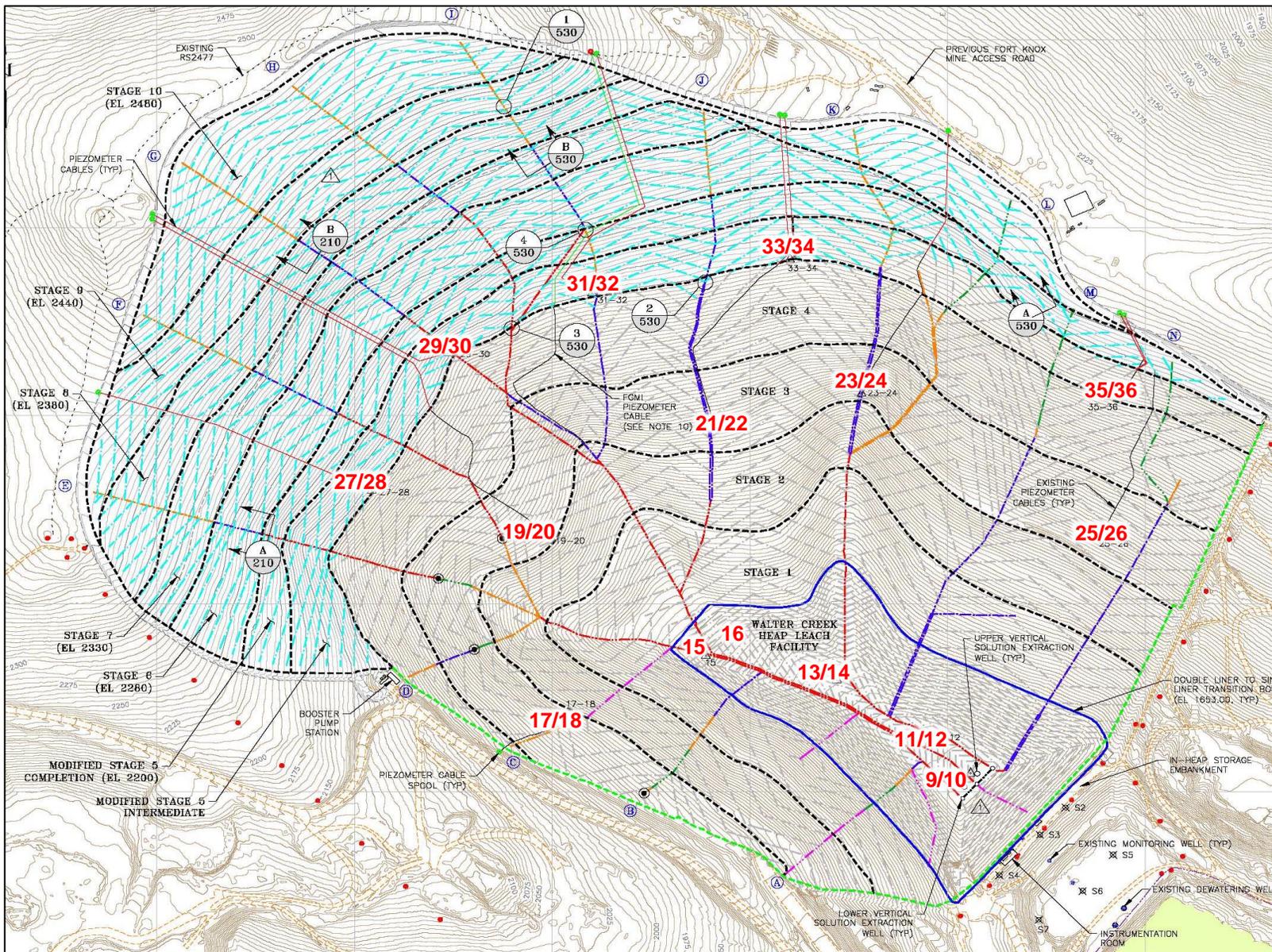
- Pairs 9-14 are installed in the in-heap pond area
- Pairs 15-16 are installed above the in-heap pond in stage 1 overliner
- Pairs 17-26 are installed in the stage 3 overliner
- Pairs 27-36 are installed in the stage 5 overliner

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 is 330 gpm. A pond level at elevation 1648 feet will result in an estimated 520 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

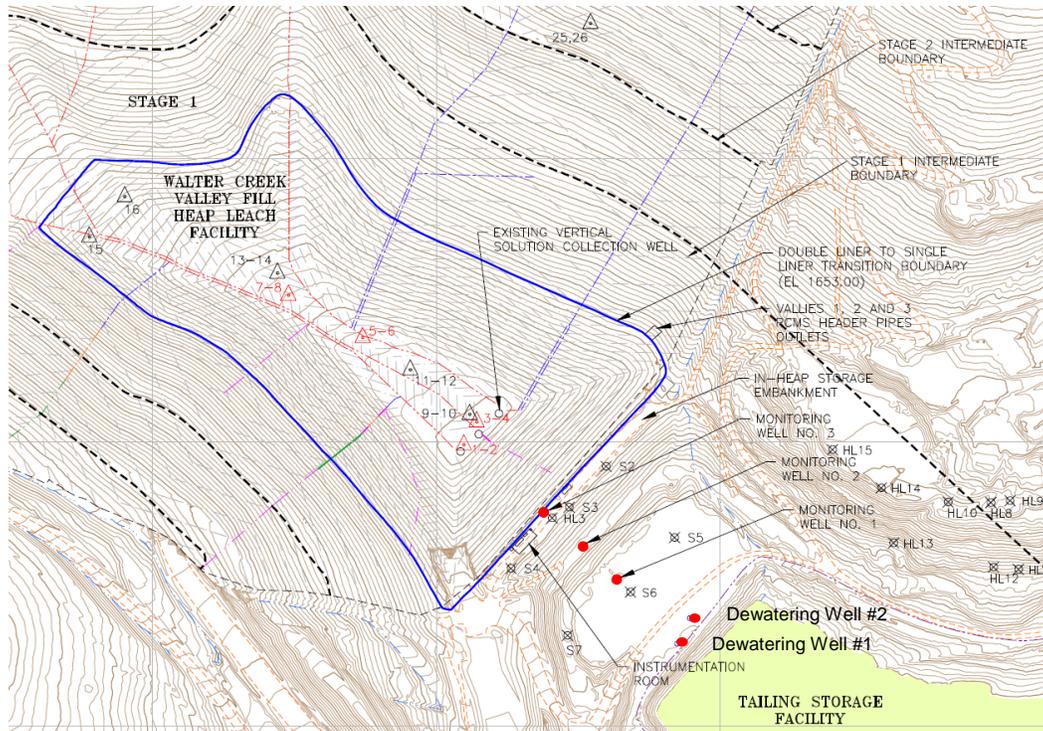
On a weekly basis, a representative of the environmental department will sample the PCMS for WAD Cyanide and pH is there is measureable flow.

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 heap leach dewatering wells have their water depths checked and recorded in FULCRUM on a weekly basis by the environmental technicians.

TSF Pond operators verify the pump is operational, check the water depth, and make any necessary adjustments. This information is recorded on the Tailings Barge/ Reclaim Pumps form.

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

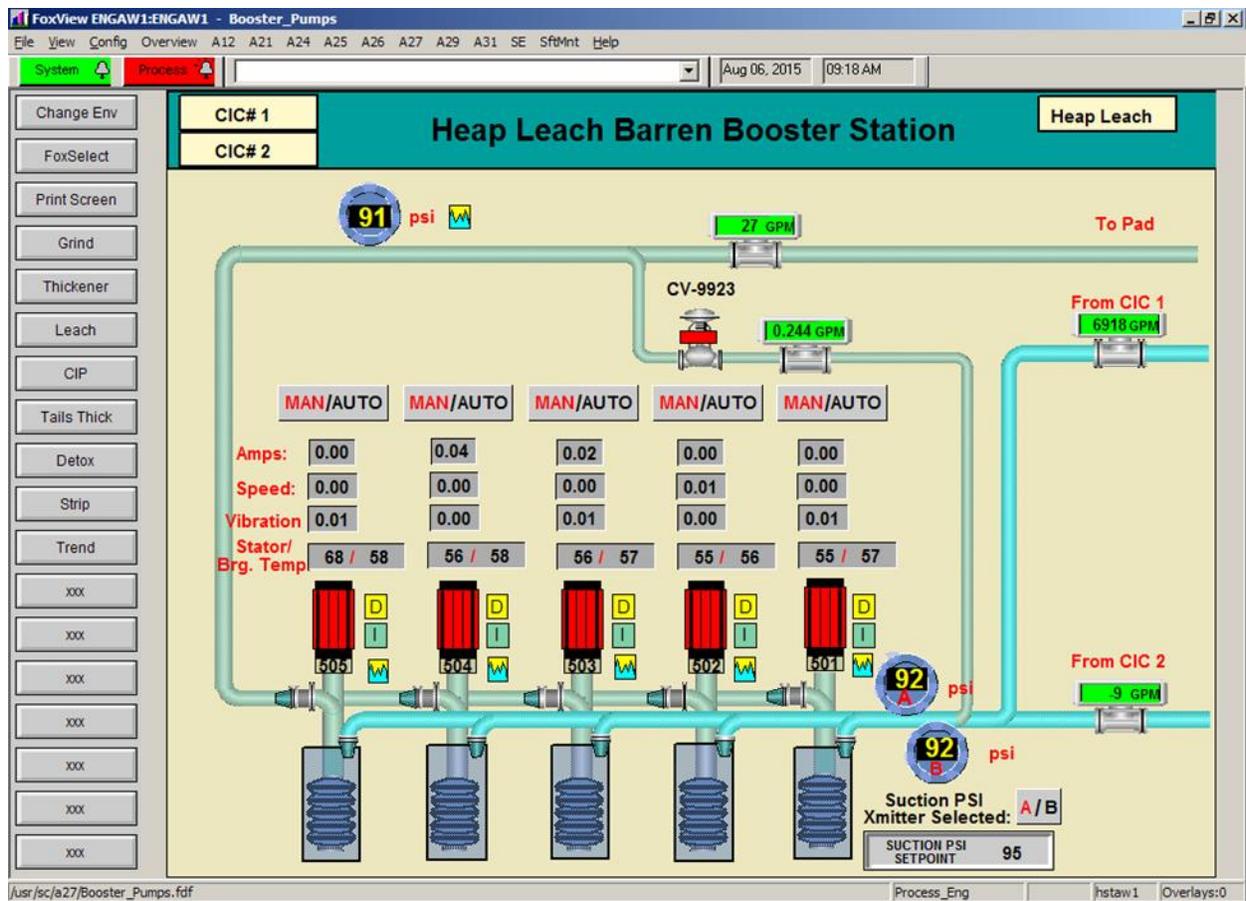
3.8.1 Operation and Maintenance – CIC Booster Station

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 setpoint, 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.

3.10 Automatic Stability Monitoring

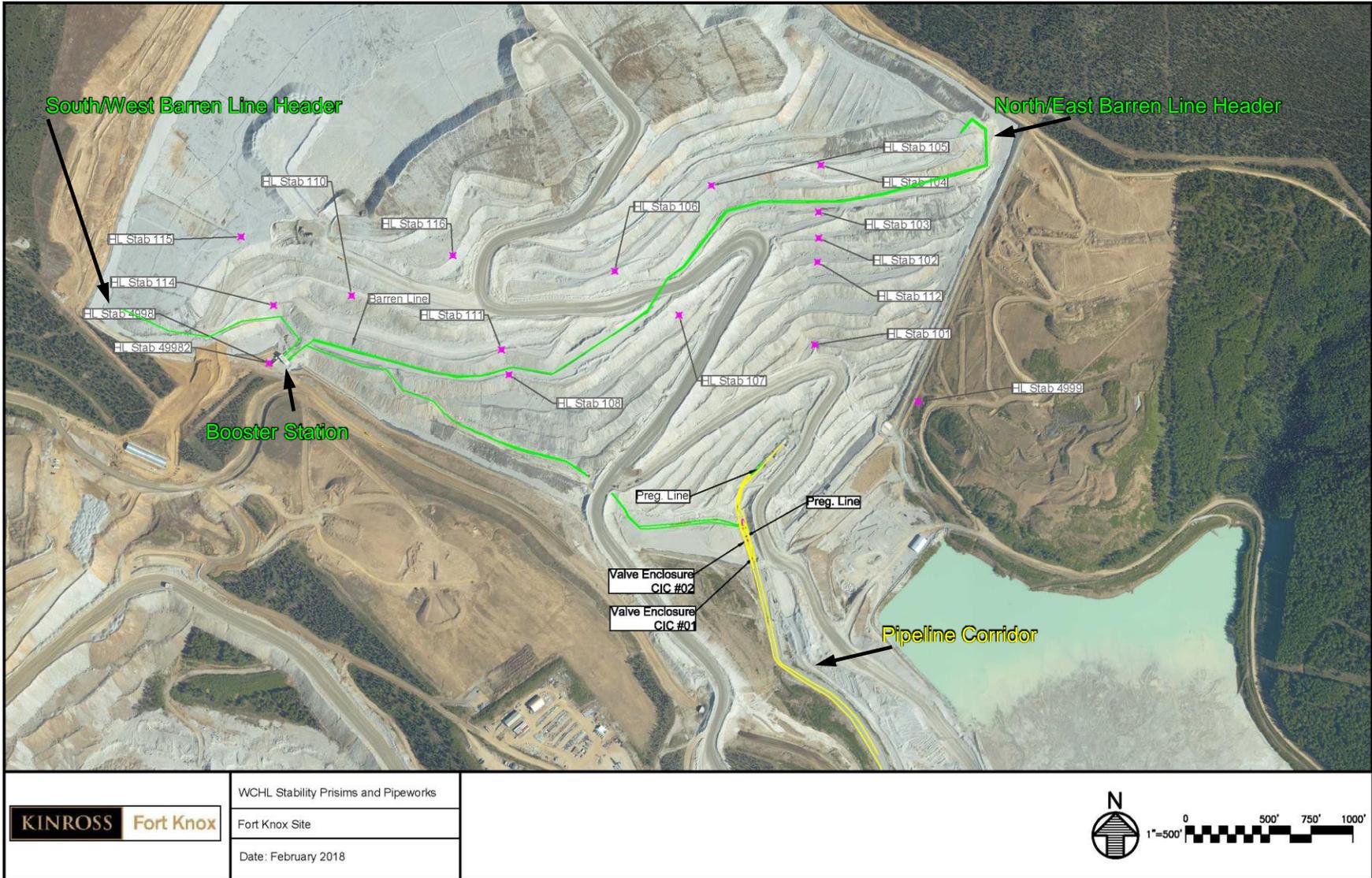
3.10.1 Operation and Maintenance – Automatic Stability Monitoring

The number of prisms in use across the facility will vary depending on the level of activity occurring along the pads face. The prisms will be surveyed robotically twice a day and the corresponding data will be stored on the designated T4D server. Prisms will be placed mainly on the unconsolidated face of the heap, and are expected to see so superficial movement over time.

3.10.2 Inspections and Monitoring – Automatic Stability Monitoring

Automatic alarm notifications will be distributed when surveys are out of tolerance by 1', 3' and 5'. Alarm notifications will be sent to the Chief Surveyor, Chief Engineer, Chief Geologist, Heap Leach Superintendent, and Technical Services Manager. The Chief Surveyor is responsible for monitoring the data received from the system. On receipt of a first level alarm, the area will be inspected to determine if actual slope failure movement is occurring. If a true stability concern is detected or thought to be potentially present, the monitoring frequency will be increased to a level agreed upon by the responsible parties above. In the event of a slope failure having occurred, or indications that one is beginning to occur are seen, the environmental department, engineer of record and site geotechnical department will be contacted to determine remediation and/or evacuation procedures. The Slope Failure form found in Appendix B will be completed and distributed. See Figure 3-13 on the following page for current prism locations.

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



3.11 Surface Water Control System

3.11.1 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

Issue	Response
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

3.11.2 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 3.4. Inspection findings or observations shall be recorded on the HL form.

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

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

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

3.12 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.

3.13 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		

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	
Peak Horizontal Ground Acceleration (PHGA) Expected at Mine Site (g)																	
Earthquake Magnitude	M 3.5	0.165	0.142	0.117	0.097	0.081	0.068	0.050	0.043	0.033		0.020		0.013	0.010		
	M 4.0	0.275	0.239	0.200	0.168	0.141	0.120		0.079	0.062	0.050	0.038		0.026	0.019		
	M 4.5	0.411	0.361	0.307	0.260	0.223	0.192		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		0.193	0.157		0.102		0.073	0.056	0.050	
	M 5.5	0.698	0.630	0.552	0.483	0.424	0.375		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		0.345	0.291		0.204		0.154	0.122		
	M 6.5	0.922	0.851	0.768	0.691	0.623	0.565		0.432	0.370		0.269		0.208	0.169		
	M 7.0	0.969	0.905	0.827	0.754	0.689	0.631		0.498	0.434		0.327		0.260	0.215		
M 7.5	0.993	0.935	0.866	0.799	0.739	0.685		0.557	0.494		0.384		0.314	0.266			
Epicentral Distance	Miles	18.6	21.7	24.0	28.0	31.1	34.2	37.3	43.5	49.7	55.9	62.1	65.0	74.6	87.0	100.0	
Peak Horizontal Ground Acceleration (PHGA) Expected at Mine Site (g)																	
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	
	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	0.000	0.000	
	M 4.5	0.026	0.021	0.017	0.015	0.013	0.011	0.010	0.010	0.007	0.006	0.005	0.004		0.003	0.002	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	
	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	
	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	
	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	
	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	0.050	0.043	0.035	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		
		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 to 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

- [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.

REVISION LOG	
REVISION NUMBER AND DATE	DESCRIPTION OF REVISIONS
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

Section 7.0 - Acronyms and Abbreviations

ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
AGI	Amax Gold Inc.
AGP	Acid Generation Potential
ANP	Acid Neutralizing Potential
CIC	Carbon-In-Columns
COE	Corps of Engineers
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
INCO	company name-patented cyanide destruction process
LCRS	Leachate Collection and Recovery System
LLDPE	Linear low density polyethylene
MHTLO	Mental Health Trust Land Office
OHMP	Office of Habitat & Permitting
OPT	Ounces per Ton
PCMS	Process Component Monitoring System
QA/QC	Quality Assurance/Quality Control
RO	Reverse Osmosis
RTD	Resistance Temperature Device
TSF	Tailings Storage Facility
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Service
WAD CN	Weak Acid Dissociable Cyanide
WCHL	Walter Creek Heap Leach

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

*****HEAP LEACH DEPARTMENT DAILY CHECKLIST*****

=====ORE HEAP AREAS=====

ARE THERE ANY INDICATIONS OF EROSION, SLOUGHING OR OTHER MOVEMENT OF THE OVERLINER?

YES NO

ARE THE SOLUTION DISTRIBUTION LINES WORKING PROPERLY?

YES NO

THERE IS NO OR MINIMAL PONDING OF LEACH SOLUTION ON THE HEAP SURFACE?

YES NO

DESCRIBE ANY REPAIRS OR REVISIONS MADE TO THE ORE HEAP AND OVERLINER OUTSIDE NORMAL OPERATIONS:

HAS ORE PLACEMENT ON THE OVERLINER DAMAGED THE OVERLINER?

YES NO

HAS THERE BEEN ANY WILDLIFE MORTALITY?

YES NO

IS THE ALKALINITY OF THE LEACHATE SOLUTION AT THE PROPER LEVEL? 10-12PH

YES NO PH _____

=====IN-HEAP POND AREAS=====

IS THE SOLUTION LEVEL AT VIBRATING PIEZOMETER PAIR 9 AND 10 ABOVE THE MINIMUM ELEVATION OF 1558 FEET TO PREVENT PUMP CAVITATION?

YES NO ELEV _____

IS THE SOLUTION LEVEL WITHIN THE NORMAL OPERATING POND RANGE BETWEEN ELEVATIONS 1603 FEET AND 1625 FEET?

YES NO ELEV _____

=====DESCRIPTION AND REMEDIATION OF ANY EXCEEDANCE OF ANY SOLUTION LEVEL==
DESCRIBE THE EXCEEDANCE AND IT CAUSE.

DESCRIBE THE ACTIONS BEING TAKEN TO RETURN THE SOLUTION LEVELS TO WITHIN THEIR NORMAL LIMITS.

=====SOLUTION COLLECTION SYSTEM=====

ANY DAMAGE TO THE SOLUTION COLLECTION PIPES?

YES NO

.
IS THERE ANY DEFICIENCY OF SOLUTION BEING RETURNED TO THE INCLINED OR VERTICA
SOLUTION COLLECTION WELLS THAT WOULD INDICATE THE SOLUTION COLLECTION SYST
IS NOT FUNCTIONING PROPERLY?

YES NO

.
=====COMPOSITE LINER SYSTEM=====

IS THERE ANY DAMAGE TO THE COMPOSITE LINER SYSTEM?

YES NO

.
=====LCRS=====

IS THE LCRS SOLUTION LEVEL BELOW ELEVATION 1554?

YES NO

.
DOES THE PUMPING RATE FOR THE DAY EXCEED THE MAXIMUM DESIGN
LEAKAGE RATE OF 520 GPM WITH THE POND IN THE NORMAL OPERATING RANGE?

YES NO

.
ARE THE LCRS PUMPS FUNCTIONING PROPERLY?

YES NO

.
DESCRIBE ANY REPAIRS OR MAINTENANCE OUT OF THE NORM.

.
HOW MANY GALLONS WERE PUMPED? WHAT WAS THE TOTALIZER READING?

.
=====DAM EMBANKMENT=====

*****CREST*****

ANY SETTLEMENT?

YES NO

.
ANY MISALIGNMENT?

YES NO

.
ADEQUATE FREEBOARD?

YES NO

.
ANY CRACKING?

YES NO

.
CREST ROAD IN GOOD REPAIR?

YES NO

.
=====UPSTREAM SLOPE=====

IS THE OVERLINER IN GOOD REPAIR?

YES NO

.
ANY EROSION OR BREACHING?

YES NO

.
TREES OR BRUSH GROWING ON SLOPE?

YES NO

.
ANY BUDGING?

YES NO

.
VISUAL SETTLEMENT?

YES NO

.
ANY SINKHOLES?

YES NO

.
IS THE "V" DITCH IN GOOD REPAIR?

YES NO

.
=====DOWNSTREAM SLOPE=====

ADEQUATE SLOPE PROTECTION?

YES NO

.
ANY EROSION?

YES NO

.
TREES OR BRUSH GROWING ON SLOPE?

YES NO

.
ANIMAL BURROWS?

YES NO

.
VISUAL SETTLEMENT?

YES NO

.
SINKHOLES?

YES NO

.
SURFACE SEEPAGE?

YES NO

.
=====ABUTMENT & DOWNSTREAM OF TOE=====

ANY EROSION?

YES NO

.
SEEPAGE, WET OR MOIST AREAS PRESENT?

YES NO

.
BOILS OR SPRINGS DOWNSTREAM?

YES NO

.
BUDGING?

YES NO

.
CRACKING?

YES NO

.
-----SPILLWAY-----

ANY SETTLEMENT?

YES NO

.
ANY MISALIGNMENT?

YES NO

.
ANY CRACKING?

YES NO

.
ANY DETERIORATION OF CONCRETE INLET RIPRAP AND CHANNEL?

YES NO

.
ANY EXPOSED REINFORCEMENT IN THE CONCRETE?

YES NO

.
EROSION?

YES NO

.
SILT OR OTHER DEPOSITS IN THE CHANNEL?

YES NO

.
-----ENERGY DISSIPATION AT TOE-----

ANY EXCESSIVE EROSION AT TOE?

YES NO

.
*****ACCESS ROAD*****

ANY SETTLEMENT?

YES NO

.
ANY EROSION OF WEARING COURSE?

YES NO

.

EASY ACCESS TO SPILLWAY?

YES NO

*****PCMS HEADER OUTLET FLOW MONITORING*****

ANY FLOW IN THE PCMS HEADER FROM VALLEY 1,2, OR 3?

YES NO

ANY REPAIRS NEEDED TO PCMS HEADER FROM VALLEY 1, 2, OR 3?

YES NO

*****COMPOSITE LINER SYSTEM*****

IS THERE ANY DAMAGE TO THE COMPOSITE LINER SYSTEM?

YES NO

=====PIPELINE CORRIDOR=====

GROUND SURFACE ALONG ALIGNMENT

ANY SETTLEMENT?

YES NO

ANY CRACKING?

YES NO

ANY MISALIGNMENT?

YES NO

ADEQUATE FREEBOARD?

YES NO

PIPELINE

ANY FLOW FROM THE LINED PIPELINE CORRIDOR INDICATING LEAKAGE FROM THE PIPES?

YES NO

NOTE FLOWS ARE EXPECTED FOLLOWING RAINFALLS OR SNOWMELT. IF FLOWS DO NOT REDUCE TO ZERO IN A REASONABLE TIME, A WATER SAMPLE SHALL BE COLLECTED AND CHECKED FOR CN.***

ANY SETTLEMENT?

YES NO

ANY MISALIGNMENT?

YES NO

ANY CRACKING?

YES NO

*****CONTROL STRUCTURES*****

MECHANICAL EQUIPMENT OPERABLE?

YES NO

*****ACCESS ROAD*****

ANY SETTLEMENT?

YES NO

ANY EROSION OF WEARING COURSE?

YES NO

EASY ACCESS TO CORRIDOR?

YES NO

=====SURFACE WATER CONTROL SYSTEMS=====

*****DIVERSION CHANNELS*****

ANY SETTLEMENT?

YES NO

ANY CRACKING?

YES NO

ANY MISALIGNMENT?

YES NO

ANY DETERIORATION?

YES NO

EROSION?

YES NO

SILT OR OTHER MATERIAL IN CHANNEL?

YES NO

ANY ICE JAMS?

YES NO

*****CHANNEL DISCHARGES*****

ANY DETERIORATION?

YES NO

EROSION?

YES NO

*****CULVERTS*****

ANY DETERIORATION OR DAMAGE OF THE CULVERTS THEMSELVES?

YES NO

ANY BLOCKAGE?

YES NO

.
*****ACCESS ROAD*****

ANY SETTLEMENT?

YES NO

.
ANY EROSION OF WEARING COURSE?

YES NO

.
EASY ACCESS TO CORRIDOR?

YES NO

.
=====LIME SILO=====

OK BAD TRAVELWAYS CLEAR OF DEBRIS
OK BAD STAIRS, GRATING, AND HANDRAILS
OK BAD LIGHTING
OK BAD ELECTRICAL ROOM
OK BAD EYE WASH STATION
OK BAD SILO TANK AND SUPPORTS
OK BAD LIME BUILD UP
OK BAD GUARDS
OK BAD SKIRTING
OK BAD PULLEYS
OK BAD ROLLERS
OK BAD CONVEYOR BELT AND CLIPS
OK BAD CONVEYOR MOTOR AND DRIVE COMPONENTS
OK BAD HOPPER, CLAMSHELL, AND HYDRAULICS
OK BAD MIRROR CLEAN

ROTARY VALVE SETTING : _____ MIN

.
CHECK LIME SILO FILL HOSES _____

.
=====VALVE ENCLOSURE=====

OK BAD DOOR ACCESS CLEAR
OK BAD HOUSEKEEPING, LIGHTS, AND HEATER ON
OK BAD PIPING AND VALVE LEAKS
OK BAD HEAT TRACE CONTROL BOX

PREG GPM: _____

BARREN GPM: _____ BARREN TEMP: _____

=====ELECTRICAL ENCLOSURE & GENERATOR ENCLOSURE=====

OK BAD DOOR ACCESS CLEAR
OK BAD HOUSEKEEPING, LIGHTS, AND HEATER ON
OK BAD ENCLOSURE CONDITION
OK BAD HEAT TRACE CONTROL BOX

PREG MOTOR AMPS:

F27PP201 _____ F27PP202 _____ F27PP203 _____

=====PREGNANT PUMPS AND ENCLOSURES=====

*****F27PP201*****

- OK BAD DOOR ACCESS CLEAR
- OK BAD HOUSEKEEPING, LIGHTS, AND HEATER ON
- OK BAD HEAT, VIBRATION, AND NOISE
- OK BAD PIPING AND VALVES

.

*****F27PP202*****

- OK BAD DOOR ACCESS CLEAR
- OK BAD HOUSEKEEPING, LIGHTS, AND HEATER ON
- OK BAD HEAT, VIBRATION, AND NOISE
- OK BAD PIPING AND VALVES

.

*****F27PP203*****

- OK BAD DOOR ACCESS CLEAR
- OK BAD HOUSEKEEPING, LIGHTS, AND HEATER ON
- OK BAD HEAT, VIBRATION, AND NOISE
- OK BAD PIPING AND VALVES

.

PREG PSI: _____

.

===== 5 S PAD ROUTE =====

LIME SILO

- YES NO BROOM
- YES NO SHOVELS
- YES NO TWO LIME BUCKETS
- YES NO LIME BARREL
- YES NO ICE MELT
- YES NO CLEANLINESS

COMMENTS :

.

.

VALVE ENCLOUSER

- YES NO BROOM
- YES NO DUST PAN
- YES NO ICE MELT
- YES NO CLEANLINESS

COMMENTS :

.

.

ELECTRICAL ENCLOUSER

- YES NO BROOM
- YES NO DUST PAN
- YES NO ICE MELT
- YES NO CLEANLINESS

COMMENTS :

.

Heap Leach Dam Inspection - Environmental Monthly

DAM EMBANKMENT

Item	Yes	No	Remarks
CREST			
1. Any settlement?			
2. Any cracking?			
3. Crest road in good repair?			
4. Any misalignment?			
5. Adequate Freeboard?			
UPSTREAM SLOPE			
1. Is overliner in good repair?			
2. Any erosion or beaching?			
3. Any trees or brush growing on slope?			
4. Any bulging?			
5. Any visual settlement?			
6. Any sinkholes?			
7. Is "V" ditch in good repair?			
DOWNSTREAM SLOPE			
1. Adequate slope protection?			
2. Any erosion ?			
3. Any trees or brush growing on slope?			
4. Any bulging?			
5. Any visual settlement?			
6. Any sinkholes?			
7. Any surface seepage?			
8. Are underdrains performing as anticipated?			
9. Any animal burrows?			
ABUTMENTS AND DOWN STREAM TOE			
1. Seepage, wet or moist areas present?			
2. Any erosion ?			
3. Boils or springs down stream?			
4. Any bulging?			
5. Any cracking?			
DESCRIBE ANY MAINTENANCE OR REPAIRS OUT OF NORM			

SPILLWAY

Item	Yes	No	Remarks
CREST			
1. Any settlement?			
2. Any cracking?			
3. Any misalignment?			
4. Any deterioration of concrete, riprap or channel?			
5. Any exposed reinforcement in the concrete?			
6. Any erosion?			
7. Silt or other deposits in channel?			
ENERGY DISSIPATION AT TOE			
1. Any excessive erosion?			

SURFACE WATER CONTROL SYSTEMS

Heap Leach Dam Inspection - Environmental Monthly

Item	Yes	No	Remarks
DIVERSION CHANNELS			
1. Any settlement?			
2. Any cracking?			
3. Any misalignment?			
4. Any deterioration?			
5. Erosion?			
6. Silt or any other material in channel?			

SURFACE WATER CONTROL SYSTEMS CONT.

Item	Yes	No	Remarks
CHANNEL DISCHARGES			
1. Any deterioration?			
2. Erosion?			
CULVERTS			
1. Any deterioration or damage of the culverts themselves?			
2. Any blockage?			



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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:

Photos of Failure:

Appendix C

Analytical Profile Chemistry

Analytical Profile II - Groundwater Inorganic Parameters

Major Ion Chemistry	Minor Ion Chemistry	Trace Ion Chemistry
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 ₃)		
Bicarbonate		
Total		
Calcium Hardness		
Magnesium Hardness		

* Dissolved